Cutting Edge Controversy:
The Politics of Animal Dissection and Responses to Student Objection

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ABSTRACT

This mixed methods study investigated the experiences and perspectives of former Ontario high school students and current Ontario science and biology teachers toward animal dissection, objection to dissection, and choice policies that grant students the right to opt out of dissection and use an alternative instead. Data was collected via a student questionnaire (*n*=311), a teacher questionnaire (*n*=153), and interviews with eight students and nine teachers. Quantitative and qualitative data analyses and reporting techniques were employed within a humane education and critical pedagogy framework to explore the experiences and perspectives of both groups.

Overall, the findings indicate that dissection remains a prevalent, yet contested practice. The majority of students (94.8%) reported having been offered dissection in high school, but almost a quarter (24%) reported harbouring objections to the practice and only 60.8% indicated they were given a choice of whether to dissect or to use an alternative. Those who objected reported a range of teacher responses to their objection, including teachers pressuring them to participate, asking them to join another group of students to observe a dissection, providing them with a dissection alternative, and warning them of compromised grades. While most teachers expressed concerns with both animal dissection and the use of dissection alternatives, 87.5% agreed or strongly agreed that real animal dissection is important to the teaching of biology. Approximately three quarters of teachers (73.7%) reported advising students verbally that they could opt out of dissection, but less than half (47.5%) believed choice policies should be implemented in the classroom, whereas 86.7% of students agreed or strongly agreed that schools should have choice policies in place.

The findings point to a need for formalized student choice policies to be adopted in all schools to ensure that students who are opposed to dissection have explicit access to alternatives, and teachers are prepared to accommodate those who object. The successful implementation of choice policies requires teacher education, curricular guidance, institutional supports, and ultimately a paradigm shift in which dissection is no longer positioned as the pedagogical norm.

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DEDICATION

This research is dedicated to the nonhuman animals who are implicated most directly in the controversies surrounding animal dissection. The estimates of how many animals are killed each year for classroom dissections range from 6 million to 12 million, making animals such as frogs, rats, turtles, fetal pigs, crayfish, cats, worms, perch, starfish, birds, clams, grasshoppers, rabbits, cows, sheep, and minks (to name a sampling) a considerable group in this research, with an obvious stake in it: their very lives. Although this research is focused on responses to dissection within the human community, it is never far from my mind that other species are deeply implicated and at the core of this research. This work is dedicated to them.

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CHAPTER ONE

INTRODUCTION TO THE RESEARCH

Animal dissection is a socially, culturally, and politically controversial pedagogical practice. Headlines of newspaper articles from the past two decades speak to the debates that surround it: "Dissection cut back amid rising student dissent" (30 April 1991, *USA Today*); "Objections to dissection may bring school guidelines" (16 November 1991, *St. Petersburg Times*); "Students, parents grow squeamish about dissection" (18 February 1998, *The Washington Times*); "Makes you think save the vertebrates: Dissection in schools is unnecessary" (18 September 2005, *Chicago Sun Times*); "School board decision could cut into dissection policy" (25 November 2005, *Kelowna Capital News*); and "Students skip slime, stink with virtual dissection" (2 June 2008, *The Associated Press*). Headlines such as these provide a glimpse into the ways dissection is being debated and restoried, as well as the growing policies—and politics—that surround it.

For many reasons, dissection has come under considerable criticism since the 1980s. In educational contexts, it raises ethical and environmental concerns regarding the killing of animals, the ignoring of animal welfare standards, the weakening of respect for life, and the "turn-off" factor for some students (Balcombe, 2000; Bishop & Nolen, 2001; Hug, 2008; Jukes & Chiuia, 2003; Marr, 2001; Oakley, 2009). These criticisms have led to the development of student choice policies, in effect in some North American cities and states, which grant students the legal right to opt out of dissection for ethical, cultural, or religious reasons (Duncan, 2008; Kramer, 2007). There is also a burgeoning industry of dissection alternatives, including numerous virtual dissection programs, that challenge the decades-old tradition of science class dissection and beg the question of whether it should be replaced with humane science education practices.

And yet, despite these criticisms and the proliferation of alternatives, dissection may be growing in popularity in Ontario. For decades it has been a part of the Grade 11 biology curriculum, which states that students are to conduct a physical dissection or a virtual dissection to achieve particular learning outcomes (Ontario Ministry of Education, 2008a), and in recent years it has been *re-introduced* into the Grade 10 science curriculum (Ontario Ministry of Education, 2008b), having been removed in 1999 (Ontario Ministry of Education, 1999). The 2008 Grade 10 curriculum states that students are to dissect, either physically or virtually, a worm, fish, or frog as part of the unit "Biology: Tissues, Organs, and Systems of Living Things" (academic curriculum) and "Biology: Tissues, Organs, and Systems" (applied curriculum). The re-introduction of dissection in Grade 10 suggests that, far from fading away, the popularity of this practice and its perceived pedagogical value remain strong in the province.

In this research, I set out to investigate animal dissection in the context of the concerns that surround it and the climate of humane education that exists today. Given the ongoing criticisms levied against dissection, the legal controversies associated with it, and research indicating that comparable student learning can take place using alternatives (e.g., Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001), I was curious to learn about the popularity of animal dissection in Ontario schools and whether students are being offered a choice to opt out of it and use an alternative instead. With the goal of producing research that inquires into the perspectives of students and teachers alike, while keeping in mind the nonhuman animals who are central to the practice and whose lives are at stake, I began my investigation into what has been labelled one of the most dramatic and controversial of school science practices (Smith & Smith, 2004).

Personal Background and Perspective on Dissection

How did I come to be interested in animal dissection? What is my position on it? These are questions I have been asked throughout my research process and have reflected upon during

my time as a doctoral student. I have come to appreciate that these questions open the door to reflexive consideration of my epistemological, axiological, and ontological commitments vis-à-vis dissection, for one, but also my relationship and belief system concerning animals[1] and the more-than-human world (Abram, 1996).

From the outset, I have approached this research from a politic of animal advocacy. By this I mean that I aim to ethically consider animals in my research, writing, and everyday life, and I work from a starting point of animals as subjects who have an inherent, intrinsic worth that merits our ethical consideration. It has been noted that much of the scholarly research about animal dissection has been spearheaded by individuals acting as advocates for animals or affiliated with animal rights or humane education organizations that consider dissection an ethically problematic activity (Hart, Wood, & Hart, 2008); I would include myself in this animal advocacy category because my understanding and enactment of social justice includes animals beyond the human. While I do not apply the "animal rights" label to my political belief system—primarily because the rights discourse is steeped in a Western framework of autonomous rights-holders to which I do not subscribe, and because it often seeks to divorce rational arguments from their emotional and cultural contexts (Donovan, 2007; Wolfe, 2003)—I *do* choose to live my life in accordance with what might be understood as tenets of animal rights, including following a plant-based vegan diet and abstaining as much as possible from contributing to the myriad modes of institutionalized animal exploitation that characterize today's political economy (Kahn, in press; Sorenson, 2010). This is, for me, both a day-to-day practice and an ethical orientation. In a practical sense, I find I am able to live a happy, healthy life while minimizing

[1] I use the term "animal" in my writing to refer to those beings who fall outside of the *Homo sapiens* category. I employ this language for ease of reading. Given that I refer to "animals" and "animal dissection" so frequently in this research, I find the use of the alternative phrase, "nonhuman animals," cumbersome and not without its own drawbacks, as "nonhuman" continues to privilege humanity and define other animals in a negative sense. Nevertheless, I recognize that in reserving the term "animal" for all those outside of the human category I am, effectively, erasing the animality of the human being, which is also problematic. My use of the term "animal" is more so a compromise than a solution to the linguistic problem of discussing "animals." For further reflections on animals and language, see Dunayer (2001) and Oakley et al. (2010).

my contribution to the suffering of animalkind (and I have seen enough evidence to convince me wholeheartedly that animals do suffer at our hands), and beyond that, the close relationships I have had the privilege of sharing with animals in my life have grounded that decision in an ethic of care, love, and respect for other species, all of which inform my viewpoint on dissection.

Caring about animals has been an overarching focus of my social justice work for the last decade. In my past research and writing I have interrogated anthropocentric practices that work to sustain the Western cultural divide between humans and other animals, and I have contemplated how education might be put to work to interrupt this divide (Oakley, 2007). From this exploration I have found that education can present both a problem and contribute to a "solution" to anthropocentrism. In present curricula, human-centredness is often embedded in overt and hidden ways and without explicit attention is only likely to be reproduced there (Bell & Russell, 1999), but there are also possibilities in formal and informal educational contexts to disrupt anthropocentric points of view, especially through critical pedagogy and humane education perspectives that proceed from an intersectionalist understanding of social justice that includes other animals (e.g., Bell & Russell, 2000; Fawcett, in press; Humes, 2008; Jukes & Chiuia, 2003; Kahn & Humes, 2009; Selby, 1995; Weil, 2004). But, what of animal dissection—what of the hidden curriculum that is passed on to students when they are presented with "specimens" to cut and examine? What does it say about the educational system when, as Selby (1995) writes, science class becomes one of the only times in school that a student will ever have contact with an animal, and a dead one at that? In the absence of competing activities or discourses, might students absorb the message that the dominant scientific framing of animals equates to a denial of animals' subjectivity? I approached this research with these questions in mind, concerned that dissection is at odds with a holistic social justice framework or what Kahn and Humes (2009) label a "total liberation pedagogy"—a pedagogy of social justice that doesn't come to a halt at the species boundary.

While dissection was not a primary focus of my previous work, I became increasingly

interested in it and concerned about it as a practice through which animals may be viewed through a reductionist scientific lens (Bekoff, 2002; Birke, 1995, 1999). Birke (1995) writes that traditional scientific epistemologies have "both justified and drawn upon a deeply held cultural preoccupation in Western culture with keeping a distance from the rest of the living world and seeing some humans as superior to it" (p. 75). As a person concerned with interrogating the ways animals are discursively framed as "other," particularly in educational contexts, I became drawn to the idea and wanted to explore it further. As I did, I came to realize the incredibly rich network of variables that intersect with animal dissection, including ethics, science pedagogy, teacher freedom, student choice, human-animal relations, gender, ecology, cultural worldviews, religion, technology, business, the legal system, and not least of all, millions of animals each year. For all of these reasons, I came to see it a complex and controversial pedagogical practice that merits further critical attention.

While considering the complexities of dissection over the past years, I have continually been asked my position on it. Colleagues, committee members, research participants, and almost anyone willing to listen to me speak about dissection have wanted to know where I stand in relation to it—and certainly, knowing the subjectivity and positionality a researcher always brings to the table (Haraway, 1991; Richardson, 2001), it is a fair question. In response, the most direct answer I can give is that I do believe there are instances in which animal dissection can be ethically performed and justified, *providing that the animal bodies are ethically sourced in the first place.* By this I mean that, from my perspective, dissection can be justified through the use of cadavers of animals who have died of natural causes, or the bodies of deceased pets that have been donated to science. This can be achieved through the purchase of "ethically sourced" animal cadavers, available through educational memorial programs (e.g., EMP, 2011) and "willed body donation programs" offered through some humane societies (Erika Sullivan, Doctor of Veterinarian Medicine, personal communication, 2010). At present, however, I do not know of any Kindergarten-Grade 12 schools making use of this option, possibly due to inaccessibility,

a lack of awareness, or school board agreements to purchase specimens through designated biological supply companies.

Making use of such programs would alleviate the ethical concerns that I (and many other animal advocates) associate with dissection. These concerns include the instrumentalist use of animals as scientific "tools" and the reinscription of an anthropocentric mindset that positions them as resources that any individual—regardless of their interest in or desire to pursue science—can use (Sapontzis, 1995; Selby, 1995). Using ethically sourced cadavers would also address the overarching concern that animals are being killed by the millions expressly for classroom dissections. The estimates of the number of animals used each year for American classroom dissections alone range from 6 million (Orlans, 1993) to 12 million (Rosenberger, 1998), and, as I explore in the next chapter, the ways in which they are collected, housed, gassed, drowned, and in some instances injected live with formaldehyde must equate to immense suffering on their part, along with the end price they pay with the loss of their lives. All of this makes dissection a deeply ethical issue, and I am in agreement with the simple formula surrounding the ethics of dissection that Balcombe (2001) has expressed: "A basic ethical principle asserts that if we have a choice between two ways of achieving something—one that causes pain, suffering, and death and the other that does not—then ethical conduct dictates using the latter method" (p. 118). This "latter method" includes the use of dissection alternatives, which I discuss in the next chapter, or the use of ethically sourced cadavers if animal bodies are used.

In discussing my position on dissection, I want to underline that my concerns about it are ethically rooted and distinguished completely from notions of squeamishness, disgust, or discomfort around the sight of blood or dismemberment (my lifelong attraction to horror movies can perhaps attest to this!). Balcombe (2000) writes that ethical concerns around dissection are sometimes rewritten as "squeamishness," and I want to clarify that this is not a basis for my concerns. On the contrary, a curiosity was sparked in me when I had the opportunity to attend

one of Gunther von Hagens' *Body Worlds* exhibits of human (and a few animal) remains, which I found fascinating. In this exhibit, however, I had levels of assurance that the human bodies on display had been donated with informed consent, as copies of the consent forms were displayed for public viewing. Could ethical delivery of cadavers be guaranteed on the human *and* animal side, I believe dissection could be a valuable experience for anyone who is interested in learning from it.

This is not to say I believe everyone *should* learn in this way, as existing literature clearly reveals that not everyone is interested in experiencing a dissection. Rather, it is my belief that if ethical forms of dissection could be offered, it should be up to individual students to decide whether or not they want to participate, regardless of whether they plan to pursue science in post-secondary education or follow a career in the life sciences. While some have suggested that dissection could be reserved for mature learners who are hoping to study medicine or veterinarian science (de Villiers & Monk, 2005; Orlans, 1991), many "lay people" may also be curious about the inner workings of the body and for them, dissection might be fascinating for its own sake. Further, dissection can serve to generate interest in the life sciences and encourage students to pursue it further (Allchin, 2005; Offner, 1993)—although conversely, it can also turn students off of science altogether (Balcombe, 2000; Bishop & Nolen, 2001; Hart et al., 2008; Hepner, 1994). These two realities highlight the importance of giving students choice.

In considering my perspective on dissection, it is also worth noting that I, like many others who have gone through the Canadian school system, participated in animal dissections. In Grade 8 I dissected a worm; in Grade 11, a frog. In previous work I have explored ways in which these dissection experiences raised questions for me about the animals in the pans in front of me: *Where had they come from? How were they killed? Was it appropriate or right for me to be doing this to their bodies?* (Oakley, 2008). These were not questions I articulated as a student, however. Instead, I completed the dissections and it did not cross my mind to request an alternative—which is perhaps not surprising given the context of the time (the late-1980s/early

1990s), at which point technological alternatives were still in their infancy and the notion of conscientious objection had yet to be popularized. More to the point, my own ethical system had not developed in the direction it has developed since, and, unlike some participants in this research, dissection did not present much of an ethical problem for me at the time. It is thus difficult to gauge whether I would have chosen an alternative even if one had been offered. I believe my identity as a young student was connected to notions of following scholastic protocol, and the fact that dissection was sanctioned in the framework of a school classroom led me to not question its ethical appropriateness.

A Foucauldian analysis might here reveal the powers of institutionalized discourse to shape an individual‟s belief system (Foucault, 1980), yet this same analysis would also linger in points of resistance and possibilities for "competing truths" to emerge. These competing truths or counternarratives emerged in me years later, as I came to grapple with the question of the animal (Cavalieri, 2001; Oakley et al., 2010) and the ethics of animal use in scientific contexts. From these interests, and through my development as a critical humane education scholar, I became interested in investigating the controversies surrounding dissection and the ways it is being resisted, by students and teachers alike.

Theoretical Framework

This research is situated in the fields of humane education (Humes, 2008; Jukes & Chiuia, 2003; Pedersen, 2004; Selby, 1995, 2000; Weil, 2004) and critical pedagogy (Freire, 1970; Giroux, 2001; hooks, 1994; Kincheloe, 2005; McLaren, 1998). Both fields speak to themes of challenging systems of dominance, thinking critically, and enacting a pedagogy that connects to student freedom and the development of students‟ critical consciousness. Further, both humane education, and approaches to critical pedagogy that are infused with humane principles (e.g., Pedersen, 2004; Russell, 2005), are concerned with power dynamics in human-animal relationships alongside power dynamics in the classroom. Theorists in both fields hold a vision

of democracy for all, with a particular focus on those whose perspectives or identities are marginalized: themes such as "education for critical consciousness" (Freire, 1970), "education for freedom" (hooks, 1994), and "education for planetary justice" (Weil, 2004) are some of the overlapping ideologies of the two pedagogies.

Humane education and critical pedagogy are aligned with the scope of this research because of their shared concern with oppression and marginalization in human communities and human-animal relationships. Both fields inform my perspective of the power imbalances that can take place in classrooms, between students and teachers *and* between humans and animals. Issues of student choice, student experiences in objecting to dissection, and the affirmation or negation of particular values in the classroom can be productively examined through these lenses. Both lenses also offer insight into how a humane form of science education might be enacted, and as such they contribute an alternate epistemology that can open up possibilities for a humane science education to flourish.

Humane Education

Humane education emerged from humane societies in the 1800s, with an early aim of promoting child protectionism, animal protectionism, and more "humane" human-animal relationships through formal and informal educative influences (Selby, 1995, 2000; Weil, 2004). It began with attempts to teach children the importance of kindness to animals, guided by an overarching hope of reducing the number of animal cruelty cases and strengthening the animal welfare movement (Antoncic, 2003). In its early years, humane education was a compulsory part of education in the United States and typically took the form of lessons about animals, contact with animals, and exposure to animal literature in the classroom (Thompson & Gullone, 2003). Lessons about animals aimed to teach children responsibility toward them, while contact with animals was arranged by bringing animals into schools or organizing classroom visits to animal shelters (Selby, 1995, 2000).

Humane education today has enriched its focus considerably by emphasizing the interconnectedness of all life and the intrinsic value of nature and animals (Helton & Helton, 2005; Humes, 2008). Weil (2004) writes that humane education today explores "how we might live with compassion and respect for everyone ... for all people ... for all animals ... and for the Earth itself" (p. 4). She adds that a humane pedagogical approach aims to foster critical and creative thinking, reverence and compassion, and a sense of responsibility and action to create a more "humane" world. Proceeding from a holistic liberatory philosophy, the maxim that "no one is free while others are oppressed" applies to humane education efforts as the lines that have often been drawn between humans and other animals are erased and the web of interconnections amongst social justice issues is foregrounded (Humes, 2008). For example, humane educators today might focus on critically exploring interconnections among a variety of issues relating to animal well-being (e.g., the use of animals for food, clothing, testing, and entertainment), human rights issues (e.g., prejudice, sweatshop labour, political oppression, and poverty), cultural issues (e.g., media and advertising influences, multinational monopolies), and environmental preservation issues (e.g., habitat destruction, resource depletion, species extinction, and climate change) (Selby, 1995; Weil, 2004). Given this interconnected focus, Pedersen (2004) writes that a humane perspective can "contribute greatly to the role that education must take in promoting compassion and respect for "the other," in the broadest sense of the word" (p. 5).

To consider dissection from a humane education perspective entails examining its impacts on students, animals, and the environment, as well as critically considering the educational value of dissection and what humane alternatives exist to it. Indeed, the issue of animal dissection is a key focus of some humane education efforts—some organizations and individuals working under its banner focus prominently on dissection and the harmful use of animals in science education (e.g., Animalearn, Frogs Are Cool, the Humane Society of Canada, InterNICHE). From a humane education perspective there are multiple points of entry into the dissection debate, including educating about the mass killing of animals for dissection purposes,

discussing the environmental footprint of dissection, promoting dissection alternatives, foregrounding health concerns associated with the practice (e.g., the use of formalin as a preservative agent), and advocating for students‟ freedom to object to dissection and use alternatives.

Some organizations (e.g., Frogs Are Cool) also work with school boards to implement student choice policies in schools. Choice policies ensure that students are informed, verbally and in writing, that they have the option to opt out of dissection and be given an equal but different way to learn the associated educational outcomes (cf. Cunningham, 2000). Hence, part of a humane education approach means respecting students as moral agents and granting them an option to opt out of dissection if they object to it on personal, ethical, cultural, religious, or environmental grounds. In this way, humane educators seek to redress power imbalances that can take place in classrooms, both between students and teachers and between the human and more-than-human worlds. There is also emphasis on identifying the speciesism embedded in scientific curricula when animals are used for experimentation or dissection practices (Pedersen, 2004).

I approached this research with the underlying assumption that humane education *is* possible, and that students can demonstrate kindness and compassion to animals alongside intellect. Proceeding from the postpositivist understanding that science is not a neutral activity but a value-laden one (Hodson, 2003; Roth & Desautels, 2002), it is evident that the meanings made around dissection are constructed within particular social, cultural, political, and historical contexts. I agree with Hubbard (1990), who writes that science should be seen “as just one way to look at nature; a particular way to relate to organisms, including people; a very powerful, hence potentially dangerous, way to comprehend and use natural capacities and resources” (p. 21). It is my hope that the scientific community will forge a path toward humane practices in science, including the implementation of student choice policies and the use of humane alternatives to dissection.

Critical Pedagogy

Critical pedagogy has been defined as an "educational movement, guided by passion and principle, to help students develop consciousness of freedom, recognize authoritarian tendencies, and connect knowledge to power and the ability to take constructive action" (Giroux, 2010, para. 1). With roots in the Frankfurt School of critical theory, critical pedagogy is grounded in an educational vision of justice and an understanding that schools are inherently political institutions (Kincheloe, 2005). Giroux (2010) writes that critical pedagogy effectively presents a mode of pedagogical intervention committed to social criticism and change; critical pedagogues seek to equip students with a knowledge of social relations that will allow them to participate in society as citizens who recognize power imbalances and are empowered to act on them.

Drawing on a Freirian framework (Freire, 1970), critical pedagogy can be understood as teaching and learning practices aligned with developing students' critical consciousness. Recognizing that education is always communicating particular ideologies that may re-entrench (or challenge) existing systems of inequality, critical pedagogy offers a lens that allows for a nuanced exploration of classroom dynamics while ensuring attention is given to political and epistemological positions that stand outside of authoritative curricular norms. In this way, it relates to the controversies associated with dissection, particularly those associated with conscientious objection and student choice.

A critical pedagogy approach to animal dissection would see educators providing opportunities for students to reflect on their personal values and act on them through the provision of choice. It would involve respecting those individuals whose perspectives are situated outside the dominant discourse of dissection, letting go of the traditional conceptualization of the teacher as ultimate authority figure and students as "vessels" to be filled with predetermined knowledge held by the teacher (Freire, 1970). An interrogation of scientific discourse and norms also connects to a critical pedagogy approach to dissection, challenging the dominance of science as the primary or sole way of knowing. As Philo and Wilbert (2000) write,

"the natural sciences have for some time been regarded as the legitimate and primary form of knowledge in many societies, Western and non-Western" (p. 8). Critical pedagogy approaches reflect a desire to transmit knowledge about the dominant social order but also to reconstruct it; part of this entails acknowledging and respecting subjugated epistemologies.

The normative scientific discourse and its framing of the nonhuman animal—often characterized as inferior to humans and driven primarily by instinct and routine (Bekoff, 2002; Birke, 1995)—can serve to legitimate dissection and concurrently *delegitimize* the perspectives of students who object. Hence, a critical pedagogy approach to dissection involves questioning the hidden curriculum: the outside-the-curriculum knowledge that is passed on through schools and that students pick up without being explicitly taught (Jackson, 1968). For example, Jukes and Chiuia (2003) suggest the hidden curriculum of dissection can amount to students learning that animal life is expendable and, if choice is not honoured, that certain values do not hold up in the scientific world.

Traditionally, critical pedagogy and critical theory literature has focused on human oppression and the distribution of power in human communities. This is a prominent bias in a field that too often falls silent about anthropocentrism and relegates nonhuman animals to a category of silenced "others" (Pedersen, 2004; Russell, 2005). Academic divides further section off nature and animals to the category of the natural sciences, leaving the social sciences and the humanities to focus on the human and subsequently ignore other animals (Pedersen, 2004; Russell, 2005). Bell and Russell (2000) note a persistent absence in the field's consideration of animals:

> In critical pedagogy… the exploration of questions of race, gender, class, and sexuality has proceeded so far with little acknowledgement of the systemic links between human oppressions and the domination of nature. The more-than-human world and human relations to it have been ignored, as if the suffering and exploitation and other beings and the global ecological crisis were somehow irrelevant. Despite the call for attention to

> voices historically absent from traditional canons and narratives … nonhuman beings are shrouded in silence. This silence characterizes even the work of writers who call for a rethinking of all culturally positioned essentialisms. (p. 191)

This raises a question of why, during a time in which we are seeing an outpouring of critical work devoted to the subject of the "other," far less attention is being paid to animals. Humes (2008) suggests this may be because critical pedagogues continue to see animal issues as less important (or unimportant) to the struggles of social justice. She writes that responses such as, "We have our own issues to worry about," or, "Animals are not like humans, they don't suffer like us," or, "How can you/we worry about animal issues when so many humans are suffering?" (p. 78) remain common among theorists who fail to acknowledge the interconnections among human and animal oppressions and liberations.[2]

The methodological approach I have undertaken in this research is a holistic critical pedagogy approach, combined with and emerging from humane education standpoints characterized by ethical concern for humans, animals, and the more-than-human world together. Tenets of humane education and critical pedagogy have informed each stage of this study, from the development of my research questions to the analysis of the study's findings. This framework has, in essence, allowed me explore dissection from a critical perspective while investigating the politics of conscientious objection and student choice.

Research Focus and Design

In approaching this research I was curious to learn about the practices of animal dissection, the prevalence of student objection, and whether and how objection is being

[2] This is not to say that no work is being done to this end. Intersectionalist understandings of social justice are evident through the approaches of several critical pedagogues who integrate issues of human rights, animal rights, and planetary sustainability in their work. For a discussion of nine educators taking this approach, see Kahn and Humes, 2009. For other discussions of critical pedagogy approaches that address speciesism, see Bell and Russell, 2000; Kahn, 2002; Pedersen, 2004; and Russell, 2005.

accommodated in Ontario high school classrooms. While dissection has been practiced in North American schools since the 1920s (Orlans, 1993), there have been incredible developments in technology since then, along with an increased awareness of animal welfare and animal rights sentiment. Since the 1980s there has also been documented objection to dissection—at times adjudicated at a legal level, as outlined in the next chapter—and considerable research has been conducted in the past decades examining the efficacy of dissection alternatives, often finding them to be comparable or even superior to traditional dissection in terms of student knowledge acquisition and students‟ ability to identify animal anatomy (e.g., Fowler & Brosius, 1968; Kopec, 2002; Lalley et al., 2010; Maloney, 2005; Montgomery, 2008; Strauss & Kinzie, 1994; Youngblut, 2001). These technological, social, and political shifts of the past decades, combined with the student choice policies that have come into effect in recent years, left me curious about the state of this practice. As such, the overarching focus of this research was to gain an understanding of the practices and perspectives of students and teachers in relation to dissection, objection to dissection, and the corresponding dynamic of student choice.

Participants

The participants in this study were divided into two groups, "students" and "teachers."

Students. The "student" sample in this research was comprised of individuals aged 18-30 who had completed some or all of their secondary school science and/or biology classes in Ontario (Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or Ontario Academic Credit (OAC) Biology[3]). These participants were asked to reflect back on their experiences with dissection, objection to dissection (if applicable), and student choice (if

[3] Ontario Academic Credit (OAC) courses were offered as "Grade 13" courses in Ontario; the OAC year was a fifth year of secondary schooling offered to students who intended to pursue post-secondary education. Unique to the province of Ontario, the OAC program began to be phased out in 1999 and is no longer offered (Brady & Allingham, 2010).

applicable) when completing a research questionnaire (Appendix A: Student Questionnaire) and, for select individuals, when participating in an interview (Appendix B: Student Interview Guide). Regardless of whether they had been offered dissection in high school or participated in it, they were invited to take part in this research. Individuals who were no longer living in Ontario, but who had completed some or all of their high school in the province, were also welcome to participate.

Adult individuals (as opposed to senior years' students) were selected for this research because the design was based on a desire to collect a large sample of student data and, due to the multiple levels of permission required when working with individuals under age 18, it is unlikely the sample size could have been matched with younger participants. Asking adult individuals to participate circumvented the challenges that would have been associated with obtaining approval from parents or guardians, teachers, principals, and school boards. There is, however, a caution that comes with asking adult participants to reflect on previous life experiences, namely, that the passage of time can distort memories. I discuss this limitation later in this chapter.

In total, 311 students participated in this research. Among them there was a significant gender skew: 80% (249 of 311) of the participants were female. Three factors may explain this gender skew. The first possibility is that one of the audiences to whom the research questionnaire was advertised was a Faculty of Education with a higher number of female than male students. The second possibility is that females tend to respond to electronic surveys at higher rates than males (Underwood, Kim, & Matier, 2000), and the third possibility is that the topic itself may be more interesting to women, as females are more likely than males to object to dissection (see Almy, Goldsmith, & Patronek, 2001; Capaldo, 2004). Research shows that females express greater concern about animal welfare and are more likely to oppose animal-based research than males (Gaarder, 2011; Hagelin, Carlsson, & Hau, 2003; Phillips & McCulloch, 2005; Pifer, 1994; Plous, 1996), and these may be contributing factors to the high female participation rate in this study. There is, however, a caution that comes with having an

imbalance of female and male participants: given that research identifies female students as objecting to dissection more often than males, and given that 80% of respondents in this study were female, the statistical results may be skewed against dissection. This limitation is also discussed later in this chapter.

Teachers. The teacher sample in this research was comprised of Ontario-based teachers who, at the time of the research, were teaching or had taught secondary school science and/or biology classes in the province (Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or OAC Biology). Similar to the student participation qualifications, the teacher participants did not have to currently reside in Ontario to participate, nor did they have to be currently teaching. Teachers were asked to reflect back on their career in teaching to discuss their classroom experiences with dissection, objection to dissection, and student choice.

In total, 153 teachers participated in the study. Within this group there was also a gender skew (albeit a less pronounced one than in the student sample): 64% (98 out of 153) of the teacher participants were female. This is an interesting skew in that women remain underrepresented in science majors and careers (Blickenstaff, 2005), yet they made up more than half of all participants in this sample. Similar to the student sample, this gender skew may influence the research findings and present a caveat in their interpretation. At minimum, the fact that more female students and teachers participated in this study than males highlights the relevance of considering the research from a gendered perspective, both in interpreting the results and ascertaining who is wanting and/or willing to share their perspectives and experiences on the topic in the first place.

Research Questions

Ten research questions were developed to guide the research process. These questions were divided into two categories to reflect the two groups of participants in the research: the "student" group and the "teacher" group.

Questions for student participants.

- What are students‟ attitudes toward animal dissection and dissection alternatives?
- Are students offered a choice of whether or not to participate in animal dissection in their secondary school science/biology classes?
- How many students object to animal dissection?
- What are the experiences of those who object?
- What are students‟ perspectives of, and experiences with, student choice policies?

Questions for teacher participants.

- What are teachers‟ practices and attitudes toward animal dissection and dissection alternatives?
- What is the frequency with which teachers experience objection to animal dissection in their classrooms?
- How do teachers respond to objection to animal dissection?
- Do teachers have a student choice policy (formal or informal) in effect in their classrooms?
- What are teachers‟ perspectives of student choice policies?

A Mixed Methods Approach

To investigate these research questions I employed a mixed methods design, combining quantitative and qualitative data collection, analyses, and reporting techniques. I chose a mixed methods approach to gain a breadth of understanding about the trends in Ontario science/biology classrooms, along with a depth of understanding in relation to some individuals‟ specific experiences. This study could be described as exploratory and descriptive in nature, with the qualitative and quantitative data working together to illustrate the research findings (Creswell, 2008; Plano Clark & Creswell, 2008). This exploratory, descriptive approach makes the study slightly more qualitative than quantitative in emphasis and design. This is supported by the fact that more of the research questions are qualitative than quantitative in nature, and also by the design in which there was no hypothesis guiding the research process (hypotheses being a hallmark of quantitative research). As such, the paradigm emphasis of this study was qualitative → quantitative, with the qualitative approach given slight priority.

Mixed methods research is characterized by the use of quantitative and qualitative research methods and data. According to Plano Clark and Creswell (2008):

> A mixed methods study involves the collection or analysis of both quantitative and/or qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of the data at one or more stages in the process of research. (p. 165)

The mixing of quantitative and qualitative methods can happen at multiple stages of the research process: in the development of research questions, during the collection of data, during the data analysis process, and/or in writing up the research results, in which the findings may be presented in combined narrative and numeric forms (Tashakkori & Teddlie, 2003). There are also strategies unique to mixed methods research, notably data conversion or transformation, in which quantitative numeric data is converted into qualitative thematic/narrative data and vice-versa (Teddlie & Tashakkori, 2009).

I selected a mixed methods approach for this research as I believe it is best suited to the questions under study. This approach, guided by the question of "what works" in relation to the topic of inquiry, is sometimes labelled a pragmatist approach. Tashakkori and Teddlie (2003) elucidate:

> Pragmatism is a deconstructive paradigm that … focuses ... on "what works" as the truth regarding the research questions under investigation. Pragmatism rejects the either/or choices associated with the paradigm wars, advocates for the use of mixed methods in research, and acknowledges that the values of the researcher play a large role in interpretation of results. (p. 713)

Tashakkori and Teddlie (2003) write that pragmatic mixed methods researchers first decide what they want to study based on what is important within their particular value systems, and then study that topic in a way that is congruent with their value systems, including focusing on variables they believe will yield interesting responses. Through such an approach the research questions take centre stage: a researcher first determines the questions she or he wants to study, then decides what methods will be best suited to studying them. In this way there is acknowledgement within mixed methods communities that the ultimate goal of a research project is to answer the questions set forth in a study, and that multiple (and mixed) methods can offer the most comprehensive way to achieve this (Johnson & Onwuegbuzie, 2004).

The mixed methods approach offers some advantages over qualitative or quantitative approaches alone. One advantage is that a researcher can extrapolate a fuller picture of the phenomena under study (Johnson & Onwuegbuzie, 2004; Morgan, 2007). With the recognition that all methods have limitations, and that there are always biases within any singular method, mixing methods can work toward addressing the shortcomings of one method alone (Morgan, 2007). Other advantages include the opportunity for a greater assortment of divergent views, the ability to address a range of confirmatory and exploratory questions, and a built-in form of methodological and data triangulation (Teddlie & Tashakkori, 2009).

There are, however, challenges inherent in this undertaking. To be effective, mixed methods researchers must have a degree of methodological fluency in the discourses and methodologies of both qualitative and quantitative work. This includes techniques for designing research instruments, gathering data, analyzing data, and presenting findings. In effect, this can result in a near-doubling of the workload at many stages of the research process (Teddlie & Tashakkori, 2009). With this precaution in mind, I aimed to develop highly focused research questions and instruments, and a plan for each major stage of the research process, as discussed in the "Methods and Procedures" section below.

A Brief History of Mixed Methods Research and the "Paradigm Wars"

It is worthwhile to briefly review the history of mixed methods research and its relationship to what some have termed the "paradigm wars" (Gage, 1989). This history is worth recounting because it explains the origins of a discomfort that some researchers—particularly those who might describe themselves as "purists"—continue to hold toward mixed methods research. I have experienced this discomfort first-hand in the academic community and discussions of it have been published in peer-reviewed journals (e.g., Dillon & Wals, 2006; Guba & Lincoln, 1989), which suggests that the conversation around the (in)validity of mixed method research is ongoing. Although mixed methods research is now popular and widely legitimized—there are journals devoted to it specifically and some have labelled it the "third research movement" in the social sciences (Johnson & Onwuegbuzie, 2004; Morgan, 2007)—there is continued concern, and what I see as legitimate caution, around research that results in a blurring of paradigms.

Paradigms may be understood as "systems of beliefs and practices that influence how researchers select both the questions they study and methods that they use to study them" (Morgan, 2007, p. 49). At the centre of the conflict surrounding mixed methods research is concern about conflicting paradigms within a single study. Quantitative and qualitative

methodologies have traditionally been pitted against each other with the understanding that particular paradigms underlie particular research methods; specifically, that positivism is linked to quantitative research and constructivism is linked to qualitative research. The subsequent concern is that different epistemological, axiological, and ontological viewpoints are associated with each paradigm, and that mixing the two types of research, as is done in mixed methods research, can result in what Datta (1994) referred to as "mixed up models" of research.

The paradigm "wars" emerged in the 1960s when qualitative research, and the underlying epistemology of constructivism, ascended into popularity. During this time, quantitative research was often considered to be at odds with qualitative research, largely because of the publication of several books that were highly critical of what was labelled the "positivist" orientation underlying quantitative research methods (Teddlie & Tashakkori, 2009). In the place of positivism, qualitative-oriented authors forwarded the constructivist orientation. The two positions were then pitted against each other as they were seen to be competing on fundamental grounds concerning the nature of reality and what could be known (Guba & Lincoln, 1994). Kuhn (1962), for example, suggested that the differences amounted to "incommensurable paradigms," and for mixed methods researchers this led to the "incompatibility thesis," which suggested it was inappropriate to mix qualitative and quantitative methods due to foundational differences in the paradigms underlying each.

To be sure, there are key differences between a positivist and constructivist orientation. Positivism is characterized by the ontological belief that there is a single reality or "Truth," that the relationship between researcher and data are independent, that inquiry is value-free, and that context-free generalizations are possible. Through the positivist approach, logic is obtained primarily through deductive reasoning (as evidenced by the hypothesizing nature of quantitative research) and data is numeric in form. In contrast, the constructivist position holds that there are multiple constructed realities, that inquiry is value-bound, and that context is key in understanding and interpreting research results. Inductive reasoning is preferred (as evidenced

through the technique of grounded theory, for example), and data tends to be narrative in form and thematic in analysis (Johnson & Onwuegbuzie, 2004; Morgan, 2007; Teddlie & Tashakkori, 2009).

To some extent, it would appear that the paradigm wars today have been put to rest as most researchers legitimize multiple paradigms and proceed from a position that is inherently *postpositivist* in nature (Johnson & Onwuegbuzie, 2004; Morgan, 2007; Teddlie & Tashakkori, 2009). Postpositivism, which developed from a dissatisfaction with positivism, emerged from quantitative and qualitative research communities alike. Postpositivism shares many of the beliefs underlying the constructivist orientation. For example, in both positions there is acknowledgement that research is influenced by the theory or framework an investigator uses, that knowledge is fallible, that there is a value-ladenness to inquiry, that it is possible for more than one theory to explain a phenomenon, and that research is a social enterprise in nature (Johnson & Onwuegbuzie, 2004; Tashakkori & Teddlie, 2008). The postpositivist position therefore reflects shared viewpoints across qualitative and quantitative communities, although it remains bound to the quantitative orientation of research.

With this understanding—that mixed methods researchers are likely proceeding from an epistemological position that is postpositivist in nature—various authors have suggested the debate concerning mixed methods research has been, to some extent, "settled" (Johnson & Onwuegbuzie, 2004; Morgan, 2007; Plano Clark & Creswell, 2008; Teddlie & Tashakkori, 2009). While there is agreement that researchers must continue to reflect on their stances in research, the majority do not consider the mixing of methods to equate to, or result in, incoherency in a researcher‟s epistemological positioning.

In taking up this call and reflecting on my own research orientation, I recognize that my interests and positionality influence the questions I ask and that there are likely multiple approaches through which my research questions could be explored. I have followed the advice of mixed methods practitioners who recommend starting with my research questions—that is,

determining first what I want to study—and then choosing from a selection of methods that are best suited to "answer" the questions under investigation. Selecting both qualitative-oriented and quantitative-oriented questions, and then determining what methods might be employed to investigate these questions, I arrived at a mixed methods study involving questionnaires and interviews.

Methods and Procedures

The methods employed in this research were questionnaires (also known as surveys) and interviews. This combination was selected to allow for the collection of a breadth of data, including attitudinal and behavioural data (e.g., regarding dissection practices and perspectives), numerical trends (e.g., regarding the frequency of student objection), and narrative data (e.g., regarding the experiences of individual students and teachers), all of which were reflected in my research questions.

The combination of questionnaires and interviews is in keeping with the recommendation that mixed methods researchers choose methods that have complementary strengths and non-overlapping weaknesses (Johnson & Turner, 2003). While questionnaires can generate large numbers of responses that produce information across a broad range of topics in a relatively short period of time, they do not allow for much depth of response. Interviews, on the other hand, take much longer to execute and analyze, but offer a depth of response that brings a human voice to the data and elucidates the experiences of participants in greater detail (Patton, 2002).

Questionnaires and interviews are both instruments of survey research—a popular form of research conducted by collecting information from people to describe, compare, and/or explain knowledge, attitudes, and behaviours (Alreck & Settle, 2004; Creswell, 2008; Fink, 2003; Fowler, 2002; Patton, 2002). Fink (2003) writes that survey research tends to be descriptive in nature, with an aim to "produce information on groups and phenomena that already exist" (p. 22). Survey research involves sampling from a population, collecting data from

that sample, and obtaining a high response rate (Creswell, 2008). In selecting two methods of survey research for my data collection, I was able to secure both qualitative and quantitative data.

Questionnaires

Questionnaires, like all research methods, have strengths and weaknesses. A prominent strength of questionnaires is that they allow for the collection of attitude- or behaviour-related data over a large sample, in a manner that is reasonably quick and inexpensive (Alreck & Settle, 2004; Fink, 2003; Teddlie & Tashakkori, 2009). They are limiting, however, in the types of responses they generate and the ways participants can frame their responses. Further, given their mass spread, impersonal nature, and people‟s busy schedules, response rates are ordinarily low—usually less than 40% (Alreck & Settle, 2004; Creswell, 2008; Thomas, 2004). To counter low response rates, questionnaires should be kept to a reasonable length for the target population. The cover letter, questionnaire, and overall design should be compelling, and multiple strategies for participant recruitment should be in place (Creswell, 2008).

Creswell (2008) writes that the process of designing questionnaires involves several considerations relating to validity, or the ability of a research instrument to measure that (and only that) which it is supposed to measure. Threats to validity occur when systematic bias is introduced into any stage of the research process and the results—intentionally or not—become pushed or pulled in one direction (Alreck & Settle, 2004). With questionnaires, validity can be compromised with poorly worded questions. If respondents have to guess at the meaning of a word, or a question is worded in such a manner that it leads the respondent to answer in a particular way, the questionnaire will not be valid. Other potential pitfalls in question formulation include unclear language, poor or incomplete wording, questions that overlap, double-barreled questions, questions that are long and overly complex, overemphatic questions,

questions that contain undefined terms, and questions not applicable to all participants (Alreck & Settle, 2004; Berg, 2004; Fowler, 2002).

The flow of questions and overall design of a questionnaire can also have an impact on its validity. To this end, it is recommended that questionnaires begin with demographic and other simple questions, and then proceed to more complex and personal questions to "ease" participants into the questionnaire (Alreck & Settle, 2004). Grouping questions in a manner that is internally logical and meaningful to participants is also recommended to create a flow in which questions build on each other (Alreck & Settle, 2004). Finally, the layout of questionnaires and the generous use of white space are also important considerations, considering Fowler's (2002) assertion that putting many questions on a page reduces response rates, compared to having the same number of questions spaced attractively over more pages.

Keeping these principles in mind, I developed two questionnaires for this research: one for the student sample (Appendix A: Student Questionnaire) and one for the teacher sample (Appendix C: Teacher Questionnaire). Both questionnaires were designed using *SurveyMonkey*™ software. *SurveyMonkey*™ is an online survey creation tool that gives researchers creative control over the design and collection of web-based surveys. Participants access the survey through a designated URL, complete it online, and then submit it electronically when they are finished. The software was set to allow for only one completed survey per Internet Protocol (IP) address, meaning only one survey could be completed from any given computer. This option was enabled as a safeguard to discourage the occurrence of a respondent completing the survey more than once.

Both questionnaires were prefaced with an invitational letter that provided details on the research, followed by a consent form and qualifying questions to ensure participants formed part of the target demographic. The student questionnaire (Appendix A) featured 25 questions; the teacher questionnaire (Appendix C) had 30 questions. Both questionnaires contained demographic, attitudinal, and behavioural-related questions, primarily in closed-ended formats,

using checklists and five-point Likert scales. Both questionnaires also featured a limited number of open-ended questions (two on the student survey and four on the teacher survey), as well as numerous fields for additional comments so that respondents could elaborate, clarify their responses, or generate their own categories of meaning if they felt their experiences or perspectives were not captured in the pre-existing responses. Both questionnaires also allowed respondents to skip questions (with the exception of the consent form and qualifying questions), and both ended with a request for contact information if participants were willing to participate in a follow-up interview. Additionally, both questionnaires asked participants to provide an email address so that their name could be entered in a draw following the completion of the questionnaire collection. A draw for an iPod Touch was held for the student group, and a draw for a $100 Chapters gift certificate was held for the teacher group. These draws were included to encourage individuals to participate in the research, as well as being a means of offering a small gesture of thanks for their participation.

Both questionnaires were pilot-tested by colleagues, professors, teachers, family, and friends prior to being launched. The student questionnaire was pilot-tested by 21 individuals; the teacher questionnaire, 11 individuals. The feedback from pilot testers was very helpful in identifying unclear language, questions that overlapped, and questions not applicable to all participants. Some pilot testers suggested adding additional questions, and one particularly helpful suggestion was to add an option so that students could indicate they had “mixed feelings” about dissection, rather than reactions that were characterized as exclusively positive or negative (or degrees thereof). The popularity of this response revealed its importance as a category to describe experience.

Following approval from the Research Ethics Board and revisions from the pilot testing phase, the questionnaires were launched. The student questionnaire was launched first and ran for five consecutive weeks (February 28-April 4, 2010). It was advertised through several channels, including a campus-wide communication bulletin at Lakehead University to both the

Thunder Bay and Orillia campuses, an email sent to undergraduate students in the Faculty of Education at Lakehead University, and email messages sent across Ontario to colleagues who in turn forwarded the invitation to their students. The questionnaire was also advertised by word of mouth, through an automated tagline attached to my outgoing emails, and via a "status update" on Facebook. Although all of these channels likely yielded some responses, the response rates spiked most notably after the campus-wide communication bulletins were released.

I closed the questionnaire after five weeks, at which point I had collected 311 completed questionnaires, considerably more than my original goal of 200 (a number in keeping with published survey research examining student responses to dissection (see Bowd, 1993; Kopec, 2002)). During the last two weeks of data collection I found the statistical spread of responses did not change significantly; it seemed the data had somewhat "settled" after collecting approximately 200 questionnaires. In the final week of data collection I collected only a few completed surveys, and took this as a cue that the collection period was drawing to a close. In addition to the numerical data generated by the questionnaire, this data collection phase yielded 452 open-ended responses that student participants shared.

The teacher questionnaire ran for eight consecutive weeks, beginning two days after the closing of the student questionnaire (April 6-June 1, 2010). During this time, 153 completed questionnaires were collected. The data collection for the teacher questionnaire required considerably more advertising than did the student questionnaire. It was first advertised through the monthly online newsletter of the Science Teachers" Association of Ontario, *STAONews*. When this advertising netted only 11 completed questionnaires (and I was expecting it to be the most lucrative mode of recruiting teacher participants!), I turned to direct marketing techniques by telephoning and emailing school boards, Research Officers, Heads of Science, and individual science and biology teachers across Ontario and inviting them to participate. I also asked the Science Teachers" Association of Ontario if they would advertise the questionnaire a second time in the following monthly newsletter, to which they generously agreed. By the end of the seventh

week I had reached my goal of collecting 150 teacher surveys. During the final week, an additional three questionnaires were collected, for a total of 153 questionnaires that included numerical data and 777 open-ended responses. I closed the questionnaire after the eighth week, as I was hearing from teachers that this was their busiest time of year (June) and they could not commit to participating in the research.

Interviews

Interviewing is widely regarded as a powerful mode of inquiry that can elicit detailed, personal data in participants‟ own words (Denzin & Lincoln, 2000; Fontana & Frey, 2000; Holstein & Gubrium, 1995; Patton, 2002; Seidman, 2006). Unlike questionnaires, interviews are usually nondirective and feature questions that are general in nature (e.g., “Tell me about…”). Seidman (2006) writes that at the heart of interviews is “an interest in other individuals‟ stories because they are of worth” (p. 9); Patton (2002) suggests interviewing is one of the most common and powerful ways in which we try to understand our fellow human beings.

Much has been written about the interview process. Berg (2004), for example, outlines various “commandments” for interviewing which centre around practicing in advance, presenting a natural front, remembering your purpose, demonstrating aware hearing, and being respectful, cordial, and appreciative. He writes that researchers must be aware of ways that data can become biased through a researcher‟s interpretation (also known as an investigator effect). While there is no way to guarantee research that is free of bias, he notes that the search for answers should be predicated on attempts to elicit meaningful responses from respondents and to report their responses accurately, and these are skills that can be developed. Techniques for developing rapport (a stance that involves taking the role of respondents and trying to see the situation from their viewpoint) and neutrality (a stance toward the content of what a person is saying) should be developed (Alreck & Settle, 2004; Creswell, 2008).

Interviewing is widely regarded as both an art and a science (Seidman, 2006), and as such much has been written about the qualities of what might be deemed "successful" interviews. Similar to questionnaire development, much of the effort involved in conducting a successful interview occurs in advance through the development of quality questions. A researcher must know what he or she wants to find out, and then ask tightly focused questions to elicit relevant answers (Patton, 2002). Many of the questionnaire-specific principles of developing quality questions also apply to interviews, including following a general-to-specific sequencing of questions; ensuring questions are clear, singular, and straightforward; and keeping all questions focused on the area of investigation (Alreck & Settle, 2004). Similarly, the cautions surrounding poorly worded questions are also applicable to interview questions and can threaten their validity (Alreck & Settle, 2004; Berg, 2004; Fowler, 2002). Finally, consideration must be extended to crafting open-ended questions that will elicit descriptive responses, rather than simple "yes" or "no" answers (Alreck & Settle, 2004; Creswell, 2008).

Prior to conducting the interviews for this study, I developed semi-structured interview guides to delimit in advance the issues to be explored. Interview guides were developed for the student sample (Appendix B: Student Interview Guide) and teacher sample (Appendix D: Teacher Interview Guide); both guides included questions addressing experiences, opinions, feelings, and behaviours. They also included "probes," or branching questions, to encourage participants to elaborate on their responses as appropriate. The final question on each guide—*Is there anything else you care to add?*—was included following the advice of Patton (2002), as well as the findings of my previous interviewing experiences, in which I discovered that rich data can often come from this final inquiry or the question that is *not* asked.

After receiving feedback from committee members on the interview guides, I created lists of potential interview participants from the pool of student and teacher participants. Potential interviewees were those individuals who had, via the questionnaires, volunteered to participate in

a follow-up interview. A generous number of students and teachers offered to be interviewed: 102 students (of 311) and 64 teachers (of 153).

From the student sample I was interested most in hearing from those who objected to dissection, therefore, I shortlisted potential participants by selecting those who (a) agreed to be interviewed and (b) reported harbouring objections to dissections. I then stratified the participants by gender (as I was interested in hearing from both males and females) and selected 12 candidates (6 female and 6 male) to interview, paying attention to selecting participants with a diversity in the responses given for why they objected to dissection (e.g., for personal, animal rights, ethical or moral, environmental, religious, or cultural reasons, or a combination thereof). The goal of the interviews was to obtain more depth of information regarding individual students'' experiences with objection, but due to the time commitments associated with conducting, transcribing, and analyzing interview data, conducting more than 12 interviews did not seem feasible. After shortlisting potential interview candidates I emailed each person to invite them to participate. In the emails I explained the purpose of the interview and indicated that, if the individual chose to participate, our conversation would be conducted by telephone and recorded and transcribed. I also attached a copy of the interview guide (Appendix B) to the email so they could consider the questions in advance and reflect on whether they wanted to participate. Of the 12 individuals contacted, 8 (5 female, 3 male) agreed to be interviewed.

The eight student interviews were conducted in May 2010. The length of interviews ranged from 14-26 minutes, with the average being 18.5 minutes. In all interviews I followed the interview guide (Appendix B) and asked probing questions, as appropriate, to prompt participants to flesh out their responses. Following each interview I transcribed the telephone conversation and emailed the transcript to the participant as a form of member-checking, inviting them to verify the transcript to ensure their sentiments were accurately and satisfactorily captured. All participants were invited to revise their transcript as they saw fit, but none requested any changes.

From the teacher sample I also selected 12 individuals to interview, based on diversity in the responses given on their questionnaires. I achieved this by dividing the potential participants into two groups, based on gender, and then selecting 6 female and 6 male teachers to interview, based on diversity in their years of teaching, diversity in the responses given pertaining to their dissection practices and use of dissection alternatives, and whether or not they offered choice in the classroom. Similar to the protocol followed for the student interviews, I emailed the 12 teachers and asked if they would be interested in participating in an interview. I also attached the interview guide (Appendix D) to the email. Of the 12 teachers I contacted, 9 (4 female, 5 male) agreed to an interview.

The teacher interviews were conducted in June and July 2010. Following the process of the interviews with students, all interviews with teachers were conducted by telephone and recorded. The length of these interviews ranged from 18-36 minutes, with the average being 25 minutes. For each interview I followed the interview guide (Appendix D) and probed for further detail as appropriate. Each interview was transcribed shortly after the conversation took place, and all teacher participants were emailed a copy of the transcript and invited to modify it as they saw fit. One teacher requested minor changes to one passage in her transcript to better reflect her perspective, while the others indicated they were fine with the transcripts as they were. Upon completing the transcriptions of the teacher and student interviews, I was ready to begin analyzing the data.

Reflections on the Data Collection Process

The number of individuals willing to participate in this research was encouraging, signaling that people have an interest in discussing the pedagogical and controversial dimensions of animal dissection. Achieving a high response rate is desirable in survey research because it is

"important to select as large a sample as possible so that the sample will exhibit similar characteristics to the target population" (Creswell, 2008, p. 394). Having reached my target numbers, I was pleased with both the quantity of data collected and its quality, as many participants were generous in their open-ended responses on the questionnaires and willing to participate in a follow-up interview.

It became apparent from the data collection process that the two sample populations had differing stakes in the research. This is an obvious statement when it is considered that the teacher participants were sharing practices related to their livelihood, which may be closely aligned with their identities, whereas student participants were reflecting back on experiences that may or may not have been intimately connected with their livelihoods or identities. At the outset I imagined these differing stakes might result in a higher number of teacher participants than student participants; however, there are many variables influencing participation rates, including available time, interest, the number of possible participants in a given population, and success in reaching the target populations. Consequently, it is difficult to extrapolate with any certainty on why the response rates were as they were. For example, the lower number of teacher participants may have resulted from the fact that I approached teachers at an extremely busy time of year for them, or they may have seen the invitation to participate only once, whereas the students may have been exposed to repeated messages via communications bulletins, emails, and other advertising strategies. The reality that there are significantly more qualifying individuals in the "student" category than the "teacher" category could also account for the discrepancy. It must also be noted, however, that a higher percentage of teachers (41.8%) than students (32.7%) offered to participate in a follow-up interview, which points to an encouraging level of teacher interest among those who did participate.

One of the indicators that the two sample populations had differing stakes in the research was that teachers requested considerably more information about the study than did students. Some teachers emailed me with specific questions about the study before committing to

participating, asking me about my research goals, my position on dissection, and my intention for the end results of the research (e.g., where the data might be published). I responded to these queries and, anticipating others, began adapting my invitational request to teachers. Eventually, my invitational letter was more than twice as long as the original communication had been! From the student sample I did not receive any similar queries, although a few students did email me to express their keen interest in the research. The different reactions from the two groups suggest different stakes were held by the two communities, and that some teachers may have been reticent to participate in the study because of my animal advocacy position and critical perspectives on dissection.

A final reflection on the data collection process is that it was highly relevant to include both students and teachers in the study. In an earlier conceptualization of the research design I anticipated working exclusively with teachers; in a second design, I planned to work exclusively with students. Having incorporated both groups, it is clear that a more nuanced understanding and comprehensive picture emerged from hearing from both sides of the classroom. This combined approach enabled me to gain a more thorough and balanced understanding of the practices, perspectives, and controversies associated with dissection, objection, and student choice. This is not an approach I have seen undertaken in other mixed methods studies pertaining to dissection, but it has been effective in bringing a depth of understanding to the particular areas of inquiry in this study.

Data Analysis

Data analysis in mixed methods research entails drawing on techniques for analyzing both qualitative and quantitative data, as well as techniques for mixing the two. Typically in mixed methods research the analysis of differing types of data occurs concurrently, following an inductive-deductive cycle where the researcher moves from data to ideas and ideas to data (Teddlie & Tashakkori, 2009). In this research, data analysis took place in several overlapping

phases: I analyzed questionnaire and interview data separately and then in tandem, and then considered the data holistically in a final stage of analysis.

Analysis of Questionnaire Data

A preliminary form of data analysis took place during the collection phases of the student and teacher questionnaires. *SurveyMonkey*™ software allows survey administrators to view individual questionnaires upon their completion and to compile preliminary results while the collection phase is in progress; as such, I was able to preview results and identify early trends in the data. This allowed me to take note of emergent themes and see how the results were "settling" over time.

When the collection phase was complete, I began the official analysis. The first stage was to code each questionnaire with a number (the date and time were captured automatically by the software), and to scan each questionnaire to ensure it was acceptable for inclusion in the research. Questionnaires were discarded from the research pool if participants did not meet qualifications for the target population or if the questionnaires had been terminated prior to completion. Through this process, the final data set of student questionnaires (n=311) and teacher questionnaires (n=153) was established.

Most questions on both questionnaires were closed-ended, numeric, and quantitative in nature. To analyze responses for these quantitative questions I used simple statistical analysis techniques, calculating percentages and determining measures of central tendency (e.g., means, modes, and medians). Much of this analysis was performed through the *SurveyMonkey*™ software, through which users can analyze and represent data via statistical plots, frequencies, charts, and lists. The software also allows users to calculate univariate statistics, through which one variable of the analysis is linked to others. For example, I could examine whether gender was associated with teachers‟ responses toward students who requested a dissection alternative, or whether the length of time a teacher had taught related to her or his opinion of student choice

policies. Given the straightforward and single-variable nature of my research questions, however, deeper levels of multivariate analysis were not conducted. I recorded the results from the quantitative analysis phase on spreadsheets (one for the student data and one for the teacher data), and drew upon this data for discussion in the research articles (Chapter 3).

Qualitative data emerged from the questionnaires‟ open-ended questions and comments fields. In total, the student questionnaire yielded 452 open-ended comments and the teacher questionnaire yielded 777 open-ended comments. These comments ranged in length from a single word (e.g., the identification of a dissected animal species that was not listed in the given categories) to several paragraphs (e.g., an explanation of a classroom experience or the opinion espoused by a participant).

I began the analysis of this qualitative data by printing the qualitative responses and reading through them several times in an attempt to become immersed in, and highly familiar with, participants‟ words. As Tilley (1998) writes, this is an important process in remaining faithful to the research findings. Identifying themes in the data was achieved through a line-by-line coding process, in which I marked particular words or phrases in the data and wrote preliminary theme ideas in the margins. This process was repeated several times until a multitude of themes had been identified that were grounded in the data.

I then reviewed the themes and collapsed them into meta-thematic categories that captured the data at a higher level of analysis (Fontana & Frey, 2000). Next, I organized the comments into the established themes, counted the number of comments under each theme, and ordered the themes in order of frequency. Finally, I transferred the themes to a coding spreadsheet and copied and pasted the relevant passages under each code. This process was completed separately for the open-ended data in the student questionnaires and the teacher questionnaires. The resultant two spreadsheets were then used in the analysis of the data, the cross-comparison of the data (discussed below), and the eventual writing of research articles (Chapter 3).

Analysis of Interview Transcripts

Each of the 17 interviews was transcribed within 24 hours of being recorded; in most cases, transcription took place immediately after the interview. I chose to transcribe the interviews as soon as possible on the advice of others who suggested this could facilitate the process as the conversations would be fresh in my mind. It also had the benefit of allowing me to "relive" the conversation a second time, and to begin a preliminary analysis in identifying emergent themes and points of interest. Once the interviews were transcribed and member-checked by the 17 participants, I read each transcript several times and also listened to the audio recordings again to become highly familiar with the data.

The coding of the interview transcripts took place in a similar manner to the process followed in analyzing the open-ended questionnaire data. I first marked passages that were compelling or of interest in the transcripts; from there I considered how the passages might be labelled. I then conducted a line-by-line reading of the transcripts in which I marked particular words or phrases and assigned preliminary themes to them. This process was repeated several times until multiple themes had been identified. I then reviewed the categories and grouped them into higher-level themes, as well as themes that could be compared to the questionnaire data. I counted the number of comments under each theme to rank the themes in order of frequency, and finally I transferred the themes to a coding spreadsheet and copied the relevant passages under each code. This process was completed separately for the student interview transcripts and the teacher transcripts, and the resultant two spreadsheets were used for further analysis and cross-comparison purposes. These spreadsheets, with all of the quotations from the interviews grouped into high-level categories, were integral in writing the research articles (Chapter 3).

Cross-Analysis of Quantitative and Qualitative Data

Once I had completed analysis of the questionnaire and interview data I undertook a final stage of cross-analyzing the two data sets. This final stage of analysis is unique to mixed

methods research; the goal is to allow the two sets of data to "speak" to each other (Teddlie & Tashakkori, 2009). At this stage of analysis the two sets of data are combined, connected, or integrated. This can involve data transformation or conversion (e.g., quantitizing the qualitative data or vice-versa), data correlation and comparison, and a third stage of analysis working from the combined data sets.

I first cross-analyzed the data by group, considering the dominant themes emerging from the student questionnaires and interviews, and the teacher questionnaires and interviews. I then considered how these themes connected or diverged from each other. This involved reviewing my research questions, examining the prominent themes in all data sets, and comparing responses of both groups. Through this process I began to identify "answers" to my research questions; in most cases, these answers were comprised of quantitative data and illustrative narrative quotations that brought depth to the responses.

I then considered the data holistically, looking at the responses emerging from all data sets together. In total I had created six data sets: one quantitative data set from the student questionnaire and one from the teacher questionnaire, one qualitative data set from the student questionnaire and one from the teacher questionnaire, and one qualitative data set from the student interview transcripts and one from the teacher interview transcripts. Collapsing these six data sets together, I produced a seventh spreadsheet that captured the research findings at the highest possible level of analysis. This data set provided an overview of all of the research findings together, synthesizing the data. However, given that I had established *a priori* research questions specific to student and teacher sample populations, the final data set was used only to capture generalized findings from the research and not specific responses to research questions.

Part of the process of mixed methods data analysis entails selecting ways to represent the data. The results of mixed methods research tend to be represented in formats that are also mixed, involving a written discussion of results and accompanying graphs, tables, and/or visual representations (Creswell, 2008). Returning to my research questions and considering the

findings, I realized the responses to some questions could be succinctly represented in chart or table form, while other responses would need to be fleshed out in expository writing. In writing the scholarly articles to discuss my findings (Chapter 3), I drew upon all data sets and different modes of representation. For example, the quantitative questions are answered with quantitative data but supporting qualitative findings are included to bring deeper understanding to the topics under consideration; similarly, the qualitative findings are in some instances contextualized in quantitative data to shed light on how commonly a theme was discussed. Hence, the research articles, while primarily narrative in format, also include quantitative results, and the qualitative results are sometimes discussed in quantitative terms.

Format of this Dissertation

This dissertation is divided into four chapters, plus appendices. Each chapter reflects a different stage of the research journey. This first chapter provides an introduction to the research, including my personal reasons for pursuing this topic, the theoretical framework I employed, and the choices I made in regard to research questions, methods, and data analysis. The goal of Chapter 1 is to provide an overview of the entire research process and a context for understanding how I conducted the research, along with its limitations and delimitations.

Chapter 2 comprises the literature review I conducted prior to and during the research process. The purpose of this literature review is to bring an historical, social, cultural, and political context to dissection, and to outline the corresponding trajectories of objection to dissection and student choice policies. The literature review also highlights findings of relevant empirical studies examining the efficacy of dissection and use of dissection alternatives, as well as research elucidating student and teacher perspectives on these practices. The process of writing this review provided an inspiration and foundation for my research, through which I aimed to contribute a unique study to the scholarly literature while building on existing areas of knowledge (Boote & Beile, 2005).

Chapter 3 is comprised of three research articles I wrote following the analysis of the collected data. Effectively, this is the "results" chapter of the dissertation. I begin this chapter by outlining the themes of the articles, as well as their intended audiences and the peer-reviewed journals to which I submitted them. I also outline a rationale for my use of this "alternative research format" (Duke & Beck, 1999), of writing scholarly articles to discuss my research findings. The three research articles then follow, each addressing a particular theme. Article 1 relates to student objectors' classroom experiences, Article 2 recounts teachers' perspectives on dissection and alternatives, and Article 3 addresses the sometimes-divergent perspectives of students and teachers in relation to choice and choice policies. Taken together, the three articles respond to my research questions. Following the articles, I include a brief discussion of some of the research trends and tensions *not* addressed in the scholarly papers, which could form the basis of future writing and research.

The final chapter provides an overview of nine recommendations emerging from the research. Most of these recommendations are also addressed in the articles in Chapter 3, but Chapter 4 outlines them individually and includes a brief discussion of each. The purpose of this chapter is to provide an executive summary of the research recommendations for sharing with relevant stakeholders, including teachers, schools, school boards, school trustees, curriculum developers, Faculties of Education, Ministries of Education, students, researchers, humane educators, humane societies, and animal advocacy organizations. These recommendations are included as a summary of best practices to help inform policy and classroom protocol.

Limitations of the Research

There is always a principle of indeterminacy that pervades research and places limitations on its generalizability and success in completely "answering" the questions under study (Seidman, 2006). Given that there are limitations to any study by virtue of the methods and methodologies undertaken, the modes of analyses, and the questions asked in the first place, it is

important to recognize limitations inherent in the research design. Three limitations in this study include research method limitations, design limitations in which participants were asked to recollect previous experiences, and limitations pertaining to generalizability.

Research Method and Design Limitations

The data collection methods employed in this study were questionnaires (Appendix A, Appendix C) and interviews (Appendix B, Appendix D). Both methods have limitations that potentially threaten the validity of the findings. A limitation of the questionnaires used in this research, for example, is that they relied predominantly on closed-ended questions that limited participants‟ depth of response and assumed their experiences could be captured in *a priori* categories. As a result, the data collected from the closed-ended questions may be superficial and not indicative of the nuance or detail of participants‟ perspectives or experiences. Although I aimed to supplement the closed-ended questions with some open-ended ones, along with numerous open-ended comments fields, the responses captured in the closed-ended questions remain tightly controlled and limited in terms of the number of themes that can be extracted from the data.

The online administration of questionnaires also has limitations, given the impersonal nature of online surveys and the fact they are completed without the involvement of the researcher. It is possible that participants misinterpreted questions or did not answer them fully, which could compromise the validity of the data. The self-reported nature of the questionnaires also means the results cannot be empirically verified and must be accepted at face value (Alreck & Settle, 2004; Creswell, 2008; Thomas, 2004).

The electronic nature of the questionnaire can also introduce potential limitations. At the outset of this research I imagined conducting both electronic and paper-and-pencil versions of the questionnaires, but as I realized the success rates of the electronic surveys, I chose to rely on one medium alone. This could mean I unwittingly eliminated individuals who would have

otherwise participated in the study, as I presumed participants had access to technology and a high comfort level in working with it. Further, there is concern that females tend to respond to electronic surveys at higher rates than males (Underwood, Kim, & Matier, 2000), and this too presents a limitation as it can skew participant demographics toward female respondents.

Finally, the self-selected nature of the student and teacher sample populations introduces the possibility of selection bias in this study, as respondents with strong responses to animal dissection may have been more motivated to participate than others who felt neutral toward it. Student participants who objected to dissection, for example, may have viewed the questionnaire as a forum to voice their opinions, and conversely those who associated strong positive feelings with their dissection experience may have been highly motivated to participate. The self-selected design could equally affect the teacher sample, as teachers who recognized the controversial nature of dissection may have been particularly drawn to—or repelled from—completing the questionnaire. As self-selected participants can compromise the randomness of a given sample, this limitation should be noted in reflecting upon the questionnaire findings.

There are also limitations to interviews as a research method. One of these limitations is that interviews are reliant on the comfort level of interviewees in disclosing information about their experiences. Although I aimed to mitigate this by stressing that participants could decline to answer any question and could opt out of the interview at any time, it is possible that some participants were not comfortable with me or my (perceived) stance on dissection, and, if so, this could have limited the nature of the information they shared with me. Developing a rapport with participants is crucial and I attempted to achieve this through pre-interview conversations and email exchanges, as well as sharing details about myself and my research prior to "officially" beginning the interview. Nonetheless, interviews rely on participants being comfortable and willing to share information, and these factors can never be entirely assured. The fact that all interviews were conducted by telephone also meant I did not have access to a visual reading of participants" reactions and responses, and this too could limit my interpretation of the findings.

As previously discussed in this chapter, I selected a mixed research design incorporating questionnaires and interviews because I believed this design was best suited to the questions under study. This combination enabled me to collect a breadth of data including behavioural data, attitudinal data, numerical trends, and narrative data. My hope in mixing methods was to uncover accurate responses to my research questions while benefiting from the built-in triangulation that mixed methods research offers (Teddlie & Tashakkori, 2009); however, I realize there are also limitations to the design that must be held in mind while considering the findings.

Data Based on Recollections

Participants (students and teachers) were asked to reflect upon and report their experiences pertaining to secondary school animal dissection. The findings must therefore be understood as representing participants‟ *recollections* of classroom experiences. This design could introduce levels of uncertainty in the data due to participant errors in recollection, particularly in the student sample, as individuals aged 18-30 were invited to participate and reflect back on their high school experiences. As previously discussed, the age range of the student sample was chosen to circumvent the need for multiple layers of permission, as it was anticipated that obtaining the requisite permission for individuals under age 18 (from parents or guardians, teachers, principals, and school boards) would present a challenge in obtaining a large sample size. Following Bowd‟s (1993) research design, in which university students were asked to recall their high school experiences, I anticipated that student participants‟ memories of their classroom dissection experiences would be reasonably accurate, given that dissection is characterized as an emotionally evocative and memorable experience (Smith & Smith, 2004). However, there is a possibility that time can distort memories (Seidman, 2006), and this caveat should be noted when considering both the student and teacher data sets.

Generalizability

A final limitation pertains to the generalizability of the research. Samples in a research study need to be representative of the population as a whole in order to be generalizable within that population (Teddlie & Tashakkori, 2009). In this study the findings have limited generalizability, for two reasons. The first pertains to the gender skew that pervades both sample populations and especially the student sample, in which 80% of respondents were female (in the teacher sample, 64% of participants were female). As previously discussed, there are various possible reasons why more females than males participated in this research; nonetheless, the fact that there were significantly more participating females than males presents a limitation to the generalizability of the study‟s findings, given conclusions of previous studies that found females are more likely than males to object to dissection, to oppose animal-based research, and to express concern about animal welfare (e.g., Almy et al., 2001; Capaldo, 2004; Gaarder, 2011; Hagelin et al., 2003; Phillips & McCulloch, 2005; Pifer, 1994; Plous, 1996). These gendered trends should be held in mind when interpreting the number of students who reported opposition to dissection.

The limitations and delimitations of the sample size and geographic area in which this study was undertaken also mean the results should not be generalized to other locations or wider populations. Curricular requirements differ by province in Canada and differ across countries (indeed, dissection is not a global practice), which means the results of this study are geographically most specific to Ontario. Ultimately, the participants in this study formed a convenience sample, delineated by geography, and the results should be understood as reflecting this in the population.

Rationale and Stakeholders

A goal of this research is to add to the existing body of literature through an investigation of Ontario students‟ and teachers‟ experiences of and perspectives toward animal dissection,

objection to dissection, and choice in the classroom. At present, there is a paucity of research focused on objection to dissection and very little that examines the situation in an Ontario/Canadian context. As such, one of the goals of this research is to contribute an understanding to the topic while furthering the discourse about it. Although critical research on dissection has been ongoing since at least the late 1980s and has taken many forms since then, from empirical to philosophical to phenomenological, the voices of teachers and students have often (and surprisingly) been omitted from these discussions (Hart et al, 2008). Based on the research that makes up my literature review (Chapter 2), the dominant forms of research to date have been philosophical discussions about the appropriateness of dissection, and studies measuring the efficacy of dissection alternatives. The focus of my research on objection and student choice, from teachers‟ and students‟ perspectives, contributes an underrepresented angle to the literature.

It is hoped that this study may help inform policy decisions regarding classroom protocol and best practices. As such, recommendations emerging from this research are outlined in the research articles (Chapter 3) and final chapter of recommendations (Chapter 4). These recommendations are relevant to multiple stakeholders: schools, school boards, school trustees, curriculum developers, Faculties of Education, Ministries of Education, students, researchers, humane educators, humane societies, and animal advocacy organizations. All of these groups are implicated and/or have ongoing interest in issues surrounding objection to dissection and student choice.

A third goal of the research is to keep dialogue open among the various stakeholders. Two of the primary stakeholders are teachers and students, as represented by participants in this research. For participating teachers, a goal of this research was to provide a sounding board to discuss dissection as a pedagogical practice. For wider groups of teachers, there will ideally be an opportunity to learn from the discussion through published articles, including one that was published in the Science Teachers‟ Association of Ontario‟s *CRUCIBLE* online newsletter in

September 2011 (not included in this dissertation). It is hoped that the published papers included in this dissertation, and perhaps others to come, will help teachers in thinking (or rethinking) and developing (or redeveloping) practices in relation to dissection. For students—and particularly those who have resisted animal dissection—it is hoped that this study will, importantly, help to bring their voices to the discussion.

Finally, an overarching goal in undertaking this work is to contribute to the growing body of scholarship in critical animal studies that seeks to resist the hegemonic scientific positioning of animals as "tools" or "data" of the science lab. In solidarity with other animal advocates, I see the animals themselves as the most important stakeholder in this study and hope that this research can add to an appreciation of them as living, feeling beings who care what happens to them. If this research can contribute in even a small way to a critical reappraisal of traditional forms of dissection, it will have been worthwhile.

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CHAPTER TWO

REVIEW OF THE LITERATURE

Given the many trajectories that this literature review took, this chapter is parsed into several sections. I first address the historical contexts of dissection and situate the practice in science education. I then review research discussing student objection, student choice, and the use of dissection alternatives, particularly in regard to their effectiveness compared to traditional dissection. Finally, I explore the multi-faceted "dissection debate" (Madrazo, 2002): the range of arguments that have been presented through discussions of ethics, animal rights, and animal welfare, and the social, pedagogical, and environmental arguments articulated for and against dissection. In presenting this review, my aim is to provide an overview of the politics associated with dissection and the ways the practice has been both canonized and challenged in educational contexts.

Historical Contexts of Dissection

The historian MacDonald (2005) writes that "dealing with the dead always requires some form of rationalization; it is part of the process through which access to bodies is socially negotiated" (p. 15). In writing this, she is referring to the contentious practice of *human* dissection, but the same can be said of animal dissection: it has been rationalized, and continues to be rationalized, in particular ways. "Dealing with the dead" is never a neutral practice; regardless of the species of cadaver, some form of rationalization is always in effect. In the case of animals, this rationalization often relates to the idea of animals being of "lower" moral rank than humans (i.e., substantially different from us), yet similar enough to us that their bodies can stand in as surrogates for our own. This seeming double-standard—that animals are both different enough from us that it is ethically justifiable to use them, yet similar enough to us that it

is worthwhile for us to use them—has run through the Western history of animal dissection and been debated for much of its timeline.

This history of animal dissection is deeply entwined with that of human dissection, and as such, it makes sense to consider them together. While it is beyond my purview to review either of these histories in depth, and other authors and historians have already considered them carefully (e.g., Baumans, 2004; MacDonald, 2005; Sawday, 1995), it is worthwhile to trace a brief trajectory of some key historical moments that have led to the present moment, in which animal dissection has become a normalized part of North American science curricula.

The earliest known dissections, both human and animal, date back to ancient Greece. The earliest known animal dissections were performed in the third century BCE by Aristotle, who used them as a basis for comparative anatomy in mapping out the structure and function of the human body (Baumans, 2004; Guerrini, 1989). A century later, the earliest known human dissections were conducted, credited to Greek anatomists Herophilus of Chalcedon and Erasistratus of Ceos of the Alexandrian Ptolemaic medical school (von Staden, 1992). While the work of these Greek anatomists, carried out on the cadavers of convicted criminals, is said to have led to extraordinary physiological discoveries, only fragments of their writings remain due to a seventh-century fire that destroyed the great collections of medical books at Alexandria (Lassek, 1958). Further, following the deaths of the two anatomists, a prohibition on human dissections was enacted in Rome that left dissection stalled for over 10 centuries (Hart, Wood, & Hart, 2008; von Staden, 1992).

Hart et al. (2008) write that for many centuries there were deeply held emotional, moral, and religious issues surrounding the dissection of human bodies. Emotionally, there was a horror at the thought of being cut up after death, and within some religious perspectives the act of dismemberment interfered with notions of the afterlife and resurrection of the body. The combination of these reactions led to a prohibition on human dissection for well over a thousand years, while animal dissection and vivisection continued unfettered.

Five centuries after Aristotle it was Galen, physician of Roman emperor Marcus Aurelius, who compiled anatomical knowledge in a medical treatise disseminated to medical schools in Alexandria in the second century AD (Baumans, 2004). Like Aristotle, Galen performed extensive physiological experiments on animals, which provided a basis for medical practices in the centuries to follow (Baumans, 2004). Galen‟s exclusive use of animals resulted in numerous errors and misconceptualizations about the human body, however (as had Aristotle‟s work)—as Knight (1980) writes in his book, *Discovering the Human Body:*

> Without human bodies for study by dissection there could be no meaningful anatomy… and although such men as Aristotle and Galen were undoubtedly geniuses, their attempts to transpose aspects of animal anatomy to the human body sometimes led to ludicrous conclusions. (p. 166)

These "ludicrous conclusions" included, for example, Galen‟s depiction of humans having kidneys positioned like a pig‟s and the anatomical brain structure of a cow, and women having a womb similar to a dog‟s. Further, when he examined a network of nerves at the base of an ox brain, he believed he had found conclusive proof of Plato‟s belief in a "tripartite" human soul (Nutton, 2002).

It was not until the 13th and 14th centuries that some of the erroneous conclusions emerging from comparative anatomy could be corrected, as the practice of human dissection began again at the Salerno medical school in Italy (Hart et al., 2008). The style of these early human dissections involved a lector, who would stand apart from the cadavers on a raised pulpit and give instructions to a sector, or so-called "barber-surgeon," who would perform the incisions below (McCance, 2008). The lector‟s instructions came from readings of classical texts. McCance (2008) suggests this one-person-removed approach served to keep the works of esteemed scientists Aristotle and Galen alive: "[T]he lector… serves as but a relay, an „academic conduit,‟ for the words of classical authors, words whose authority is attested to iconographically by the large size and high placement of the volume being read" (p. 68). Given that this was the

standardized approach to dissection in the late Middle Ages, it was considered revolutionary, and controversial, when Vesalius of the 16th century elected to dissect cadavers himself, rather than relying on a barber-surgeon to do it. His methods sparked the genesis of a new, "hands-on" era in scientific investigation, one that continues today and can be seen via classroom animal dissections (Hart et al., 2008).

By the dawn of the Renaissance, fascination with the interior of the body had spread through the sciences and the arts. Human dissection was on the rise in medical schools but also popular among artists: Leonardo da Vinci and Michelangelo, for example, participated in dissections to render detailed drawings of human anatomy, and dissections also took place as public spectacles, at carnivals and in theatres built especially for public viewing (Hart et al., 2008; MacDonald, 2005). Wax museums and other museums of human remains also opened, offering new ways for the public to contemplate the interior of the body (MacDonald, 2005). Writers, poets, and playwrights, including Shakespeare, also explored themes of the anatomy table in their work (Sawday, 1995). In short, dissection was gaining widespread interest and raising questions in multiple realms: medical and physiological, but also artistic, philosophical, ethical, religious, sexual, and psychological (MacDonald, 2005; Sawday, 1995). As a continually contested practice, none of these questions had easy answers.

One question always in negotiation concerned *which* bodies could be dissected. In response, both legal and illegal acts emerged. In the legal sphere, various Anatomy Acts were developed that specified that cadavers of convicted murderers and other criminals could be used posthumously, with the rationale that dissection would serve as additional punishment for their crimes (MacDonald, 2005). This did not meet the growing demand for bodies at the time, however, and in response, the cadavers of certain marginalized groups became targeted as "material" upon which anatomists could practice their investigations. These groups of targeted individuals included the bodies of the poor, the "insane," Indigenous populations, people who committed suicide, orphans, and those who died in hospitals but whose bodies were not claimed

(MacDonald, 2005; Sawday, 1995). More generally it also included the recently deceased, as evidenced by a macabre history of grave-plundering in America, England, and Scotland (Sawday, 1995). Finally, in one notorious chapter in history, it included people who were murdered specifically *for* dissection purposes: in the 19th century, Edinburgh‟s William Burke and William Hare were convicted of killing 16 destitute people and selling their bodies to science (Hart et al., 2008; MacDonald, 2005).

While particular rationalizations were employed concerning which human bodies could be dissected, differing rationalizations existed for animals‟ bodies. Historically, one of the most prominent of these was encompassed in the mechanistic viewpoint of Rene Descartes, whose influential 17th century philosophy dictated that experiments on animals could be performed without posing a moral problem (Ghasemi & Dehpour, 2009). The Cartesian philosophy, outlined in Descartes‟ writings in *Discourse on the Method* (1637), was that the animal body was much like a machine without a spiritual principle (soul), and as "machines," animals could neither think nor feel pain. Descartes placed great emphasis on speech as a marker of thought and sentience. He considered speech an external sign denoting that an individual was thinking, and he believed that thinking was, in turn, essential for sentience (hence his famous quotation, "I think, therefore I am") (McCance, 2008). Following Descartes‟ logic, animals became constructed as unspeaking, unthinking, and therefore unfeeling beings, much like automatons or mechanistic clocks. Vivisect them (as he did, in one instance nailing the family dog to a board by the dog‟s four paws and dissecting the dog alive) and they might "scream," but their screams are nothing more than internal mechanisms at work, much like that which prompts a clock to chime, he argued (Guerrini, 1989; McCance, 2008). Descartes also provided a theological justification for animal research, forwarding that God had made nature for humanity‟s use and that experiments on animals could be defended on the grounds of seeking to gain knowledge about God‟s creation (Guerrini, 1989).

Descartes‟ ideas were not unanimously accepted, either inside or outside of scientific communities. In philosophic circles some countered his ideas from a religious perspective, arguing that human kindness to animals was paramount as it reflected God‟s kindness to humanity. Thomas Aquinas was one individual who voiced this argument. He and others presented a counter-argument to the "beast-machine" philosophy with the ethical message that God did not create the world for humanity alone (Guerrini, 1989). Utilitarian philosopher Jeremy Bentham argued directly against Descartes‟ philosophy, declaring that justifications of animal use should be drawn along lines of whether animals are capable of *suffering*, not whether they possess capacity for reason or speech. As he famously wrote—and which would later form an ideological basis for the animal liberation philosophy spawned by the publication of Singer‟s (1975) *Animal Liberation*—"The question is not, can they reason? Nor, can they talk? But, can they suffer?" (Bentham, 1789, Chapter 17, section 1).[4]

Bentham was one of a few philosophers at the time who wrote about what would later be termed "the animal question"—the question that has arisen as a result of philosophy‟s exclusion of nonhuman animals from the ethical domain (Castricano, 2008). While opposition to the use of animals in vivisection and dissection has likely existed as long as the practices themselves, Guerrini (1989) writes that a pronounced period of change began in the early modern era, away from the view of animals as servants to humanity and toward a recognition that they, too, feel pain and emotion. The treatment of animals therefore became a moral question, taken up by philosophers including Jean-Jacques Rousseau, who argued that animals are sentient beings, and Voltaire, who seemed to respond directly to Descartes as he wrote about the loyalty of dogs and the cruel treatment they may receive from people in return:

[4] Later scientists and philosophers, including Singer (1975), would argue that we can be confident that animals can and do suffer because of their behavioural and physiological responses to pain-inducing stimuli, the similarities between their nervous systems and our own, and animals‟ presumed evolutionary adaptation to be sensitive to pain.

> There are barbarians who seize this dog, who so greatly surpasses man in fidelity and friendship, and nail him down to a table and dissect him alive, to show you the mesaraic veins! You discover in him all the same organs of feeling as in yourself. Answer me, mechanist, has Nature arranged all the springs of feeling in this animal to the end that he might not feel? (Voltaire, quoted in Singer, 1975, p. 210)

Alongside philosophical treatises was a burgeoning antivivisection movement, championing not only changed attitudes toward animals but also welfare Acts and more humane versions of science (Buettinger, 1997). Antivivisection dates back to the 1690s in France and the 1700s in England, but it was in the 19th century in England, America, and Canada that its membership was strongest, in reaction to the appearance of the first animal experimentation labs (Buettinger, 1997; Connor, 1997; Guerrini 1989). Antivivisection activists argued that many of the experiments taking place in the labs were cruel, lacked utility, and morally brutalized the scientists who performed them. Further, in the context of Victorian thought of the time, the experiments were deemed by some antivivisectionists to reflect an "inner sickness" of the soul (Connor, 1997).

A notable theme of the antivivisection movement was that it was largely organized by women and women assumed key positions of leadership within it. Many antivivisection groups, regarded as radical in their time, were founded by women, including the British National Anti-Vivisection Society founded by Frances Power Cobbe in 1875 and the American Anti-Vivisection Society founded by Mary Lovell and Caroline White in 1895 (Buettinger, 1997). Linkages between the women"s movement and the antivivisection movement were persistent; Lansbury (1985) writes that for students and increasingly the public in the 19th century, the two were part of the same movement. Perhaps not surprisingly, similar patriarchal attitudes were also levied against both, often positioning the women participants as irrational. As Buettinger (1997) notes: "Nineteenth century science already classified women as less capable than men of

sustained rational thought, as the sex whose emotions were apt to break free from the control of their rational side. Female irrationality … became a vivisectionist theme" (p. 867).[5]

The antivivisection movement was fragmented in its politics and did not necessarily represent a categorical condemnation of animal research (Lansbury, 1985). Multiple arguments were raised through it, some against the use of animals in science and others against particular forms of experimental research. For Cobbe, feminist leader of the British movement, the "coldly rational materialism" of science was the enemy. Cobbe argued that as scientists sought an "objective" stance that trumped emotion in their work, they were "hardening their hearts" and becoming morally coarse (Rose, 1995). This faction of the antivivisection movement thus struck back at the Cartesian ideology of a mind/body split, arguing for the importance of emotion in an ethical consideration of lab animals. Cobbe also stressed a close connection between women‟s and animals‟ liberation, pointing out linkages in the cruelty that both women and animals suffered at the hands of men in general and the male medical profession in particular.[6] The theme of the strong exploiting the weak also lent itself to comparisons between men‟s power and women‟s relative lack thereof—a politically apt comparison in a time when suffragettes were championing women‟s voting rights (Lansbury, 1985).

Other antivivisection themes of the Victorian era related to the advancing of Christianity and the "proper" molding of the young (Buettinger, 1997; Rose, 1995). Antivivisectionists drew upon Christian ideals in insisting that inflicting pain and death on innocent animals was contrary to theological teachings to be merciful. Vivisection was equated with sin, and hell became a

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[5] This discursive coupling of women and emotion reifies the Cartesian divide of rationality (considered a masculine trait) and emotion (considered a feminine one). More generally, it demonstrates a pitting of masculine science against feminine animal protectionism—a persistent theme to this day, as explored in texts such as *Reinventing Biology* (Birke & Hubbard, 1995) and research identifying that women are more likely than men to express concern about, or object to, animal-based research (Gaarder, 2011;Hagelin, Carlsson, & Hau, 2003; Phillips & McCulloch, 2005; Pifer, 1994; Plous, 1996).

[6] For example, in the Victorian era, poor and working-class women were often diagnosed with "uterine diseases" that left them subject to painful and humiliating medical treatments and sexual surgeries. In light of this, some antivivisectionists saw themselves as connected to lab animals in a pattern of medical exploitation (Lansbury, 1985).

metaphor for the laboratory (Buettinger, 1997). Not surprisingly, then, the practice of vivisection that sometimes took place in schools was seen by antivivisectionists as degrading to children‟s moral character. Overall, women who championed antivivisectionism from a Christian perspective believed that harming animals threatened the sacred trusts of Christianity and impeded children‟s proper moral development (Buettinger, 1997).

By the end of the 19th century, the antivivisection movement was accompanied by the rise of the humane movement, as the first humane societies and Societies for the Prevention of Cruelty to Animals (SPCAs) were established in Canada, Britain, and America (Buettinger, 1997; Connor, 1997). These organizations had close ties with child welfare and antivivisection organizations; often the activists of antivivisectionist organizations comprised influential contingents inside SPCAs in addition to having their own organizations (Connor, 1997). The combined efforts of humane and antivivisection organizations, as well as outcry from the general public, led to some legislative victories concerning the protection of lab animals. One of the most significant of these was the adoption of the 1876 Cruelty to Animals Act in England (Lansbury, 1985; Rose, 1995). This Act stipulated that in experiments involving the infliction of severe pain on animals, the animals must be anaesthetized for the duration of the experiment and killed as soon as the experiment ended. While the passing of this Act represented a victory and set precedent for other Acts to follow in Canadian provinces and American states, it was a far cry still from the abolition of animal-based research or the assurance of ongoing humane treatment of lab animals (Buettinger, 1997).

The humane movement also made inroads with schools in 19th century America, where the first compulsory humane education program was implemented in 1886 in Massachusetts (Thompson & Gullone, 2003). The humane education movement had the protection of animals and children at its core, focusing on principles of compassion, goodwill, and humanity toward all life (Selby, 1995). Typically, early humane education efforts took the form of lessons about animals, contact with animals, and exposure to animal literature, such as *Black Beauty,* to

promote themes of kindness and compassion (Thompson & Gullone, 2003; Unti & DeRosa, 2003). By 1920—which in some ways could be considered the "golden era" of humane education—20 American states had compulsory humane education programs in place; however, the vast majority of these states had no sanctions for non-compliance and this resulted in humane education being observed unevenly, at best, across the country (Antoncic, 2003). Further, after the Second World War, the focus in America shifted away from compassion and kindness and toward patriotism and nationalism, which left humane education marginalized in curricula, where it has largely remained since (Selby, 2000; Unti & DeRosa, 2003).[7]

In spite of its marginalization in schools, humane education has grown through other educative organizations and has had an especially close relationship with the biological sciences, due to the historic and continued use of animals in scientific contexts. One of the key developments in this relationship was the 1959 publication of Russell and Burch's now-classic book, *The Principles of Humane Experimental Technique* (Russell & Burch, 1959). In this book, the authors/scientists write that it is imperative that we strive toward the humane treatment of animals for the sake of the animals, our own humanity, and for successful science, as "by now it is widely recognized that the humanest possible treatment of experimental animals, far from being an obstacle, is actually a prerequisite for successful animal experiments" (chapter 1, para. 2). To this end, Russell and Burch outlined principles for promoting humane technique in the sciences, labelled the "Three Rs," pertaining to the *replacement*, *reduction*, and *refinement* of harmful animal use. In their words:

> Replacement means the substitution for conscious living higher animals of insentient material. Reduction means reduction in the numbers of animals used to obtain information of a given amount and precision. Refinement means any decrease in the

[7] In Canada, the history of humane education is far more spotty. Efforts toward teaching humane education have largely come from individual teachers who have aimed to incorporate humane content in the classroom (Selby, 2000).

> incidence or severity of inhumane procedures applied to those animals which still have to be used. (1959, chapter 4, para. 2)

Since the publication of their book, the principle of the Three Rs has been accepted internationally as a humane guideline for animal use in science and education (Hart et al., 2008; King, 2004; Smith & Smith, 2004). Some of the factors contributing to its popularity include changing attitudes toward animals, vast gains in technology that have in some cases replaced consumptive animal use altogether, and the development of ethics committees and animal care committees that critically review and/or monitor animal-based research (Baumans, 2004). Educational and humane organizations such as InterNICHE (International Network for Humane Education) and Animalearn promote the enactment of the Three Rs by assisting educators in finding non-animal methods to teach the life sciences.

What impact has the publication of *The Principles of Humane Experimental Technique* had on classroom animal dissections? Surprisingly, it was shortly after the book"s publication in 1959 that dissection became a regular part of secondary science curricula (NABT, 1990). While the earliest accounts of classroom dissection date back to the 1920s, it was in the 1960s that dissection became a regular practice of science education (NABT, 1990; Orlans, 1993). This reality, combined with the stronghold dissection continues to have today, suggests the Three Rs principle has not yet filtered down to school-based science education contexts in a meaningful way.

Despite this, dissection *has* been hotly debated in the scholarly literature for the past 30 years. Since the 1980s many controversies have been associated with the practice, and as I explore in "The Dissection Debate" section below, many of the questions posed by ethicists and humane educators today evoke themes from the histories of protest to animal-based research, including: *Is it ethically justified? Does it morally harden the students who participate in it?* and *What can or should be done to replace, reduce, and/or refine harmful animal use?* The endurance of these ethical questions reflects the long-standing debate surrounding dissection and,

more generally, the use of animals in scientific research. For, as Kramer (2007) reminds us, dissection is indeed a form of animal research, and is usually a person‟s first (and often only) experience with it.

Today we sit at a complex crossroads regarding the contested role of animal use in science, yet scientific interest in the interior of human and animal bodies remains strong. On the human side, this interest is evidenced through the continued use of cadavers in higher medical education and the remarkable displays of plastinated bodies in Gunther von Hagens‟ popular *Body Worlds* exhibits. On the animal side there is also growing interest, as well as growing debate. In the past decades the amount of critical attention, activism, and scholarship related to animal use in science has increased at a rapid pace; however, so has the number of animals used for scientific research, mainly due to developments in the field of genetic modification (Baumans, 2004). The continued use of animals is on one hand defended as imperative in leading to significant medical advances, but it is also deeply challenged on ethical grounds. It is further criticized given that the vast majority of scientific work involving harmful animal use does not lead to medical advances (or even publication), and, as a result, millions of animals suffer and die, sometimes horrible deaths, in vain (Dagg, 2008; Greek & Greek, 2003). The animals used for classroom dissections are no exception.

It is valuable to know something of the historical tensions surrounding dissection and the use of animals in science to understand the myriad influences on the topic and how enduring the debate has been. With this history in mind, I focus next on the literature most directly related to my research topic: animal dissection in contemporary school science contexts.

Animal Dissection and the Science Education Context

It is written that the majority of North American students—an estimated 75-80%—will participate in at least one classroom animal dissection during their primary and secondary years

(Balcombe, 2000; Orlans, 1993).[8] While school dissections are not practiced exclusively in North America, the vast majority of the available literature speaks of this context, likely because globally, this is where dissection is most prominent (Balcombe, 2000). In Sweden, Germany, and England, dissection is rare in elementary and secondary schools, and five countries no longer conduct dissections in schools at all: The Netherlands, Switzerland, Argentina, Slovak Republic, and Israel (Balcombe, 2001; Waltzman, 1999).

Research into the prevalence of dissection suggests most American and Canadian teachers continue to offer animal dissection to students, a finding that was confirmed by this study (see Chapter 3). King, Ross, Stephens, and Rowan (2004) found that in their sample of American middle and high-school biology teachers (*N*=494), 79% of respondents reported using dissection in their current teaching practices and 51.4% reported that they performed three or more dissection-based laboratory classes per course. From this same study, 69% of respondents characterized dissection as an "essential" hands-on activity for students. A second American study (Almy, Goldsmith, & Patronek, 2001) examined the practices of science teachers in Massachusetts (*N*=667) and found that 78.1% of respondents said they offered dissection at least once in the last five years, and over half of respondents (54%) agreed that dissection was an "important or essential" part of science education. A third American study, based on responses from members of the National Biology Teachers Association (*N*=215), found that 75% of respondents reported intending to use animal dissection in their science classes (Cockerham, 2001). Finally, Bowd"s study (1993), the only Canadian study I found of this nature, reported that 88.4% of undergraduate students in an education psychology course (*N*=191) had participated in an animal dissection in school.

It is difficult to translate these numbers into the total number of animals used each year for dissection. Orlans (1993) extrapolates that if 75% of the four million American high school

[8] Dissection is not limited to science classes, however. It can also form part of science camps or summer camps, as is the case with the Thunder Bay Superior Science camp at Lakehead University.

students participate in dissections, with each student dissecting one animal, then approximately three million animals are killed each year for dissection purposes in the U.S. alone. A higher estimate, cited in Rosenberger (1998), is that 10-12 million animals per annum be used. In Canada, it is not known how many animals are dissected each year because schools are not required to maintain records on animal use, unlike at higher levels of education where records are maintained through animal care committees (Canadian Council on Animal Care, 2006). The fact that there are many variants of dissection activities—for example, each student may dissect one animal or more, students may pair up to dissect, or teachers may model dissection with students watching—makes it impossible to provide anything other than a rough estimate, although the total number of animals used for dissection in North America is surely in the millions each year.[9]

There is immense variety in the species dissected in science classes. While traditionally, frogs have been ubiquitously associated with dissection—and certainly they continue to be dissected—this may be changing in light of the global decline in amphibians due to habitat loss, disease, climate change, and other unknown causes (Cormier, 2008; Souder, 1998). Other dissected animals listed in the literature include fetal pigs, rats, minks, earthworms, turtles, rabbits, birds, snakes, cats, guinea pigs, crayfish, perch, starfish, animal parts and "plucks" (e.g., cows‟ eyes, sheep lungs, bull testicles), and a wide range of insects (Bowd, 1993; Hart et al., 2008; King et al., 2004).

Many teachers procure animals through biological supply companies, where, as Hart et al. (2008) note, "it seems that virtually any animal specimen imaginable is available for purchase" (p. 160). Through online biological supply companies such as WARD‟s Natural Science and Boreal Northwest, individuals affiliated with an educational institution can purchase

[9] Overall, this represents a very tiny fraction of animals used globally for scientific research. Bishop and Nolen (2001) write that worldwide, approximately 35 million animals are used in research each year, but this number must be increased tenfold to account for the vast amount of animals not covered by Animal Welfare Acts, including rats, mice, and birds.

animals, alive or dead, with a credit card and a few clicks of a mouse. Many specimens sold through biological supply companies are wild-caught from natural environments, while others come from animal breeders, dealers, shelters, pounds, fur farms, and slaughterhouses (Balcombe, 2000). Without question, there is a convenience in purchasing through biological supply companies, as the animals can be purchased in bulk and delivered directly to schools along with any required lab equipment such as pans, scalpels, and pins (Hart et al., 2008).

There is also a vast market of alternatives to dissection available for purchase, including virtual dissection software, films of dissection, plastinated specimens, anatomical models, posters and charts. Research regarding teachers‟ use of dissection alternatives is sparse, however, making it difficult to gain a clear picture of alternatives‟ prevalence or popularity. Further, there are many variables that can influence a teacher‟s decision to use alternatives, either in lieu of conventional dissection or in conjunction with it, including: knowledge and access to alternative technologies, perceptions of the effectiveness of alternatives, willingness to explore new modes of learning, and available resources, budgets, and supports (Cockerham, 2001; Hart et al., 2008). Cockerham‟s (2001) study, for example, entitled *Factors that Predict the Use or Non-Use of Virtual Dissection by High School Biology Teachers,* found that teachers‟ likelihood of using a virtual dissection was positively related to their attitude toward virtual dissection, their previous experience using a virtual dissection, and their intention to use a real animal dissection. Gender and educational level were not shown to influence decisions.

The limited research to date suggests teachers mainly use alternatives as supplements, rather than substitutes, to conventional animal dissection. This is demonstrated in King et al.‟s study (2004) of American middle and high-school biology teachers (*N*=494), where teachers who reported using dissections in their classroom demonstrated an equal or numerically higher prevalence of the use of other resources. Most notably, respondents reported using charts (76.8%), videos (67.9%), 3D models (52.8%), CD-ROMs (35.5%), and other computer-based resources (34.2%). Further, 31.4% of respondents reported that they believed alternatives were

"as good as dissection for teaching anatomy and/or physiology," while 55.1% disagreed. Similar findings were noted in Almy et al."s (2001) study of science teachers in Massachusetts (*N*=667). In this study, 78.1% of the teachers who offered dissection also reported offering alternatives. When asked how alternatives compared to dissections, half (50.8%) of respondents ranked computer simulation as comparable or superior to dissection—and here, unlike Cockerham"s (2001) findings, gender was a variable in predicting teachers" outlook on computerized programs, with female teachers significantly more positive about computer programs than males. Overall, given contradictions in the data and a paucity of research in this area, further study is needed to understand teachers" practices and perspectives toward dissection alternatives.

Conventional dissection *and* dissection alternatives figure into the Ontario science curriculum. In Ontario, dissection forms part of the Grade 10 Science and Grade 11 Biology curricula, which state that students will undertake a conventional dissection, a virtual dissection, or use a mounted anatomical model to achieve particular curricular goals (Ontario Ministry of Education, 2008a, 2008b). This is outlined in the following curricular passages:

> [Students will] investigate, through a laboratory or computer-simulated dissection of a plant, worm, fish, or frog, the interrelationships between organ systems (Grade 10 Science, Academic) (Ontario Ministry of Education, 2008a, p. 75)
>
> [Students will] locate, through a laboratory or computer-simulated dissection, the organs of a specific system of an animal (e.g., a worm, a frog, a fish) and describe their interrelationship (Grade 10 Science, Applied) (Ontario Ministry of Education, 2008a, p. 87)
>
> [Students will] perform a laboratory or computer-simulated dissection of a representative animal, or use a mounted anatomical model, to analyse the relationships between the respiratory, circulatory, and digestive systems (Grade 11 Biology: University Preparation) (Ontario Ministry of Education, 2008b, p. 57)

> [Students will] perform a laboratory or computer-simulated dissection of a mammal to identify organs, and explain the relationships between the structures and functions of body systems (Grade 11 Biology: College Preparation) (Ontario Ministry of Education, 2008b, p. 71)

There is no further discussion of dissection in the curriculum beyond the above-listed objectives, except for a brief passage in both documents under the heading, "The Role of Information and Communications Technology in Science," where it is noted that "Technology … makes it possible to use simulations—for instance, when field studies on a particular topic are not feasible or dissections are not acceptable" (Ontario Ministry of Education, 2008a, p. 40; Ontario Ministry of Education, 2008b, p. 42). This leaves science and biology teachers largely without curricular support in making the decision whether to offer conventional dissection or use alternatives. Silences surrounding dissection in curricula have been noted by Hart et al. (2008), who write:

> [W]e continue to be surprised at the scarcity of information on dissection, especially since it is such a pervasive aspect of secondary school biology education… It seems surprising … that dissection still continues in intermediate and high schools, much as it was fifty or more years ago, even though it fails to appear in discussions of educational standards and frameworks. (pp. ix-x)

Given the controversies associated with dissection and the increasing availability of alternatives, it would seem that more, not less discussion in curricular guides would be helpful to assist teachers in navigating this topic.

Conscientious Objection and Student Choice

The history of student objection to dissection dates back to the 1980s at the high school level, starting with the well-publicized case of Jenifer Graham, who refused to dissect a frog in biology class and eventually took the matter to a state court to argue for her right to not dissect.

Graham was a 15-year-old Victorville, California high school student who, in April 1987, refused to dissect a frog on moral grounds. In her words, she said:

> I feel a strong kinship with animals to which God has given life … what I feel toward animals is what I feel toward friends: we are both alive and both have a soul, so to speak; animals are in different kinds of bodies. (quoted in Hepner, 1994, p. 67)

Upon refusing to dissect the frog, Graham was told she would fail the course. She and her mother legally challenged the school‟s decision policy, taking the matter to court with the help of the Humane Society of the United States. They argued that her ethical beliefs were equivalent to a religion and that the school district was violating her right to freedom of religion. Graham‟s case was settled and not fully adjudicated, but it resulted in the amendment of a bill, signed by the governor of California in 1988, which mandated that students have the right to conscientious objection to dissection or other educational projects involving the harmful use of animals.[10] The bill further stated that in the case of such objections, teachers and students should work together to develop an alternative (Beauchamp, Orlans, Dresser, Morton, & Gluck, 2008; Hepner, 1994; Kramer, 2007; Orlans, 1993).

Graham‟s case sparked national attention. CBS made a movie for national television recounting her story, entitled “Frog Girl,” which aired in October 1989. Her case also marked the beginning of anti-dissection campaigns by humane societies and other animal advocacy organizations, which adopted slogans such as, “Cut the Class, Not the Frog” and “Say No to Dissection” (Orlans, 1993). Graham also set precedent for other students to take litigious action against their schools on the grounds of refusal to accommodate conscientious objection, which in turn contributed to the development of student choice policies in other American states and within some Canadian school boards.

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[10] Conscientious objection can be defined as objection based in moral, ethical, or religious reasoning (cf. Cunningham, 2000).

Student choice policies, also known as choice legislation, give students the right to "refuse to participate in classroom activities and demonstrations… that they find objectionable on the basis of personal moral, ethical, or religious convictions … [and] to have access without penalty to alternative learning methods, models, and approaches" (Cunningham, 2000, p. 192). Balcombe (2000) writes that ideally, choice policies should include written and verbal components, discussions in class, an explicit awareness among students that there is no penalty for choosing alternatives, comparable alternatives being available, and no demand on teachers to dissect. Duncan (2008) adds there should be no demand on students to obtain parental consent to substantiate their choice.

Today, choice policies are in place in five school boards in Canada: Vancouver School Board (Vancouver, British Columbia), Burnaby School District #41 (Burnaby, British Columbia), Central Okanagan School District #23 (Kelowna, British Columbia), Toronto District School Board (Toronto, Ontario), and South Shore District School Board (South Shore, Nova Scotia) (Frogs Are Cool, 2011). In America, 10 states have enacted choice legislation (Florida, California, Pennsylvania, New York, Rhode Island, Illinois, Virginia, Oregon, New Jersey, and Vermont), and five school districts have passed resolutions that encourage or advise teachers to provide alternatives to dissection (in Massachusetts, New Mexico, Maine, Maryland, and Nevada) (AAVS, 2011; Kramer, 2007). While these policies clearly represent a victory for students in these jurisdictions who do not want to dissect, it is unclear how the policies are enforced or monitored. For this reason, Kramer (2007) argues better laws are needed to ensure conscientious objectors receive the protection and humane alternatives they deserve. Further, the great majority of North American jurisdictions lack policies in the first place, meaning students in these regions have no legal support.

It is surmised that increasing numbers of students are objecting to invasive procedures on animals, fueled in part by the growing popularity of the animal rights movement (Capaldo, 2004). Research—including this study—finds that objection to dissection is sufficiently common

that the majority of science teachers who conduct dissections have experienced it. One study found that 84% of science teacher respondents reported having had students object (King et al., 2004), while another found a lower number, 74.4% of teacher respondents, reported having this experience (Moir, 2000). In a third study, teacher respondents varied enormously in the number of students they reported as refusing to dissect in their classes over a five-year period (estimates ranged from 0 to 225!), but a mean number of 10 students per teacher over the previous five years was found (Almy et al., 2001).

Orlans (1993) suggests that in a typical classroom, three to five percent of students will verbally object to dissection and a higher percentage may harbour objections but not feel comfortable voicing their opinions. For a number of reasons, there may be a disconnect between how students feel about dissection and whether they verbally object. For example, the power dynamic inherent in the teacher-student relationship may be such that a student will not feel entitled to express his or her opinion, or may fear embarrassment in front of his or her peers. Considering that students are at an age when they are vulnerable to peer pressure, challenging the authority of the teacher or the curriculum can be daunting (Balcombe, 2000; Cunningham, 2000). Further, dissection may be presented as a requirement; one study found that some teachers still refuse to accommodate students‟ requests for alternatives and have even reported failing students who refuse to dissect (King et al., 2004). In light of these potential challenges, some students may perceive that going along with a dissection—even in a detached or desensitized manner—may be the best way to deal with an uncomfortable situation.

Research indicates that of the students who do verbally object, there is a gendered composition. Educators have reported that almost three times the number of female students object to dissection than males (Almy et al., 2001). This mirrors the overarching finding that females demonstrate greater concern about animal welfare than males (Phillips & McCulloch, 2005), that opponents of animal-based research are predominantly female while supporters are predominantly male (Hagelin, Carlsson, & Hau, 2003; Pifer, 1994; Plous 1996), and that there is

a gender imbalance in the number of people who identify as animal rights activists, in a movement that "consistently shows higher female participation than male" (Taylor, 2005, p. 3). Vegetarians are also less likely to support classroom dissection and females are more likely to be vegetarians than males (McAllister Smart, 1995), which again supports a pattern of more females objecting to dissection. Interestingly, gendered patterns have also been found among biology teachers: a study of 242 prospective biology teachers' experiences with dissection showed that 55% of males cited positive responses to their initial dissection experience while only 33% of females cited the same (de Villiers & Sommerville, 2005).

Objection to dissection is sometimes dismissed as "squeamishness," which may also have a gendered implication (Jukes & Chiuia, 2003; MacPherson, 2000). The use of this pejorative term implies that students are not able to deal with the harsh reality of the life sciences—the use of a scalpel, the sight of blood, the act of incision, and so on. Labelling students "squeamish" implies they may be "too sensitive," "non-objective," "too feminine," or "not man enough" (Jukes & Chiuia, 2003). This may further explain patterns of female preponderance of objection to dissection, as male students may interpret dissection as a test of their masculinity and seek to distance themselves from the notion of not being "macho enough" to dissect.[11]

Teachers' responses to conscientious objection can vary considerably: they may investigate, develop, and implement alternatives to replace animal use, with or without the mandate of legislation; they may also use alternatives in conjunction with animal cadavers, ask students to find their own ways of meeting the learning objectives, oppose students' requests altogether, and/or respond in a defensive, emotionally-charged manner (Jukes & Chiuia, 2003). Aggressive questioning of students and dismissive treatment of their concerns is not unheard of; students have suffered the threats and subsequent reality of low grades, no grades, and even

[11] Attempts to discredit those who object to harming animals by labelling them "squeamish" and "feminine" echoes a pattern of the 19th century, where those involved in the antivivisection movement were labelled overly "sentimental" (Buettinger, 1997).

expulsion for refusing to dissect (Hepner, 1994; Jukes & Chiuia, 2003; King et al., 2004). Educators may also feel their authority is being threatened by students who object and they may refuse choice for that reason; alternatively, they may believe that animal use is "indispensable" to education and that no adequate alternatives exist (Cunningham, 2000). Finally, they may simply be attached to traditional modes of teaching animal anatomy and physiology, and not want the challenge of learning anew (Balcombe, 1997).

Certainly, conscientious objection can create a challenging situation for teachers as it raises questions about their established practices and academic freedoms. It can also be seen in a very positive light, however. Jukes and Chiuia (2003) stress that conscientious objection is rooted in positive cultural values, including respect for life and a commitment to not harming. Moreover, well-developed critical and creative thinking skills are often evidenced by students who object, and these skills should be encouraged in the name of science:

> Students who object are likely to be active critical thinkers, and therefore good potential scientists. Being able to question the orthodoxy is a sign of critical, scientific thinking. There would not have been any innovation—or any science—if it weren't for creative thinking and the challenging of established norms. Many objectors are also among the brightest of students, and this intelligence often has a direct relationship with their willingness and ability to challenge. (Jukes & Chiuia, 2003, p. 67)

The process of giving voice to conscientious objection can be enlightening and empowering for students, forcing a critical refinement of their positions and honouring their evolving ethics (Capaldo, 2004). For these reasons, many argue it is worthwhile for teachers to support conscientious objection and student choice (Balcombe, 2000; Capaldo, 2004; Cunningham, 2000; Duncan, 2008; Jukes & Chiuia, 2003; King et al., 2004; Kramer, 2007). This also connects to humane science practices, for, as Kramer (2007) puts it, student choice "opens up the door to a new generation of scientists who, from their earliest leanings, approach science as an intrinsically humane process that neither wastes nor abuses animal life" (p. 286).

Cunningham (2000) outlines a host of reasons why teachers should support student choice. These include: (a) the emotional and social welfare of students; (b) the recognition that forcing students to dissect can interfere with the learning process and send students the implicit message that their beliefs and values do not hold up in the academic world; (c) the widespread availability of alternatives; (d) cost savings associated with dissection alternatives; (e) compliance with the Three Rs ideology and the fact that animal use is not a prerequisite to professional studies; and (f) the ethical problems associated with animal use. He writes that while most schools today have no written policy, it would be in their benefit to have one as this would mean students would know their rights and teachers would be prepared to offer alternatives. In this way, neither students nor teachers would have to experience conflict regarding dissection in the curriculum.

Alternatives to Dissection

Alternatives to dissection have been defined as "humane educational aids and teaching approaches that can replace harmful animal use or complement existing humane education" (Jukes & Chiuia, 2003, p. 9). Alternatives were first developed in professional schools, with the strongest initiatives to reduce animal use coming from veterinary schools (Hart et al., 2008). In veterinary schools, the success of alternatives and commitment to the Three Rs has been considerable, with alternatives mainstreamed and in some cases replacing the consumptive use of animals entirely (Hart et al., 2008). In medical schools, alternative teaching methods have also gained prominence. The Physicians Committee for Responsible Medicine reports that most medical colleges in the United States no longer use animals to train medical students, and in Canada, 11 out of 16 medical universities no longer use live animals in their teaching curricula (PCRM, 2002, 2008). Indeed, it is now possible to obtain a medical or veterinary university degree without ever killing an animal. A question that remains, however, is whether this culture of alternative use in higher education is trickling down to the school level.

Many dissection alternatives are available to schools. The most common of these are the computerized dissection simulations/CD-ROMs such as *Digital Frog*, *CatLab*, *DryLabPlus Fetal Pig,* and *Froguts*. Computerized dissection programs have become increasingly sophisticated in the past decades, with many of the programs today allowing students to complete all stages of the dissection procedure virtually, from pinning an animal down to removing and labelling the animal‟s parts. Students can mimic the dissection procedure by gradually "removing" layers to reveal underlying structures and tissues, and they can move from region to region of the body digitally (e.g., tracing the route of an aorta through the body or taking a "tour" inside an animal cavity). Many programs include 3D graphics, sounds and narration, picture banks with hundreds of images, video clips showing and discussing animals in their natural habitats, explanatory textual information, assessment tools, and accompanying student and teacher handbooks (Jukes & Chiuia, 2003; Smith & Smith, 2004).

There are several benefits associated with the use of computerized alternatives. Notably from a student‟s perspective, the programs allow for advancement at an individual‟s preferred pace. Procedures can be repeated over and over, unlike the one-time nature of a conventional dissection (Jukes & Chiuia, 2003). Computerized alternatives put students in control of their learning, with multiple ways to explore data and gain exposure to key concepts. Built-in assessments tools test student knowledge throughout the program, meaning students cannot advance to a new conceptual area until an assessment is successfully completed. Smith and Smith (2004) summarize these and other benefits of computerized alternatives:

> Student reactions tend to be positive to the use of alternatives, although this depends greatly upon how the alternative is presented, the type of education in which they are used and their degree of successful integration in the course as a whole. They are usually cost-effective… [and] avoid the traumatic psychological events that can occur with animal use. Experiments can be repeated indefinitely, with no constraints of time or place

> … Built-in self-assessment is easy to arrange, and animation techniques allow "fly-through" experiences that are impossible in real life. (p. 37)

Schools can also save money using computerized alternatives, as they can be used year after year. According to the Physicians Committee for Responsible Medicine‟s calculations, over five years a school might spend $2,387 on conventional frog dissections. This includes the cost of purchasing a dissecting set (used for five years), dissection pans and pins (used for five years), and 30 frogs per year from a biological supply company, at a cost of $310 for 30 frogs per year. Comparatively, a site license for *Digital Frog* 2 CD-ROM sells for a one-time cost of $899, or the five-in-one dissection package *DissectionWorks Deluxe* (encompassing dissection simulations of a frog, fetal pig, earthworm, crayfish, and perch) sells for $2,099 and can be used by various science classrooms in the same school year. Based on these calculations, over five years, choosing alternatives could save a school between $288 - $1488 (PCRM, 2004).[12]

While digital simulations are perhaps the most obvious form of replacement for conventional dissection, other types of technology or pedagogical approaches can be used to meet curricular objectives. Smith and Smith (2004) outline other possible alternatives: (a) charts, slides, and dissection manuals; (b) 3D models, simulators, and manikins; (c) films and photographs; (d) online presentations; (e) experimentation on people/self-experimentation; and (f) experiments on cell cultures, plants, or micro-organisms. Another creative possibility outlined in the literature is for students to build anatomical models of animals (or humans) with modelling clay, an activity that is inherently constructive, rather than destructive, in nature (DeRosa & Winiarskyj, 1990).

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[12] These calculations are in American dollars but similar savings can be found in Canadian pricing. For example, as of September 2011, according to the Ontario-based WARD‟s Natural Science biological supply company website <http://wardsci.com>, 25 six- to seven-inch formaldehyde-free bullfrogs costs $256.25. Over five years, the cost of purchasing the frogs would be $1,281.25, and this does not include the purchase of pans, pins, or dissecting tools. *Digital Frog 2*, by comparison, costs $959 Canadian, which includes the CD-ROM and license to install the program on a network of 10 computers.

Other types of dissection alternatives involve neutral or beneficial work with animals. In keeping with humane approaches to the life sciences, one possibility in effect in some veterinarian medicine schools is to use "ethically sourced" animal cadavers or material. This entails the purchase of cadavers of animals that have died naturally or in accidents, or animals that have been euthanized secondary to natural disease or serious non-recoverable injury, or the donated bodies of companion animals ("pets") that have died (EMP, 2011; Jukes & Chiuia, 2003). Ethically sourced cadavers and animal material may be obtained from Educational Memorial Programs, also known as "Willed Body Programs," "Client Donation Programs," and "Body Donation Programs" (EMP, 2011).

Another pedagogical possibility involves working with live animals, including studying them in their natural settings or for brief periods of captivity (in such instances, care must be taken to ensure the animals' protection and that habitat disturbance is minimal) (Jukes & Chiuia, 2003). A class field trip to a veterinarian to observe an actual animal operation could be another possible learning opportunity (Smith & Smith, 2004). This has the benefit of encouraging respect and consideration for animals while providing practical experience.

Given the number of teachers who use dissection in the classroom and see alternatives as a supplement, rather than replacement, for dissection, it is not surprising there is disagreement whether alternatives are appropriate pedagogical choices. As I explore in "The Dissection Debate" section below, there is considerable debate about the worthiness of alternatives. A common criticism concerns alternatives' (in)ability to simulate the complexity and uniqueness of a real animal body, and related concerns that the texture, colour, density, delicacy, and special relations among parts of an animal can never be faithfully revealed in a model (Allchin, 2005; Kline, 1995).[13] Another concern is that students will not be as interested or engaged in working

[13] As a rejoinder to the argument that there can be no replacement for the sight and touch of a real specimen, Balcombe (1997) writes that those who make this argument "will also know that the rubbery texture, discolored appearance, and powerful chemical odor of animals preserved for weeks or months in formaldehyde doesn't replace the sight, touch and smell of an animal, either" (p. 24).

with a simulation, and the lack of "hands-on" experience can result in shallow learning. As Offner (1993) writes:

> No model, no video, no diagram and no movie can duplicate the fascination, the sense of discovery, wonder and even awe that students feel when they find real structures in their own specimens. When students know a specimen is real, their attention is heightened, and the information they learn is somehow registered as "real." It is a more profound and permanent kind of learning that cannot be obtained in any other way. (pp. 147-148)

While debate over the value of working with animal cadavers versus alternatives continues, the student learning that can come from either experience has been researched considerably. The ability of alternatives to pedagogically "measure up" to conventional dissection is undeniably important, as teachers are required to provide students with learning experiences that enable them to meet curricular objectives. How effective, then, are dissection alternatives in relation to student learning?

Research suggests that learning with alternatives can be comparable, and in some cases superior, to learning with actual animals, particularly in relation to students‟ ability to identify anatomy (Fowler & Brosius, 1968; Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Strauss & Kinzie, 1994; Youngblut, 2001). Two meta-reviews of research measuring student learning with conventional dissection versus alternatives conclude that most learning objectives can be met with alternatives, that knowledge gain tends to be equivalent, that costs are less, that students are generally positive when using alternatives, and that alternatives provide better support for weaker students (Balcombe, 2003; HSUS, 2008). Specifically, Balcombe‟s (2003) meta-review of 30 published studies concluded that student learning can be comparable or at times heightened with the use of dissection alternatives. A similar study undertaken by the Humane Society of the United States reviewed 35 studies, which were broken down into three categories: those demonstrating equal or comparable student performance between dissection and alternative methods (18), those demonstrating that

alternatives were more effective instructional aids than dissection (15), and those demonstrating dissection to be a more effective instructional aid than alternative methods (2) (HSUS, 2008). These meta-reviews encompass research conducted at all levels of education, including post-secondary medical and veterinarian contexts, but the overall trend points to the efficacy of alternatives at every level. A review of school-based research, investigating dissection and alternatives in science classrooms, follows in chronological order.

The earliest published report found in this literature review was published in 1968. Fowler and Brosius (1968) examined the value of using a film of a dissection instead of having students perform an actual dissection. In their study, 156 Grade 10 biology students in Pennsylvania were divided into an experimental group (which watched films of earthworms, crayfish, frog, and perch dissections) and a control group (which conducted dissections of these animals), to determine "whether motion pictures were capable of contributing significantly to the attainment of some objectives in tenth-grade biology instruction" (p. 56). A pre- and post-test design evaluated students' performance. The researchers found that the acquisition of factual knowledge favoured the film treatment over the dissection treatment. No significant differences were found in the other variables measured, including skills in problem-solving, attitudes toward science, and manipulative skills. The authors conclude it is perhaps not essential that biology students have the experience of "cutting up stuff" (p. 57).

A 1994 study examined the effectiveness of *Interactive Frog Dissection*, an interactive videodisc simulation, as an alternative to frog dissection (Strauss & Kinzie, 1994). The researchers sought to compare the level of learning and retention of a frog's internal anatomy between two groups of students: one using the interactive videodisc and the other conducting a conventional dissection. Student attitudes toward the use of animals for dissection were also compared between the two groups, with gender included as an independent variable. Two small high school biology classes participated in the study, with eight students in the videodisc group and nine in the dissection group. Each student was given a pre-test and two post-tests on frog

anatomy. No significant differences were found between the groups on either pre- or post-tests, although the simulation group performed somewhat better on the second (delayed) post-test than did the dissection group. Students were also asked to respond to a Likert-style attitudinal scale related to their attitudes toward the use of animals for dissection. The findings were that students in the dissection group felt somewhat more positive toward dissection than those who used the simulation. The authors note that although the sample sizes were too small for generalizations, the results suggest "that the *Interactive Frog Dissection* can be as effective as traditional frog dissection in the high school biology laboratory" (p. 401).

An objective of Youngblut's (2001) doctoral research was to examine seventh-grade students' experiences with *Digital Frog 2* versus conventional dissection, based on student test performance on a follow-up paper-and-pencil test. Four classes participated in the study, with Classes A and B (n=50) using *Digital Frog 2* software and Classes C and D (n=58) performing a conventional dissection. The major finding of the study was that multimedia-based virtual dissection was more effective than conventional dissection in helping students learn about frog anatomy. Interestingly, this result was achieved when the time available for the virtual dissection was approximately 44% less than the time allocated for the conventional dissection. Youngblut found that students' attitudes toward animal dissection and computer simulation experiences were positively correlated to their achievement scores. A significant majority of students selected virtual dissection as helping them learn the most about frog anatomy. No relationships were found between either gender or students' dissection experience and achievement test outcomes. Students rated virtual dissection as easier than a conventional dissection, although they assigned equivalent ratings for their enjoyment of virtual and hands-on dissection.

Kopec's (2002) doctoral research also investigated how a digital frog dissection program, *Net Frog,* compared with a conventional dissection. Similar to the research design of previous studies, Kopec used a pre- and post-test to measure student achievement regarding basic frog anatomy. As an additional variable, he explored how student achievement compared among three

differing ability levels of students (Honors, General Ability, and Foundations level high school classes). A guiding question of his study was whether *Net Frog* was a suitable alternative for students who, for whatever reason, did not participate in the actual laboratory experience. The participants in the study were 218 biology students among the three different ability levels, with approximately half of the students participating in the virtual dissection and the other half in the laboratory dissection. The results indicated that there were no significant differences in achievement between the virtual and conventional dissection groups, although there were significant differences in achievement score means among the three ability levels. There was no significant interaction between gender and achievement. Overall, Kopec concludes that the *Net Frog* program is a viable alternative to conventional dissection.

Michel-Clark‟s (2003) doctoral research also examined the effectiveness of a computer-simulated dissection (*Digital Frog 2*) versus conventional dissection in relation to student knowledge of frog anatomy. Student knowledge was measured with two post-dissection tests: one that took place two days following the dissection or experience with the simulation, and another that took place two weeks later. Notably, both of these post-tests were conducted using actual frogs. Participants in the study consisted of 115 high school biology students from four classes taught by two teachers. Each teacher had one class that conducted a dissection of a frog and another class that completed the simulation program. The results of this research were distinct from previous findings in that students who participated in the actual dissection scored significantly higher on both post-tests than those who completed the simulation. These higher scores on the post-tests were maintained across gender, grade level, and students‟ previous science grades.

Maloney‟s (2005) research aimed to determine whether a virtual pig dissection could be a viable alternative to a conventional dissection. The participants in this study were 224 students enrolled in biology classes in an all-girls high school. The participants were spread over 11 classes, taught by three different teachers. Four of the classes (n=88) completed a conventional

dissection while the remaining seven (*n*=136) conducted a virtual dissection. Following the dissections, all students were given a practical test (consisting of 27 PowerPoint slides with pictures of organs and structures from actual fetal pig specimens to be identified) and an objective test (consisting of 60 questions that were matching, true-or-false, and multiple choice in design) to determine knowledge acquisition. The results indicated that students who completed the virtual dissection scored significantly higher on both tests than the control group. The author notes that further research could explore whether gender is a variable in the research results, and that the results should not be generalized to girls in mixed-gender classrooms.

A doctoral dissertation by Montgomery (2008) examined the effectiveness of a virtual frog dissection program, *Cyber Ed Dissection Series,* compared to a conventional frog dissection in relation to student achievement. The participants in the study were students from a southern New Jersey high school (*N*=84). The students were divided into three groups: those who performed a conventional dissection, those who dissected virtually, and those who were given a choice. All students took a pre-test before beginning a unit on amphibians, and following the intervention took a post-test consisting of general knowledge questions. All students also participated in a lab practicum test in which they were asked to identify organs and organ functions in actual frogs. The research findings were that there was no significant difference between traditional dissectors and virtual dissectors on the general knowledge post-test, but a significant difference was found on the lab practicum test in favour of the conventional dissection group. No significant differences among sub-groups were found in relation to gender, grade level, or ethnicity.

Finally, in Lalley et al.'s (2010) study, the researchers examined and compared the effectiveness of a virtual frog dissection using *V-Frog*, a program that allows users to interact with a virtual frog using 3D navigation, and a physical frog dissection. The participants were 102 secondary school students in a life science class in a suburban high school, divided into two treatment groups: a virtual group and a physical group. The researchers examined student

learning in three ways: via (a) a pre-test, and a post-test administered immediately after the two types of dissection; (b) a survey measuring affect, or students‟ responses to various statements on a Likert scale (e.g., “This is the way I like to learn”; “Lessons like this are easy to understand”); and (c) a delayed post-test to measure retention one week following the instruction. Their findings on each of the measurements were as follows: (a) on the first post-test, the virtual group had higher scores than the physical group; (b) no significant differences were found between the two groups in terms of affect; and (c) on the delayed post-test, no retention differences were found between the two groups. The authors conclude that while delayed student retention using *V-Frog* was not better than physical dissection it was also not worse, and as such, they suggest virtual dissection could be a viable teaching alternative to physical dissection, as well as appealing to teachers and students for practical or ethical reasons.

Looking at this empirical research collectively, some similarities among the research designs and findings emerge. Most of the research, with the exception of two studies (Fowler & Brosius, 1968; Maloney, 2005) comparatively tested student learning with a frog-themed virtual dissection program versus a conventional dissection. The research predominantly sought to measure students‟ knowledge of frog anatomy, and all designs followed a pattern of pre-test/post-test or pre-test/post-test/delayed post-test in design. Further, most of the research designs entailed pencil-and-paper assessments to test student knowledge, with the exception of Maloney‟s research (which also involved PowerPoint slides) and Michel-Clark‟s and Montgomery‟s study (where post-tests involved a lab practicum). Collectively, the research suggests that using a virtual dissection program can result in comparable learning to conventional dissection when knowledge is measured with a written (or visual) post-test. The findings of Michel-Clark and Montgomery, however, suggest that students who participate in virtual dissections will have weaker scores on subsequent lab practicums involving real frogs.

One of the limitations of these studies lies in their predominant focus on computerized alternatives, as all except Fowler and Brosius (1968) used simulated programs for the

comparative analysis. Research investigating the validity of other alternatives, such as anatomical 3D models, could be insightful. Another limitation of the research concerns *what* is being measured by the studies, as all purport to measure students‟ knowledge of basic frog anatomy, and some purport to also measure affect or student attitudes. The curricular objectives for Grade 10 Science and Grade 11 Biology in Ontario, however, suggest the purpose of dissection is not only to teach basic anatomy but also to "investigate … interrelationships between organ systems" (Ontario Ministry of Education, 2008a, p. 75), "locate …the organs of a specific system of an animal and describe their interrelationship" (Ontario Ministry of Education, 2008a, p. 87), "analyse the relationships between the respiratory, circulatory, and digestive systems" (Ontario Ministry of Education, 2008b, p. 57), and "… explain the relationships between the structures and functions of body systems" (Ontario Ministry of Education, 2008b, p. 71). Further, it is stated in the curricular documents that:

> The goal of science education is more than just providing students with a knowledge of facts. Mastery of the subject can no longer be evaluated solely in terms of students‟ ability to recall specialized terminology, memorize isolated facts, or repeat a theory. Rather, students must be given opportunities to learn through investigation. (Ontario Ministry of Education, 2008a, p. 19; Ontario Ministry of Education, 2008b, p. 20)

Thus, further research investigating the match between many of the curricular goals stated in Ontario curricula and the use of dissection alternatives could be helpful. Overall, existing research is not particularly helpful in validating computerized alternatives as they relate to the Ontario curriculum.

While much of the research relating to alternatives aims to measure their effectiveness in relation to traditional dissection, other factors could be explored to understand why teachers do or do not use alternatives. Several factors can hinder the successful introduction of alternatives in the classroom, including teacher attitudes, the initial cost of purchasing alternatives (especially computerized programs), a lack of adequate technology to meet the demands of an entire class if

computerized programs are used, and a lack of access to information about appropriate alternatives. While there have never been more resources available to educators, many are expensive to purchase and teachers may have to make a selection among them without even trying or seeing them first (Hart et al., 2008). Teachers may also have significant constraints imposed on their schedules that can limit their time or motivation to search for new materials, and without guidance in educational documents or information in pre-service programs, they may feel overwhelmed or intimidated by the new technologies (Jukes & Chiuia, 2003). They may also experience feelings of loss of academic freedom and fears related to giving up teaching control, or even frustration at imposed legislation. For many, dissection is a "tried and true" method, and its persistence may be due in part to its familiarity and the comfort of teaching the way one was taught (Balcombe, 2000; King et al., 2004).

On the flipside, there are also factors that can *encourage* the introduction of alternatives. These include knowledge of the efficacy of alternatives, demonstrations of alternatives, peer reviews, and evaluations of products to help teachers make decisions (Smith & Smith, 2004). To this end, teachers can consult resource databases (e.g., NORINA) and organizations (e.g., InterNICHE, NAVS) in their search for information, and/or read reviews of alternatives published in journals such as *The American Biology Teacher.* Teacher attitudes toward alternatives and new technologies are also key predictors of their willingness to use them—as Cockerham (2001) found, teachers" likelihood to use a virtual dissection is correlated positively to their attitude toward virtual dissections. Having a desire or willingness to reduce harmful animal use in the classroom could thus be a contributing factor (Jukes & Chiuia, 2003). More generally, deeper engagement with what Madrazo (2002) labels "the dissection debate" could help teachers approach their decisions about dissection from an informed perspective and perhaps encourage them to consider the use of alternatives more thoroughly. I review this debate in the final section below.

The Dissection Debate

> The time has come… for teachers to take a hard look at the use of dissection in the classroom, to review its history, to analyze its pros and cons, and to become familiar with educationally sound alternatives. In view of the considerable amount of time commonly spent on dissection, is the knowledge gained worth it? (Orlans, 1988, p. 37)

The above quotation, now over 20 years old, remains as true today as when it was first written. A considerable portion of the academic literature focuses on this question: is dissection worth it? Ethicists, animal advocates, humane educators and organizations, science teachers, scientists, researchers, and students have contributed to this controversial debate, weighing in on whether dissection is justified. A range of arguments have been presented in the literature: some in support of dissection, some against it, and some championing a middle ground in which certain parameters are placed around the practice. I have parsed this final section into four themes to reflect some of the dominant ways the debate is being articulated: through discussions of ethics and animal rights/welfare, social development concerns, pedagogical concerns, and environmental and health concerns.[14]

Ethical and Animal Rights/Animal Welfare Arguments

King (2004) writes that ethical issues are at the heart of the dissection debate, centered on two distinct themes: (a) a moral concern for the destruction of animals, and (b) a utilitarian approach, presuming that animals may be used in educational exercises but the benefits must outweigh the costs. Various researchers have argued that dissection is an unnecessary and

[14] A fifth category, that of culture, should be included in these discussions but has not yet been taken up in the literature as far as I can find. This category merits attention in recognition of the fact that dissection has emerged from a Western scientific perspective, characterized by a reductionist epistemology (Bekoff, 2006; Sabloff, 2001). Other cultural frameworks and ontologies, for example those of Aboriginal peoples, offer differing perspectives on human-animal relations and science itself. In informal discussions with First Nations colleagues, for example, I have learned that some responded to the culturally foreign practice of dissection by simply skipping class. This oversight in the literature demonstrates a Western bias.

ethically problematic activity, one in which the benefits are *not* validated by the costs (Balcombe, 1997, 2000, 2001, 2003; Hug, 2008; Nobis, 2002; Sapontzis, 1995; Selby, 1995). This position is also supported by animal advocacy and humane organizations, including the Humane Society of Canada, the Humane Society of the United States, the National Anti-Vivisection Society, and People for the Ethical Treatment of Animals.

One way the ethical argument is framed is based on the premise that if viable alternatives to dissection exist, and the objectives of the curriculum can be met with them, then killing animals for this purpose is unethical. As Hug (2005) writes:

> A key issue that dissection in school laboratories raises is whether or not the killing of animals in order to teach the concept of form and function is justified, and necessary. There are alternatives to the use of real animals to teach this concept… With similar learning, it becomes difficult to argue for the use of animals for teaching form and function. (p. 602)

As reviewed in the previous section, research suggests that learning with alternatives can be comparable to performing a conventional dissection in relation to certain learning objectives. However, some authors, such as Balcombe (2001), stress that even if the match in learning with alternatives and the "real thing" is not exact, there is a moral imperative to choose ways of learning that honour the "life" in life sciences.

Animal welfare concerns are a key point in the ethics-related literature. Moore (2001) writes that animal dissection can be morally and pedagogically justified if the animals are treated humanely and the scientific objectives are sound. However, the question of animals' treatment is difficult to investigate because animals used in dissections are often procured from biological supply companies that do not divulge information about the animals' backgrounds. Closed-door policies and limited forthcoming information from the companies point to the possibility of an inhumane industry, and the fact that the animals used for dissection in schools are not protected

under any Animal Welfare Act strengthens the likelihood of this claim (Hart et al., 2008; Orlans, 1993; Sapontzis, 1995).

Two published investigations into the practices of biological supply companies do not paint an encouraging picture regarding the humane treatment of animals procured for dissection. One early study, dating back four decades, outlines conditions of the capture and housing of frogs bound for dissection (Gibbs, Nace, & Emmons, 1971). The researchers found that the frogs were taken from a network extending thousands of miles throughout North America. The frogs were captured and stored in large sacks, with approximately 40 pounds of frogs per sack, sometimes for a week or more until they were transported to a supply company. During that time, their only care was being sprayed intermittently with water. Upon arrival at the supply company, the frogs were placed in large tubs of water, where they were kept for weeks to months with no food until a request came in for their shipment. When a request came, the frogs were sorted—at a rate of 25 frogs per minute per sorter—on the basis of size (small, medium, or large). Badly damaged, "broken," and dead frogs were discarded. Gibbs et al. note that common frog injuries included sores, reddened legs, missing toes, and bleeding eyes, which were probably caused by mishandling at least as frequently as by disease. The frogs that were deemed "healthy" were then shipped alive in boxes lined with sphagnum moss, 40-50 frogs to a box.[15] The authors describe high mortality rates at each stage of the process, as frogs would perish from being crushed during capture, from overheating, from exposure to unsanitary holding tanks, or from starvation or being crushed during shipment.

A second investigation into the treatment of animals bound for dissection was conducted by employees of the organization People for the Ethical Treatment of Animals, who were hired to work for the Carolina Biological Supply Company and WARD"s biological supply company for over a year (PETA, 2006). During that time, they used hidden cameras to videotape the

[15] Today, frogs that are bound for dissection are more commonly killed prior to shipment. This is done by dropping them in a solution of alcohol and water; on average, it takes 15-20 minutes for a frog to die this way (Balcombe, 2000).

treatment of animals in the facilities. Their video documents callous treatment of many animals. One scene shows cats arriving at the facility in crowded wire cages and being beaten and poked with a metal rod, then prodded into gas chambers. Some cats survive the gassing and are shown still alive, weakly moving their paws, while they are injected with formaldehyde. A dog is shown being lifted off the ground by the neck with a choke pole, then dumped into a gas chamber. Live rats are seen wriggling on restraining devices while they are being pumped with formaldehyde; one worker is shown spitting on a rat while the rat dies. Racks and piles of dead animals are shown strewn about the facilities, in what appears to be filthy conditions. In total, it is noted that the investigators documented 181 violations of the American Animal Welfare Act and 99 violations of Carolina anti-cruelty statutes during their investigation.

The Physicians Committee for Responsible Medicine writes that animals suffer through every step in the process leading up to their dissection, including the ways they are collected, transported, handled, raised, and killed (PCRM, 2007). Sapontzis (1995) similarly writes that "the catching, confining, transporting, handling, and killing of these animals apparently does involve significant pain, fright, deprivation, frustration, and distress" to them (p. 187). He also notes that "[p]rofit-minded companies in this business can be expected to cut corners in the care of soon-to-be-dead, throw-away animals" (p. 187).

The treatment of animals in modern-day industrialized farming complexes, also known as factory farms, is also worth considering in a discussion of ethics because this is the industry from which many dissected fetal pigs and "plucks" (animal parts) come from. For example, the use of fetal pigs—the most commonly dissected animal as reported by participants in this study—almost certainly implicates factory farms, given the dominance of this model to the point of pushing family farms in the pork industry to near extinction (Fraser, 2001). The intensive confinement of incarcerated animals in these complexes, along with ongoing reports of rampant abuse, neglect, and a lack of legal protection afforded to them, equates to their enormous

suffering prior to being killed for food and/or sale for dissection purposes (D'Silva & Webster, 2010; Mason & Finelli, 2006; Robbins, 2001).

Considering the widespread use of fetal pigs for dissection also raises questions about sow impregnation prior to slaughter. Given that in factory farm models, every facet of pigs' lives are controlled, including their breeding, it is doubtful that it is by "accident" that so many sows are pregnant at the time of slaughter as to continuously provide biological supply companies with a supply to sell (Lewis, 1999). A possible explanation behind the fetal pig industry is that sows are deliberately impregnated prior to slaughter because farmers are paid "on the hoof," or at a fixed price per kilogram, when an animal is slaughtered, and thus it is profitable for farmers to impregnate the sows beforehand (James Collins, WARDS/Boreal biological supply company, personal communication, 2010). Another possibility, although I have been unable to confirm this with biological supply companies, is that the recognized desire for fetal pigs has created a market whereby sows are impregnated so that the fetal pigs can be sold by the companies. While the specific processes are unknown regarding how an ongoing supply of fetal pigs is made available, schools must consider the reality that they are supporting industries (factory farms, slaughterhouses, and biological supply companies) where the inhumane treatment of animals has been widely documented (e.g., Mallon, 2005; Mason & Finelli, 2006; PETA, 2006; Robbins, 2001; Sapontzis, 1995; Selby, 1995).

But even if the animals are treated more humanely than what is outlined in the above examples—or are treated *completely humanely* at all stages of their lives and deaths—the question of whether their deaths are justified still remains. Orlans (1993) considers this question carefully. Her underlying position is one of animal welfare, holding that animal well-being should always be considered but that some forms of scientific animal use are justified under a "greater good" calculation. She writes that while some forms of scientific animal use are trivial, repetitive, and unwarranted, others are important in their potentialities. The factors she considers in judging the validity of scientific animal use include: animal pain and suffering; other

infringements on the life and interests of the animal, including death; classification of the animal‟s sentience level; the purpose of the experiment (e.g., to obtain original knowledge, to test products, for pedagogical purposes); the competency of the experimenter; the quality of the facility and resources where the work is done; the application of the Three Rs ideology; and public accountability. In considering classroom dissections, she cites Smith and Boyd‟s (1991) report:

> If a scientist claims it is necessary to use animals in a particular project in order to achieve some goal, he [*sic*] is required morally to demonstrate at least four things: (1) that the goal is worthwhile; (2) that it has a high moral claim to be achieved; (3) that there is no less drastic method of achieving it; and (4) that there actually is some reasonable possibility of the project achieving the goal. (quoted in Orlans, 1993, p. 43)

In considering this criteria, Orlans concludes that dissection at the school level is not justified. Ghasemi and Dehpour (2009) similarly suggest that the Three Rs criteria, and other rationales, need to be in place to justify animal-based research:

> [B]efore using animals, it is mandatory for researchers to clearly clarify their scientific purpose. There should be a reasonable expectation that the research will result in increasing scientific knowledge … and also will increase understanding of the species under study or provide results that could improve the quality of health or welfare of humans or other animals. The scientific purpose of the research should be of sufficient potential significance to justify the use of animals. (p. 2)

While some argue that animal-based research is warranted in some contexts but not as a classroom activity, others hold that dissection in science education does not pose an ethical problem to begin with (Moore, 2001; Offner, 1993; Wheeler, 1993). These authors, science teachers themselves, suggest dissection is not a pressing ethical issue given that the number of animals used makes up an extremely small percentage of the total number of animals consumed by humans. In one estimate, animals used in educational research make up only 0.3% of all

animals used by people (Moore, 2001). It is also argued that dissection has produced knowledge that has improved human lives, deepened our appreciation of biology, and reduced needless pain and suffering; in this sense, Moore (2001) suggests the ethical issues associated with our use of animals is trumped by a greater good. Wheeler (1993) goes a step further, suggesting it might be unethical *not* to exploit animals fully in our quest to learn and reduce human suffering.[16]

Balcombe"s (2000) rejoinder to the argument that the number of animals used in dissection is inconsequential is that this line of reasoning negates the possibility of finding value in every life. Drawing an analogy, he notes that the number of human fatalities from plane crashes is very small—perhaps "inconsequential" when compared to fatalities from car crashes—however, an ethic of valuing all life, instead of looking only at aggregate numbers, leads us to care about all loss of life and strive to protect it. That biology is the study of *life* should point us toward preserving life, he argues. The assertion that animal life is of value and deserves preservation remains at the core of the ethical debate.

Social Development Arguments

One of the arguments emerging from the dissection debate involves the potentiality of a link between animal cruelty and children"s moral development. This presumed linkage dates back centuries: discussions of it can be found in writings of early philosophers and 19th century antivivisection activists. While a correlation between cruelty to animals and cruelty to people is difficult to ascertain, researchers have found that instances of childhood animal abuse can be considered a "red flag" or warning of potentially antisocial behaviour to come (Lockwood & Ascione, 1998; Thompson & Gullone, 2003). To cite an extreme example pertaining to dissection, it has been noted that serial killer Jeffrey Dahmer began his fascination with death through animal dissections he conducted in and out of the classroom (Hart et al., 2008). I have

[16] I have not uncovered any documentation of advances in human well-being emerging from classroom dissections, however.

found no empirical evidence in the literature suggesting that participating in an animal dissection will later connect to violent behaviour in the human community, although Orlans (1991) identifies what she sees as an inherent disconnect in the activity, writing that "in times when we are struggling to reduce violence in our society, the practice of harming and killing sentient creatures to conduct an „educational exercise" seems out of place" (p. 12).

Some reject claims of a corollary relationship between animal violence (if dissection is characterized as such) and human violence. Kline (1995), for example, writes that the argument that dissection promotes immoral or antisocial behaviour has never been proven; Moore (2001) echoes this sentiment, arguing that there is no evidence that dissection has negative social consequences for students in terms of their moral development. Given the enormous number of variables related to moral development, it seems doubtful that this argument will ever be settled.

What can be argued with significantly more authority is that some students experience negative emotions while participating in a dissection, including sadness, ethical conflict, guilt, aversion, and disgust. It seems unanimously agreed upon in the literature that dissection is an emotional and memorable experience for students, for better or for worse. Hart et al. (2008) explain that this is because many students have experiences of animals as pets or special friends, even best friends, and as such dissection can prompt a range of reactions, including negative ones. The dissection of "pet" animals, such as cats or guinea pigs, can be especially upsetting to students, for example.

Survey research has found that considerable numbers of students report experiencing negative emotional reactions to dissection. Lock and Millett (1992) found in their questionnaire administered to year 10 students in England (N=468) that students reported a wide range of attitudes toward dissection, many of which were considered negative. The top 14 student responses concerning student attitudes toward dissection were: unnecessary (80), neutral (64), feel squeamish (47), cruel (44), wrong (37), interesting (30), don"t know (29), [animals] should not be specifically killed (23), use [animals] that died naturally (23), use [animals from] abattoir

materials (23), dislike it (10), of limited value (10), should have choice to do [dissection] (5), and don‟t use rare animals (2). The study also found clear differences between the attitudes of boys and girls, with more girls reporting that they felt dissection is unnecessary or wrong and more boys expressing neutral feelings toward it.

A second study by Stanisstreet, Spofforth, and Williams (1993) asked students, aged 11-16 (*N*=433), to respond to the statement: "[It is] wrong to dissect dead animals for teaching." In response, 25% of students strongly agreed, 23% agreed, 21% neither agreed nor disagreed, 21% disagreed, and 10% strongly disagreed. A third study, conducted by Bowd (1993) and administered to undergraduate education students (*N*=191) found that among the students who had participated in a dissection, 29.7% reported experiencing a positive or neutral emotional reaction, 26.7% reported experiencing a negative reaction, and 38.4% reported experiencing mixed emotions.

While there are limitations to questionnaire-style research—results can be superficial and are limited to the questions asked—it is nonetheless interesting to consider data emerging from these earlier studies investigating student attitudes toward dissection. The data suggests that considerable numbers of students experience negative emotions toward dissection. Juxtaposed with a low number of reported students who verbally object to dissection, the research presents a potential picture of many students "going along" with the activity despite having negative or mixed feelings about it.

More recent qualitative research has shed deeper light on student reactions. Barr and Herzog (2000), who observed a series of fetal pig dissection sessions in a high school biology class and conducted follow-up interviews with students (*N*=17), found that students‟ responses varied considerably. In their findings, 12 students characterized the experience as positive while 5 viewed it primarily in negative terms. A range of participant reactions were reported, including moral and emotional ambivalence, distress, guilt, apprehension, ethical concerns, religious

concerns, and concerns that the activity seemed "more like mutilation than dissection" (p. 59). One student expressed her mixed emotions in saying:

> I filled up with tears actually because I could look at it [the pig] as a baby. A life that's taken … It was definitely mixed emotions because it does interest me. I am interested in it, but thinking back on the fact that it is a life form, I get upset, you know. I'm distraught over that thought… . (quoted in Barr & Herzog, 2000, p. 58)

Solot and Arluke (1997) also observed student reactions to a fetal pig dissection. In investigating how sixth-grade students managed the dissection experience, they found that most students were initially ambivalent and expressed concern about the animals' origins, but that they quickly transformed the animals into "specimens" as a potential coping mechanism. The authors write that many students appeared to become hardened to the procedure as it progressed, describing themselves as becoming "immune" or "adapted" to it. Toward the end of the dissections, some of the students they observed had progressed from initial apprehension to outright mutilation of the animals: students were plunging dissection tools into pigs' heads and bodies, and decapitating the animals and parading their heads around the classroom. From this, the authors conclude that dissection risks imparting a callous attitude in students toward animals and the natural world, and that the behaviour of poorly supervised students can degenerate to a point where little or no meaningful learning takes place.

Balcombe (1997) also discusses how dissection can degenerate into a "mutilation" activity. He cites one student who explained:

> When the long, miserable week [of frog dissection] was over, the class was allowed to "do as you wish" with the remainders of the bodies. So all of the boys broke bones, tore off body parts, tossed them around—it was absolutely horrible. I can still hear the bones of those poor souls breaking and cracking. I had nightmares. (quoted in Balcombe, 1997, p. 14)

Various authors point out that the way a teacher models the activity is deeply important in setting an appropriate tone (Allchin, 2005; de Villiers & Sommerville, 2005; Madrazo, 2002; Offner, 1993). Since teachers are mediators between the learners‟ views of the world and the generally accepted scientific view, their attitudes have important implications for learners, communicating respect or disrespect for the animals. Madrazo (2002) argues that if teachers insist on respectful behaviour toward animals and students are maturely guided with effective supervision throughout the process, the students are likely to intellectually benefit from the dissection lab and not suffer emotionally from it. Negative emotional reactions may also be offset by classroom discussions in which those emotions are acknowledged. Hart et al. (2008) suggest that teachers might consider conducting memorials or "gratitude rituals" that recognize and allow for feelings of loss, which might assuage some of the ethical dilemmas associated with dissection.

According to some authors, however, the discursive positioning of animals within dissection overrides the possibility that respect for animal life can be communicated. Selby (1995) writes that dissection can be interpreted as positioning animals as "mere commodities, disposable resources for our curiosity and convenience, possessing no value in their own right" (p. 255), while Sapontzis (1995) suggests dissection teaches students "that animals can be killed for trivial purposes, for example, just for curiosity or just because it has become traditional to kill animals on these occasions" (p. 185). The concern is that dissection can lead to desensitization and impress upon students a particular (and contested) view of animals, one that discourages sensitivity toward the animals and sends a message, via the hidden curriculum, that animal life is cheap. As Russell and Bell (1996) note, an anthropocentric point of view is reinforced in pedagogical activities where "the nonhuman rarely figures except as a backdrop to human affairs (or worse, as an object for dissection or other experiments)" (p. 173).

Pedagogical Arguments

A common pedagogical argument in favour of dissection is that it is a valuable, hands-on activity that presents anatomy in a way that is impossible to simulate (Allchin, 2005; Kline, 1995; Moore, 2001; Offner, 1993). The value of hands-on activities is prevalent in the literature and has long lineage of support in science education: Vesalius of the 16th century could be considered an early advocate of this approach, and more contemporarily, educational philosopher Dewey argued in favour of it, as he saw hands-on scientific experiences as the precursor to all competent reflective thinking (Dewey, 1938). Balcombe (2003), however, argues that there is no basis for concluding that the use of alternatives is any less interactive than dissection, or that a hands-on learning activity is by definition a better learning activity. What matters is the ability of a learning experience to meet curricular objectives and engage student interest and learning in the process.

Is dissection an appropriate representation of science today? Single-organism studies play a much smaller role in biology education than they used to; today there is more emphasis on ecology (habitats and communities) and cell-level and molecular activity than gross anatomy (de Villiers & Monk, 2005). As the practice of dissection nears a century old in schools and the focus of biology has shifted considerably during this time from an anatomical level up to an ecological level and down to a cellular and genetic level, there is critique about whether dissection continues to have a place in science curricula (Hart et al., 2008; Hug, 2005; Kline, 1995). Hug (2005) writes that the values of the school environment have changed but dissection has not evolved with those changing values; instead, it has "become a ritual of and in science … carried out … often without critique or evaluation" (p. 603). She thus questions whether dissection remains a valid representation of contemporary biology or whether it has slipped into the role of tradition, reproduced year after year without critical questioning.

There are also pedagogical concerns that science learning should be contextualized in students" everyday lives to be meaningful, but this is not the case with dissection, given that the

vast majority of students will never enter a career where the experience is even remotely related to their work (Orlans, 1993). In light of this, some suggest dissection should be reserved for mature learners who have made a career commitment in which dissection can assist in the acquisition of knowledge and skill (de Villiers & Monk, 2005; Orlans, 1991). Such a policy could also address the fact that students who are uncomfortable with dissection are unlikely to learn much from it, and may turn away from future biology studies on account of it. That dissection can and does turn some individuals away from a career in the life sciences is discussed in the literature (Balcombe, 2000; Capaldo, 2004; Hepner, 1994). This is a particularly problematic outcome when it is considered that females are underrepresented in certain areas of science, yet they are the ones more likely to object to dissection in the first place. Conversely, some point out precisely the opposite: that dissection can *generate* interest in the life sciences and encourage students to pursue science further, and for that reason it should remain part of the curriculum (e.g., Offner, 1993).

Another pedagogical concern is that dissection is not particularly inquiry-based but is rather a "cookbook" activity that is weak in concept learning and problem-solving (Balcombe, 2000, 2001; Hepner, 1994; Hug, 2005, 2008; King, 2004). The pedagogy of dissection can be largely procedural, as there is often "one correct way" of conducting the ritual. Hug (2005) writes that "the majority of dissection labs are *not* open-inquiry labs but are verification labs, where the answer is already known" (p. 603). This is because students are effectively verifying what has already been "discovered" countless times over.

In recent qualitative research, Hug (2008) inquired into the pedagogical value of dissection. Seeking to determine whether critical sense-making was pervasive in the activity and whether it was an opportunity for students to practice meaningful science, she reviewed videos of three middle-school classes dissecting fishes as part of an eight-week "Who will survive?" science unit activity. Her analysis revealed inconsistencies in the connections students made between the dissection and the larger driving questions of the activity. It also revealed a

procedural execution of the task. Students displayed a lack of understanding of the purpose of the dissection, and while they tried to make meaning out of their observations, they were rarely successful in doing so. Given the pedagogical limitations and ethical compromises related to dissection, Hug (2008) concludes that dissection needs a new justification. She does not suggest it has no place in schools, but rather that teachers must create opportunities to engage the tool mindfully and encourage meaningful learning.

Meaningful learning can be achieved through an appropriate pedagogical approach, Allchin (2005) argues. Well-designed labs should not rely on traditional meanings or modes of dissection and "search and destroy techniques," which cannot be justified; instead, teachers should find ways to design dissection labs to engage students" critical and creative thinking. For example, asking students to perform non-conventional tasks such as tracing the urine path backward throughout the body, or tracing a molecule of oxygen from the lung to the brain or kidney, will reveal new complexities (Allchin, 2005). Assignments involving a comparative analysis of the organs of three or four different species of animals is another possibility to stimulate students" critical thinking, highlighting differences among species and the functions of specific animal organs (Meuler, 2008).

Overall, much of the literature debating the pedagogical validity of dissection is focused on whether meaningful understandings of science can be derived from it. Similar to the research investigating student learning through conventional dissection versus dissection alternatives (reviewed earlier), a deeper focus on the ability of dissection to meet specific curricular goals is needed. Of course, pedagogy alone should not be the deciding factor in determining dissection"s validity, as ethical, social, cultural, and health and environmental arguments must also be taken into account.

Health and Environmental Arguments

Jukes and Chiuia (2003) write that the "capture, breeding, housing, killing, preservation

and transportation of millions of animals each year has a significant environmental impact" (p. 35). Given that many dissected animals are wild-caught, the practice of procuring animals for dissection can mean disruption to ecosystems (Rosenberger, 1998). The removal of frogs from ecosystems can be particularly problematic as frogs are a keystone species that play a major role in an ecosystem"s sustainability as both predators and prey, and the presence and well-being of frogs is said to be indicative of the overall health of an ecosystem (Cormier, 2008). It is quite possible that the practice of frog dissection will be less popular in years to come due to the declining populations of frogs and other amphibians worldwide (Cormier, 2008; Souder, 1998); the point remains, however, that removing *any* animals from ecosystems creates an environmental impact, as does the process of killing them, preserving them, and eventually, disposing of their bodies.

A second environmental and health concern is related to the use of formalin (a solution that includes formaldehyde) to preserve animals" bodies (Jukes & Chiuia, 2003). Formaldehyde is classified as a toxic and hazardous substance by the United States Occupational Safety and Health Administration and has been linked to respiratory tract injury, vision impairment, and skin damage upon contact. It is also classified as a human carcinogen that has been linked to nasal and lung cancers (OSHA, 2003). Exposure to formalin presents thus potential health risks to students and teachers, and in particular, to workers in biological supply companies.

Fortunately, supply companies now sell some specimens preserved in formaldehyde-free solutions. Currently, WARD"s and Boreal Northwest biological supply companies sell both regularly preserved animals and, for a higher price, formaldehyde-free animal specimens. Formaldehyde-free specimens are available for some, but not all, species.[17] The higher price and

[17] For example, as of September 2011, according to the Boreal Northwest biological supply website <http://boreal.com/>, a regularly preserved fetal pig specimen costs $27.40, whereas a formaldehyde-free fetal pig costs $35.10. A regularly preserved skinned cat costs $67.50; a formaldehyde-free specimen is $101.00. A vacuum package of 10 regularly preserved rats costs $102.00; a formaldehyde-free package of rats costs $134.00. Various animals and insects, including mice, grasshoppers, mink, clams, starfish, turtles, snakes, and crayfish are not available formaldehyde-free.

limited selection of formaldehyde-free animals may create a tension for teachers who are faced with tight budgets and must decide between costs, availability of animals, and environmental and health concerns.

Looking Forward

The use of animals in science has always been inextricably linked to values, beliefs, worldviews, and not least of all, controversies. The histories of protest to it date back hundreds if not thousands of years, and as such, it is not surprising that the relatively newer practice of classroom animal dissection has generated a contentious history of its own. In the past few decades this topic has brought science educators, students, researchers, and animal advocates into heated conversation. Although there is by no means consensus on the many tensions surrounding dissection, it is clearly a multi-faceted issue that must be considered from many angles.

As we move into a future of increasingly sophisticated ways to view the interior of the body—human and animal—questions about conventional modes of animal dissection and its stronghold in schools remain. Will the tradition persist as a privileged hallmark of students‟ science experience for years to come? Will we move into an increasingly respectful position in relation to students‟ diverse ethical, cultural, and religious orientations, and legislate choice policies widely? Or, will a Kuhnian paradigm shift (Kuhn, 1962) take place, resulting in the replacement of dissection with technological alternatives, or the removal of it from curriculum altogether? These questions remain under negotiation.

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CHAPTER 3:

RESEARCH ARTICLES

This chapter includes three scholarly articles that discuss my research findings. Each article is focused on a particular theme of the research results. While there were multiple strands emerging from the data that could be explored, I focused on overarching themes that addressed the predetermined research questions, including: student objectors‟ classroom experiences (Article 1), teachers‟ perspectives on dissection and alternatives (Article 2), and the sometimes-divergent perspectives of students and teachers in relation to choice and choice policies (Article 3). Taken together, the articles respond to the research questions developed for student and teacher participants, recapped here:

Questions for Student Participants

- What are students‟ attitudes toward animal dissection and dissection alternatives?
- Are students offered a choice of whether or not to participate in animal dissection in their secondary school science/biology classes?
- How many students object to animal dissection?
- What are the experiences of those who object?
- What are students‟ perspectives of, and experiences with, student choice policies?

Questions for Teacher Participants

- What are teachers‟ practices and attitudes toward animal dissection and dissection alternatives?
- What is the frequency with which teachers experience objection to animal dissection in their classrooms?

- How do teachers respond to objection to animal dissection?
- Do teachers have a student choice policy (formal or informal) in effect in their classrooms?
- What are teachers‟ perspectives of student choice policies?

The articles were written as stand-alone pieces for submission to academic journals. As such, there is some overlap in the contents, particularly in the overview of the research process and the discussion of relevant literature that has informed the study. Each article is written in a style reflecting its preparedness for submission to a journal, complete with an abstract, keywords, and references. At the time of writing this dissertation, the three articles had been submitted to journals and were in various stages of review/publication. The first article (“„I Didn‟t Feel Right About Animal Dissection‟‟: Dissection Objectors Share Their Science Class Experiences”) had been reviewed and accepted for publication by *Society & Animals: Journal of Human-Animal Studies.* The second article (“Science Teachers and the Dissection Debate: Perspectives on Animal Dissection and Alternatives”) had been reviewed and accepted for publication by the *International Journal of Environmental and Science Education.* The third article (“Dissection and Choice in the Science Classroom: Student Experiences, Teacher Responses, and a Critical Analysis of the Right to Refuse”) was in review at the *Journal of Teaching and Learning*. These journals were selected because their stated aims and purposes seemed a close match to the scope of the papers.

I chose to write an article-based dissertation for a few reasons. From the outset, I conceptualized formatting the research findings in a series of publishable articles in an effort to achieve my goal of sharing the results in a timely manner. Given the importance of ongoing communication about animal dissection and the politics of student choice, I wanted to share the

findings with relevant stakeholders.[18] Producing an article-based discussion of the research results seemed a practical choice to this end. Second, article-based dissertations can support the skill development of writing research articles and submitting them for peer review (Halstead, 1988)—a skill set of importance for any aspiring academic. In pursuing this route, I hoped to improve my competency as a writer and gain an opportunity to become immersed in the process of publishing. A third reason for creating an article-based discussion of my research results was to streamline the conversion process from conducting research to producing journal articles, and I anticipated this could help me to focus my writing. For these three reasons, and because I thought this "alternative research format" (Duke & Beck, 1999) could offer an interesting challenge, I chose to write articles instead of a traditional chaptered discussion of my research results.

Formatting the research findings as a series of scholarly articles necessitated making judicious selections from the data. As discussed in Chapter 1 (see Methods and Procedures), a considerable amount of data was collected during this research process: 464 questionnaires with a total of 1,229 open-ended narrative comments, plus 17 interview transcripts. Clearly, all of this quantitative and qualitative data could not be represented in three research articles. Instead, I chose particular themes and quotations from the data to explore and represent, which meant other themes and narrative data were left aside, to be addressed in potential future publications. A brief discussion of these left-aside themes, and future directions for writing and research, is included at the end of this chapter as a coda.

A Note on Coding in the Research Articles

The research articles include quotations from students (Article 1), teachers (Article 2), and both groups together (Article 3). The selected quotations are taken from the open-ended

[18] To help ensure Ontario teachers saw the results, I also shared a synopsis of the research findings via a 2000-word newsletter article in the online newsletter of the Science Teachers" Association of Ontario, *CRUCIBLE* (published in September 2011).

questionnaire data and interview transcripts. To delineate the source of each quotation, I included three indicators. First, I identified whether the quotation came from the student (S) or teacher (T) data set. Second, I indicated whether it came from a questionnaire (Q) or interview (I); and third, I included the coded number of the questionnaire or interview, the date, and the page number on which the quotation appeared. For example, the code (SI #1, March 2010, p. 1) references a quotation from Student Interview #1, conducted in March 2010 and appearing on the first page of the transcript, while the code (TQ #50, May 2010, p. 2) references a quotation from Teacher Questionnaire #50, completed May 2010 and appearing on the second page of the printed questionnaire. This coding system is used in all three articles in this chapter.

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"I Didn't Feel Right About Animal Dissection": Dissection Objectors Share Their Science Class Experiences

Abstract: This paper highlights the voices and experiences of individuals who objected to animal dissection in their high school science and biology classes. The data were collected via online surveys (*n*=311), and 8 of these participants received more in-depth telephone interviews. Participants were former students from Ontario, Canada who discussed their experiences with animal dissection in general, and objection to dissection in particular, if applicable. The findings reveal that students who expressed objection to dissection experienced a range of teacher responses including pressure to participate, the request to join another group of students and watch, the choice to use a dissection alternative, warnings of compromised grades, and other responses. The study points to the importance of choice policies to ensure that students who do not want to dissect have explicit access to dissection alternatives in the classroom, and teachers are prepared to accommodate those who object.

Keywords: animal dissection, objection to dissection, dissection alternatives, secondary school science class, student experiences

Introduction

> When I was growing up, I spent my summers watching the frogs and turtles in a catch basin near our camp. Frogs were like, well, my friends. I couldn‟t have participated in dissection if my life depended on it. (SQ #54, March 2010, p. 2)

> For me, animal ethics and animal rights are pretty big issues. So you see them wheeling in this big cart of dead pigs, and it just made me think about, "Where are these coming from? What happened to them?" Yeah, I had an issue with it. (SI #6, May 2010, p. 1)

> My parents have always taught me that you have to be respectful to all of the creatures, not just human beings. We're supposed to be the superior beings. We know better. We can control our actions, whereas animals do it out of the idea of survival. (SI #7, May 2010, p. 3)

-excerpts from individuals who objected to animal dissection

There are many reasons why a student might object to picking up a scalpel and cutting into a once-living animal in biology class. Those with an orientation toward animal rights often express ethical concerns with the practice, while others may hold religious, cultural, or environmental reasons for not wanting to participate. Yet other students experience a visceral reaction to dissection that makes them uncomfortable: a fear of blood, for example, or concern about fainting or becoming physically ill. Finally, some might be reticent to participate because dissection simply seems distasteful or "gross" to them (Balcombe, 2000; Barr & Herzog, 2000; Oakley, 2009; Solot & Arluke, 1997).

Given these numerous possibilities, it is not surprising that most science and biology teachers who conduct dissections report having had the experience of at least a few students objecting to the procedure (Almy, Goldsmith, & Patronek, 2001; King, Ross, Stephens, & Rowan, 2004; Moir, 2000). What is less clear, however, is how teachers are responding to student objectors, and what the experiences are of these students. This paper, drawn from a larger doctoral study on animal dissection (Oakley, 2011), highlights the voices and experiences of students who objected to dissection in high school science and biology classes. Given that studies show that comparable student learning can be achieved using dissection alternatives

(Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001), I was curious to find out whether or not, and how student objection is being accommodated.

I approached this research from a humane education and critical pedagogy standpoint. Humane education emphasizes the interconnectedness of all life and the intrinsic value of nature and nonhuman animals, alongside social justice concerns (Humes, 2008; Weil, 2004). To consider dissection from a humane education perspective entails examining its impacts on students, nonhuman animals, and the environment; it also means critically considering the educational value of dissection and what "humane" alternatives exist to it. Humane education can be situated in a broader framework of critical pedagogy, which is grounded in a social and educational vision of justice and equity, and recognition that education is inherently political (Giroux, 2001; McLaren, 1998). Understanding that schools are institutions where forms of knowledge, values, and social relations are formed, a critical pedagogy approach allows for deeper consideration of the influence teachers have on students" enactment of curriculum and the choices students have (or do not have) in the science classroom.

Dissection, Objection, and Student Choice

Dissection has not always been practiced in North American schools. It appears to have begun in the 1920s, and became a more regular part of science education curricula in the 1960s (Orlans, 1993). As biology lessons involving animals" deaths increased, however, so did opposition to the practice. Anti-dissection campaigns by humane societies and other animal advocacy organizations began in the 1980s, adopting slogans such as, "Cut the Class, Not the Frog" and "Say No to Dissection" (Orlans, 1993), while organizations such as InterNICHE and the National Anti-Vivisection Society began to promote and make available some of the first alternatives to dissection, including models, computer simulations, films, and videos. As dissection escalated into an ideological debate about the validity of using animals for science

class investigations, researchers began to examine student attitudes toward it and the notion of conscientious objection became popularized (Hepner, 1994; Millett & Lock, 1992; Sieber, 1986).

The documented history of objection to dissection at the high school level dates back to the late 1980s with the well-publicized case of Jenifer Graham, a California teen who refused to dissect a frog in her biology class. When Graham, an ethical vegetarian, was told she would fail the course if she did not dissect, she and her mother legally challenged the school, taking the matter to a state court with the help of the Humane Society of the United States. Graham‟s lawyers argued that her ethical beliefs were equivalent to a religion and that the school district was violating her right to freedom of religion. Her case was settled and not fully adjudicated, but it resulted in the amendment of a bill, signed by the governor of California in 1988, which mandated that students have the right to conscientious objection to dissection or other educational projects involving the harmful use of nonhuman animals (Beauchamp, Orlans, Dresser, Morton, & Gluck, 2008; Kramer, 2007).

Graham‟s case marked an early development in student choice policies in North America. Choice policies, also known as choice legislation, grant students the right to "refuse to participate in classroom activities and demonstrations … that they find objectionable on the basis of personal moral, ethical, or religious convictions … and to have access without penalty to alternative learning methods, models, and approaches" (Cunningham, 2000, p. 192). Currently, choice policies are legislated unevenly in Canada and America. In Canada, five school boards have adopted policies (Vancouver School Board, Burnaby School District #41, Central Okanagan School District #23, Toronto District School Board, and South Shore District School Board), while 10 American states have choice legislation in place (Florida, California, Pennsylvania, New York, Rhode Island, Illinois, Virginia, Vermont, Oregon, and New Jersey). Five American school districts (in Massachusetts, New Mexico, Maine, Maryland, and Nevada) have also passed resolutions that encourage teachers to provide alternatives to dissection (AAVS, 2011; Duncan, 2008; Frogs Are Cool, 2011; Kramer, 2007). While these policies represent a

victory for students in these jurisdictions, little is known about how or whether they are enforced; further, given that most North American jurisdictions lack policies in the first place, many students remain reliant upon their teacher to offer choice (Kramer, 2007).

It is estimated that in a typical class, three to five percent of students will verbally object to dissection and a higher number will be silently opposed (Balcombe, 2000). For various reasons there may be a disconnect between how students feel about dissection and whether they verbally object—for example, the power dynamic inherent in the teacher-student relationship may make it difficult for a student to feel entitled to express his or her opinions, and challenging the authority of the teacher or curriculum can be daunting (Balcombe, 2000; Cunningham, 2000). Further, dissection may be presented as a requirement; some teachers refuse to accommodate students" requests for alternatives and have even reported failing students who refuse to dissect (King et al., 2004). Given these disparate teacher responses, I sought to investigate the classroom experiences from the perspective of former students.

Methods

This research was set in Ontario, Canada, where dissection is part of the Grade 10 science and Grade 11 biology curricula. Both curricula state that students are to conduct a physical dissection *or* a computer-simulated dissection to achieve specific learning outcomes regarding the interrelationships between systems and organs (Ontario Ministry of Education, 2008a; 2008b). Teachers can therefore decide whether to offer students a physical dissection, a virtual dissection, or both. As an additional support, the Ontario Ministry of Education has an all-school site license for the virtual dissection software *Froguts*; so assuming adequate computer resources, all schools in the province have access to the software (OSAPAC, 2011).

Participants

The study was conducted over a five-month period in 2010, using a two-phase research design incorporating online surveys (*n*=311) and subsequent telephone interviews (*n*=8). In the first phase, a 25-question survey (see Oakley, 2011) was advertised to potential participants through communications bulletins in Ontario universities, email advertisements, and word of mouth. Individuals aged 18-30, who had completed some or all of their secondary school (Grades 9-12) science and biology courses in Ontario, were invited to complete a survey that featured demographic (age, gender, province where they attended secondary school), attitudinal, and behaviour-related questions about their high school animal dissection experiences.

Participants‟ agreement to be interviewed was elicited by a question at the end of survey that asked if they would be willing to participate in a follow-up discussion about their experiences. Of the 311 surveys collected, 102 individuals offered to be interviewed. From this pool of individuals, those who reported harboring objections to dissection were parsed out and stratified by gender. Twelve candidates (6 female and 6 male) were selected to be interviewed, based on diversity in the responses they gave on their surveys regarding why they objected to dissection (e.g., for personal, animal rights, ethical or moral, environmental, religious, and/or cultural reasons). The goal of the interviews was to obtain more depth of information regarding individual student objectors‟ experiences. Of the 12 individuals selected, 8 (5 female, 3 male) agreed to be interviewed.

The participant response rate in this study was highly skewed by gender: 80% of survey respondents were female. Three possibilities may explain this gender skew: (a) one of the audiences to which the survey was advertised was a department of education with a higher number of female than male students; (b) females tend to respond to electronic surveys at higher rates than males (Underwood, Kim, & Matier, 2000); and (c) the topic itself may be more interesting to women, as females are more likely than males to object to dissection (Almy et al., 2001; Capaldo, 2004). Research suggests women express greater concern about animal welfare

and are more likely to oppose animal-based research than men (Hagelin, Carlsson, & Hau, 2003; Phillips & McCulloch, 2005; Pifer, 1994), and this too may account for the high female participation rate in this study.

Given that females tend to object to dissection more than males, and 80% of respondents in this study were female, the statistical results are likely skewed against dissection. Further, given the limitations of the sample size and geographic area in which this study was undertaken, the results cannot be generalized to other locations or wider populations. As curricular requirements differ by province in Canada and differ across countries (indeed, dissection is not a global practice), the results of this study are geographically specific to Ontario and represent the experiences of a convenience sample therein.

Materials

The survey (Oakley, 2011) included 25 questions in total, 23 of which were in closed-ended formats using yes/no questions, checklists, and Likert scales, along with open-ended fields so that respondents could elaborate upon their answers if they chose. Two open-ended questions were also included, one at the mid-point and one at the end of the survey, asking respondents to share additional details about their experiences. Questions in the first half of the survey asked participants to reflect back on their high school experiences and report on whether dissection was offered to them and if so, whether they participated in it; how they felt about their dissection experience(s); whether they received an option from their teacher to opt out of dissection; and whether alternatives were made available to them. Table 1 in this paper (Students‟ Self-Reported Classroom Animal Dissection Experiences) reports the statistical findings of one of these survey questions.

The second half of the survey inquired into the particular experiences of students who objected to dissection. Participants who reported objecting to dissection (n=71) were asked a series of questions relating to why they objected, how their teacher responded to their objection,

and whether they felt supported in their decision to not dissect. Table 2 (Student-Reported Teacher Responses to Objection to Animal Dissection) outlines the statistical findings of how objectors reported that their teacher responded to their objection.

The interviews with eight participants who objected to dissection were conducted by telephone, using a semi-structured interview guide (see Oakley, 2011). Interviewees were asked to share their experiences of objecting to dissection, including why and how they objected, how their teachers and classmates responded, how they felt about objecting, and what the outcomes were of their objection. The length of interviews ranged from 14-26 minutes, with the average being 18.5 minutes. All interviews were recorded and transcribed, then coded using line-by-line content analysis techniques. In this paper, quotations were selected from the interview data, along with the open-ended survey data, to illustrate respondents‟ experiences vis-à-vis objection to dissection.

Results: Participation and Objection Rates

The vast majority of participants in the study—295 of 311 (94.8%)—had been offered dissection in one or more of their high school science/biology classes. Participants reported a great variety of nonhuman animals and animal parts being dissected in class, including (listed by frequency of response): fetal pigs, frogs, worms, rats, cows‟ eyes, grasshoppers, perch, crayfish, sheep‟s brains, dogfish sharks, cats, cows‟ hearts, mice, and many others cited in small numbers. There was also considerable diversity in participants‟ reported responses to animal dissection; Table 1 demonstrates responses to the survey question, “Which of the following best describes your experience in secondary school classes?” (Note that because participants were asked to select “all that apply,” the total responses do not add up to 100 percent.)

Table 1

Students' Self-Reported Classroom Animal Dissection Experiences

Survey statement	Percentage
I willingly participated in an animal dissection(s).	54.0%
I participated in an animal dissection but had mixed feelings about it, due to personal, ethical, cultural, religious, and/or environmental reasons.	34.6%
I did not want to participate in an animal dissection and informed my teacher, but was convinced to participate anyways.	7.6%
I did not want to participate in an animal dissection and informed my teacher, and was given an alternative mode of learning (e.g., CD-ROM or computer program, 3D anatomical model, video, chart, poster, or overhead).	6.2%
I skipped class on the day(s) of the dissection.	4.2%
I used an alternative (e.g., CD-ROM or computer program 3D anatomical model, video, chart, poster, or overhead) instead of participating in an animal dissection.	3.5%
I did not participate in an animal dissection and was given a failing grade on the assignment.	2.1%

Table 1 demonstrates the diversity in students‟ classroom experiences: 54% reported willingly participating in a dissection, 34.6% reported having mixed feelings, and some reported participating even though they did not want to—as 7.6% noted, "I did not want to participate in an animal dissection and informed my teacher, but was convinced to participate anyways." Further, some reported being granted an alternative while others were not; finally, some reported skipping class on the day(s) of dissection or failing because they did not participate.

For some students it was not made explicit to them whether they had a choice to opt out of dissection and use an alternative, and this affected whether they objected. In response to one survey question, "Were you ever given an option by your teacher to not participate in (opt out of) a dissection?," 60.8% of respondents reported they were given an option, while 39.2% said no such option was given. For some individuals, not being given an option by their teacher led them to believe that *no* option was available to them. One participant commented that she believed she had to participate because there was no discussion in her classroom about alternatives. Another wrote that when teachers do not give options, it becomes up to the student to object—and this may be difficult, depending on the teacher:

> I remember the different biology teachers in my high school, and there's a couple that I don't think I'd be able to approach and say, "I'm not comfortable with this." ... If you have a really intimidating teacher, then you're not going to approach them about it, or you're less likely to approach them about it. (SI #3, May 2010, p. 3)

That some students do not give voice to their concerns complicates the picture of how many students object. Two survey questions illustrated a discrepancy between participants' feelings of objection and whether they expressed those feelings. One question asked participants, "Did you personally object to animal dissection in your Grade 9, Grade 10, Grade 11, or Grade 12 science/biology classes?"; in response, 71 respondents (of the 295 who had been offered dissection) reported "Yes." The follow-up question asked this pool of 71 individuals, "Did you inform your teacher that you did not wish to dissect?", and here, only 54 indicated "Yes." It therefore cannot be assumed that all students will voice their opposition to dissection, especially if no alternatives are offered.

The 71 individuals who reported objecting to dissection cited the following reasons for their objection (the categories overlap as participants were asked to "check all that apply"): personal (80.3%), animal rights (71.8%), ethical or moral (60.6%), environmental (33.8%), religious (4.2%), and cultural (4.2%). Four participants checked the option "other" in response to

the question; two explained that they "dislike blood"/have a "weak stomach" and two simply wrote that they objected because they found it "gross." Balcombe (2000) asserts that most students object to dissection for reasons rooted in their belief systems rather than a desire to avoid work or because they are "grossed out" or "squeamish" about the process; the findings of this study support the reality that there are many reasons, beyond a personal negative response, why students object.

Teacher Responses to Objection to Dissection

The individuals who reported expressing objection to dissection experienced diverse teacher reactions. Table 2 outlines the survey responses to the question, "When you informed your teacher that you did not wish to participate in an animal dissection, how did your teacher respond?" (Again, because participants were asked to select "all that apply," the total responses do not add up to 100 percent.)

Table 2

Student-Reported Teacher Responses to Objection to Animal Dissection

Survey statement	Percentage
the teacher convinced me to try dissection	42.6%
the teacher requested that I watch another classmate dissect, instead of performing the dissection myself	35.2%
the teacher provided an alternative for me to use	33.3%
the teacher told me that not dissecting was not an option	24.1%
the teacher gave me a failing grade for the dissection assignment	11.1%
the teacher requested that I find my own alternative	7.4%

This table highlights that many students who objected to dissection ended up participating in some capacity nonetheless. In the following section I discuss the top five themes emerging from the survey data (as reported in Table 2), and include quotations from the open-ended survey data, and interview data, to elucidate each theme.

"I Felt Pressured Into Completing the Dissection"

The dominant response that objectors reported was that their teacher convinced them to try dissection. Participants spoke of having discussions with their teachers that left them feeling as though their concerns did not warrant alternative learning methods, or that they should try the dissection to see how they felt about it. One participant spoke of her Grade 11 classroom experience in which small groups of students were to collectively dissect a worm, frog, rat, and fetal pig as part of a unit addressing comparative anatomy. After advising her teacher that she

objected to the dissection on ethical grounds, she was told she should try it nonetheless. She recounts how she creatively developed her own alternative in her group:

> I had informed my teacher that I refused to participate in the dissection of any animal. I was forced to begin with a worm to "see how I felt" about the situation. Dissecting the worm did not change my feelings about dissection in any way. As the dissection portion of the course progressed, I continued to refuse to dissect and offered to complete all written work for my group, providing I did not have to participate. … So, I kind of worked with my group to make an alternative. (SI #2, May 2010, p. 1)

Others explained that some teachers pressured them into dissecting by questioning the legitimacy or consistency of their ethical stance. One participant discussed how she felt pressured into dissecting when her teacher questioned her commitment to nonhuman animals:

> Basically, our biology teacher told us that we would be participating in a dissection and he would give us a little bit more detail later on about the animal for the dissection. At that time I told him I was uncomfortable with it for moral reasons: animal cruelty, I don‟t agree with it. And he said, "Well, we can talk closer to the date. Depending on what the animal is, would that change your mind?" I said at the time, "No." We found out about two days before that it would be baby pigs, and I said to him at that point, "I really object to this. If there‟s an alternative assignment I‟d like to do that. I don‟t feel comfortable with this. I don‟t think it‟s right." And, instead of saying anything—like agreeing with me, or anything like that, or giving me the alternative—he said, "Well, you‟re wearing leather shoes. Or you‟ve got a leather belt on. Do you not eat meat?" Sort of playing the defensive there, and saying, "Well, you do this, and you do this, and you do this, but yet you‟re against the dissection." (SI #7, May 2010, p. 1)

In other instances, individuals who commented on this theme said they felt pressured into dissecting because it was discursively framed as an activity that could be important to them in post-secondary education or a later career. One participant shared that although she felt that

dissection was, for her, a waste of animal life, her concerns were outweighed by a discussion about how it could be important in the future. She wrote:

> I hated the thought of cutting up creatures that were once living just to see their organs. I can see this may have been beneficial had I hoped to become a doctor or a veterinarian, but as it turns out I became a teacher. Looking at pictures on the internet or even watching willing participants would have been good enough for me. (SQ #297, March 2010, p. 2)

The data in this category suggests that for many individuals, being pressured to try dissection was not a welcomed pedagogical push; no student who cited opposition to dissection expressed gratitude at being pressured to try it.

"If We Didn't Want to Dissect, We Were to Join a Group and Just Watch"

The second most commonly cited response was that teachers requested that students who did not want to dissect could observe other classmates, rather than performing the dissection themselves. Classroom dissections are often done in pairs or small group of students and because of this, students take on different roles (e.g., as dissector, as person who identifies parts, as person who draws diagrams or takes notes). Among the participants who referenced the set-up in their classroom, 11 explained how watching others dissect was presented as an "alternative" to them. One objector commented:

> [A]lthough I did not feel comfortable doing this [dissection] as I … don‟t think dissection is right, I was told I had to be in a group and even if I didn‟t do anything (i.e, cutting or touching) then I would still be able to pass the project. I was not impressed, but being young and naive I did what I was told. (SQ #292, March 2010, p. 2)

Student objectors did not uniformly agree that watching another person dissect was a valid alternative or should be labelled as such. One participant elaborated: "There was not really an alternative. In high school if we did not want to dissect then we could join a group and just

watch. But there were no alternatives like a CD" (SQ #258, March 2010, p. 2). Another expressed confusion around her classroom experience and the way that watching another student was presented as an alternative:

> I didn"t really feel like the "alternative" was a viable option since it was just to not participate. I wasn"t sure what that even meant. I let my friend, who was very interested in the process, do most of the operation. (SQ #302, March 2010, p. 2)

Some objectors added that they went along with this option because it allowed them to lessen their direct involvement in the dissection, while others noted explicitly that this was not a satisfactory compromise. The data suggests that for many students, the "alternative" was for them to participate in a more passive way.

"If We Didn't Want to Dissect, We Could Use an Alternative"

The third most frequently cited response was that teachers provided an alternative (beyond watching others dissect) for student objectors to use. This theme was referenced by respondents who participated in dissection *and* those who objected to it: among all of the participants in this study, n=89 indicated that they were offered an alternative by their teacher, and cited the following alternatives as being offered in their classes: charts, posters, and/or overheads (50%); CD-ROMs or computerized programs (33.3%); videos (16.6%); and 3D anatomical models (5.6%). Individuals who checked the option "other," in response to being asked what alternatives were made available to them, listed options including writing an essay, studying a textbook image, using Internet diagrams, conducting library research, and participating in a field trip in lieu of dissection.

Ten individuals who commented on this theme referenced positive and respectful teacher-student relationships. That dissection was optional was, for these students, made clear by their teachers: "My teacher never made anyone do it or even be there when it was happening. It was completely voluntary," one individual wrote (SQ #195, March 2010, p. 2). Another wrote that:

"[The teacher] made it clear that if we weren‟t comfortable dissecting the animal we could complete an online dissection lab" (SQ #253, March 2010, p. 2). Themes of respect, and being given an option of whether to stay in the room during the dissection, were also mentioned. One participant recalled:

> I remember my teacher was very respectful to the fact I didn‟t want to participate. I was in the classroom when they did do it. It was my responsibility to learn the material. My teacher approached me and told me personally that I did not have to participate. (SQ #21, March 2010, p. 2)

Three other respondents, however, indicated that alternatives were only made available to students in their classrooms who had particular reasons for objecting. This created a classroom environment in which choice was not offered freely but reserved for those who had what were perceived to be legitimate concerns. One person explained: "We were told we didn‟t have to, but only for religious reasons or if your family were vegetarians or something ... Not wanting to, or being squeamish wasn‟t an excuse" (SQ #140, March 2010, p. 2). Another wrote that in his class, participation was only optional if a student was concerned about becoming physically ill:

> I do remember something about, like, if you‟re not comfortable, or if you feel sick, you don‟t have to participate or you can leave. But it was definitely not around spiritual or personal beliefs. It was around actually physically getting sick. (SI #5, May 2010, p. 1)

That not all teachers use or offer alternatives to students—despite many high-tech, low-tech, and no-tech options being available—suggests that some teachers either do not see alternatives as satisfactory teaching aids or they feel alternatives should be reserved for students with specific reasons for objecting. What is perceived as a valid reason for objecting, however, may vary from one teacher to the next.

"We Weren't Given the Option to Not Participate"

The fourth most commonly reported experience was that students were not given an

option to opt out of dissection. A lack of clear communication about their options left some students assuming no other option existed and that their participation was mandatory. While teachers may proceed with the assumption that dissenting students will voice their objections, this study found this is not always the case; even the way a teacher addresses the ethics of dissection can encourage or close down conversation. One objector explained how his classroom experience began with a discussion that served to negate objections before they were even voiced:

> I was never offered an alternative but would have taken it. We were told we had to do it. I was disgusted and ethically opposed to it. The teacher gave us a consequentialist argument about the greater good (our learning) outweighing any possible opposition we may have had to it. That was the extent of the discussion. (SQ #39, March 2010, p. 2)

Confusion around whether or not alternatives were available was expressed by another respondent who explained how he found out *after* participating in a dissection that computerized alternatives were available in his school:

> I found out a couple [of months later] that some students were in the computer lab, doing the dissections on the computer … I didn"t know they had that option for people. They [the teachers] just kind of kept it quiet … they wouldn"t tell the students ahead of time that that was an option. It would have been nice to have known. (SI #4, May 2010, pp. 1-2)

Another commented that the experience of being offered choice in her school differed from one class to the next, depending on the teacher. She noted that in her class, she felt she "had to" dissect:

> There wasn"t an option. I went and asked my teacher. The thing is, where I was, at least at the time anyway, it was up to the teacher whether or not you could opt out. My sister went to the same school, and she had a different teacher, and they let people opt out, but I

had the teacher that I had, and I went and asked and they said, "No, you have to participate." So everybody in our class had to do it. (SI #6, May 2010, p. 1)

"My Marks Would Suffer if I Did Not Dissect"

The fifth most commonly cited response was that teachers either implied or explicitly stated that students" grades would suffer if they did not participate in a dissection, or that they might fail some or all of the assessment activities associated with dissection (such as a follow-up exam or bell-ringer test, in which students move from station to station, identifying parts of a prosected animal). One individual commented, "He [the teacher] told me I would lose 15% of my mark for not participating" (SQ #222, March 2010, p. 4), while another wrote, "My teacher made it known that it would be harder for me to receive a good grade if I chose the alternative" (SQ #196, March 2010, p. 4). Another explained that she participated in a dissection reluctantly because she was told the alternative would not adequately prepare her for the final exam: "I was informed that if I did the alternative CD-ROM version that my knowledge of the material would not be as thorough and I would likely fail the exam. I felt pressured into completing [it]" (SQ #9, March 2010, p. 2). This demonstrates that marks can be inextricably linked with the theme of feeling pressured to participate, although not all individuals in this study opted to participate even with warnings of compromised grades.

The theme of "dissect or fail" was commented upon by nine survey participants, including one who wrote: "Our school forced us to participate in animal dissection. If we refused we were given a failing grade" (SQ #181, March 2010, p. 2), and another who explained that she participated unwillingly because it was important to her to not fail: "I did not want to participate in animal dissection, but was told that I would be given a 0 for not participating. Therefore, I unwillingly participated because my grades were important to me and there was no alternative assignment offered" (SQ #260, March 2010, p. 2). Another student outlined her response to the choice she was given: "I asked for alternative software to complete the assignment and was told

[there was] no other option. Either participate or fail. I received a failing grade" (SQ #309, March 2010, p. 2).

Finally, one person shared her story of contesting her teachers over marks associated with dissection. She explained her attempt to find a compromise with her teacher and how her school principal, parents, and even the guidance counselor became involved:

> It was [first] taken down to the principal because I was so strongly against this [dissection], and I told him my position, and the teacher told the principal his position, and what came out of it was an agreement that I had to be in the classroom, but I didn't have to actually participate. And unfortunately, because I didn't actually participate, it did hinder my mark ... I failed the assignment and I wasn't offered any other ways to bring up my mark. I did ask for an alternative assignment afterwards, after receiving the failing grade, and was told, "No, that was the assignment. There's nothing else to do for that." I then brought that home to my parents—they knew the situation already, that it had escalated to the principal—and he [the principal] did say that, you know, "This was the situation. There was an agreement saying that she would be in the classroom but didn't have to participate, however, I guess marks weren't discussed." He said that it would be resolved. I ended up passing the class with a 52. Because ... it was never resolved. We had taken it down to the guidance counselor, and they said unfortunately, what's done is done, and I can take it at a summer school to bring up my mark, or I can just … leave it. It was on my transcript; it was there for good. (SI #7, May 2010, pp. 1-2)

Other Responses

Beyond the themes outlined above, a small percentage of student objectors shared other responses. These included being asked by their teacher to find their own alternative, and deciding to skip class on the day(s) of dissection. Finally, and perhaps most extremely, three students reported expressing their objection to dissection by dropping the class and two others indicated

that they investigated course outlines in advance to determine whether dissection alternatives would be made available to them. “When I found out that Grade 12 biology consisted of dissecting a rat, I did not enroll myself into the course,” one wrote (SQ #202, March 2010, p. 2). This response, along with the others outlined above, demonstrate that dissection can be a highly contentious issue and one that students may go to great lengths to avoid if choice is not proactively granted.

Discussion

Most students do not object to dissection, as previous research (e.g., Almy et al., 2001; Barr & Herzog, 2000) and the present study confirms. However, the number of students who do object, or partially object, may be underestimated in studies based on teacher estimates. Some students will go along with dissection even if they are against it, due to classroom dynamics or a lack of choice being offered; because of this teachers may have a skewed picture of the true number of student objectors. As previously reported in this paper, the number of objectors in this convenience sample was 71 out of 295 students who had been offered dissection.

This research points to a clear need for students to be proactively and non-coercively given a choice between dissecting and completing a comparable learning activity. Of the individuals in this study who reported objecting to dissection, only a third (33.3%) said that their teacher responded by providing an alternative for them to use (see Table 2). The other two thirds experienced less accommodating teacher reactions, highlighting the reality that teachers do not uniformly offer students choice. These findings point to the importance of choice policies to ensure that all students who do not want to dissect have access to alternative ways of learning.

There are several benefits (beyond the obvious ones for student objectors) that can accompany the implementation of choice-in-dissection policies. For teachers, having a policy in place can help ensure they are prepared to accommodate students who object, while simultaneously creating an opening for a class discussion on the ethics of dissection and the

various positions surrounding the use of nonhuman animals in science. This in turn can help to promote critical thinking and informed decision-making among students, and can also alleviate issues of peer pressure by helping students understand why others might make different choices than them. As Jukes and Chiuia (2003) write, student objectors are often conscientious people who are thinking critically and challenging the status quo—hallmarks of a good scientist—and choice policies welcome, rather than diminish or alienate, their perspectives.

Thoughtfully worded choice policies can also help to create equitable classroom environments where those who object are not positioned as a fringe minority. At present, the ways in which dissection is discursively positioned as a dominant or "normal" practice is evidenced by the language used: students who do not want to dissect must "opt out" and ask for an "alternative" way of learning. A more reasonable solution might entail having students "opt in" to dissection following a class discussion, or for them to pick from two (or more) "equal choices" in learning (Tim Battle, Alberta SPCA, personal communication, 2010). These small linguistic shifts, in concert with enacted choice policies, could help to prevent the marginalization of students who choose not to dissect.

From a critical humane education perspective, the act of offering students choice might also result in a decline in the number of animals dissected. Given this study"s finding that some students would have used alternatives had they been offered to them, it is possible that choice policies could result in fewer dissections being performed. With an estimated 10-12 million animals killed each year for American classroom dissections (Rosenberger, 1998), and widespread suffering involved in the ways the animals are procured, confined, transported, handled, and killed (Sapontzis, 1995), a decline in dissection would be welcome news to humane educators. A decline could also connect to an improved environmental and ecological footprint, given that some dissected animals, such as frogs, are wild-caught and removed from ecosystems, and some specimens are still preserved in formaldehyde-based solutions that present both health

and environmental risks (Balcombe, 2000; OSHA, 2003). Choice policies can thus represent a progressive step from both an ethical and environmental point of view.

Choice legislation also supports the development and use of humane alternatives, including virtual dissection programs and other options such as 3D anatomical models, films, charts, diagrams, or creative alternatives such as asking students to build models out of clay. To date, most research has sought to measure student learning with virtual dissection software against a traditional dissection, with several studies concluding that learning with virtual alternatives can be comparable, and in some cases superior, to learning with actual animals (e.g., Kopec, 2002; Lalley et al., 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001). Two meta-reviews of research measuring student learning with conventional dissection versus alternatives also conclude that most learning objectives can be met with alternatives, that knowledge gain is equivalent, that costs are less, and that alternatives provide better support for weaker students (Balcombe, 2003; HSUS, 2008).

And yet, despite encouraging findings about the validity of virtual dissection software, many teachers continue to privilege traditional dissection and see it as the "best" way students can learn (Almy et al., 2001; King et al., 2004). Given this study's finding that only a third of objectors were offered an alternative from their teacher, it is evident that concurrent with the implementation of choice policies is a need for improved teacher education. Teachers may be unaware of the validity of alternatives or may perceive them as pedagogically inferior to "hands-on learning." Hence, a related recommendation from this study is for enhanced teacher education programs, and opportunities for teachers to learn about available alternatives and the organizations, databases, and journals that provide reviews of them (e.g., InterNICHE, NORINA, *The American Biology Teacher*). Having opportunities in teacher education programs to gain exposure to alternatives, and to discuss the debate surrounding dissection, is an important step toward progressive humane science practices. Further research exploring teachers' perspectives is also needed—while this paper addressed the experiences of former students, hearing from

teachers is equally important to gain insight into the state of dissection and choice in schools today.

Ultimately, the disparate experiences reported by student objectors in this study point to a continued need for humane educators and animal advocates to lobby for choice in dissection policies. At present these policies are legislated unevenly across North America, and while it is unknown how they are monitored or enforced, having the policies in place is a necessary first step to ensure students have the right to say no to dissection. The reality that a considerable number of students object to dissection, that comparable learning can be achieved via humane alternatives, and that classroom practices vary from one teacher to the next, speaks to the need for choice policies to be adopted by all schools to ensure classroom environments are comfortable, equitable spaces for all students. For, as one objector in this study astutely noted: "I didn't feel right about animal dissection … [and] feeling uncomfortable is not a healthy learning environment" (SQ #211, March 2010, p. 2).

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Science Teachers and the Dissection Debate: Perspectives on Animal Dissection and Alternatives

Abstract: This study investigated Ontario science and biology teachers‟ practices and attitudes toward animal dissection and dissection alternatives. The data was collected through a mixed methods approach involving online surveys (*n*=153) and subsequent telephone interviews (*n*=9) with secondary school science and biology teachers. The findings indicate that teachers identify strengths and drawbacks to both dissection and alternatives, but the majority continue to strongly favour traditional dissection and see it as vital to biology education. Further, although teachers expressed concerns with dissection, their concerns were overshadowed by an overall dissatisfaction with alternatives. It is argued that teachers need to engage more deeply with the ethical questions that underlie dissection and consider how its learning outcomes can be achieved through humane science education practices. It is also argued that science teacher education programs should include ethical discussions about the controversies of dissection and provide training to familiarize pre-service teachers with alternatives.

Keywords: animal dissection, dissection alternatives, secondary school science education, teacher practices, ethics

Introduction

Animal dissection is a controversial pedagogical practice. In educational contexts it raises ethical and environmental concerns regarding the killing of animals, the ignoring of animal welfare standards, the weakening of respect for life, and the “turn-off” factor for some students (Balcombe, 2000; Bishop & Nolen, 2001; Hug, 2008; Jukes & Chiuia, 2003; Marr, 2001;

Oakley, 2009; Sapontzis, 1995). The "dissection debate," with ethics at its core, often centres around the validity of killing animals—an estimated 10-12 million animals per year in America (Rosenberger, 1998)—for a school science activity.

The burgeoning industry of dissection alternatives presents an additional challenge to dissection. Given that there are ways students can learn about anatomy and physiology without using animals that have been killed, should schools not pursue these alternatives exclusively? Virtual dissection simulations, 3D models, plastinated specimens, videos, slides, charts, and online presentations offer ways for teachers to avoid the ethical controversies associated with dissection without compromising student learning. Research based in middle and high school contexts indicates that outcomes pertaining to learning anatomy and physiology can be met with virtual alternatives and that student knowledge gain can be equivalent, and sometimes superior, to a traditional dissection (Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001). Given evidence that alternatives can and do work, why do teachers continue to dissect?

This study aimed to understand, from teachers' perspectives, whether and why they use dissection and what perspectives they hold toward alternatives. Bringing teachers into this discussion is important as their voices have largely been underrepresented in existing research. As King, Ross, Stephens, and Rowan (2004) write, "The use of animals in dissection activities in high school biology education is believed to be widespread … but currently, there are few data regarding its prevalence, or its role as an educative resource, from the biology teachers' perspective" (p. 475). Similarly, Hart, Wood, and Hart (2008) note that: "Although the subject [of dissection] has been a lively focus of articles among animal welfare organizations and philosophers, educators have had much less involvement in addressing this question than one might expect" (p. 49). This study aimed to investigate the choices teachers make about this controversial practice, their attitudes toward dissection and alternatives, and how they respond to the ethics of the dissection debate.

Classroom Practices: A Review of the Literature

Research suggests the majority of biology teachers in North America continue to dissect. According to three American reports, between 75-79% of biology teachers use dissection in their classes. One study of middle and high-school biology teachers found that 79% of respondents (*N*=494) reported dissecting in their current teaching practices (King et al., 2004); similarly, an examination of science teachers‟ practices in Massachusetts (*N*=667) revealed that 78.1% of respondents had offered dissection at least once in the last five years (Almy, Goldsmith, & Patronek, 2001). A third study, based on responses from members of the National Biology Teachers Association (*N*=215), found that 75% of respondents reported intending to use animal dissection in their science classes (Cockerham, 2001). These studies are based on American samples, which reflects the reality that dissection is practiced most frequently in North America. Indeed, dissection is not a global phenomenon: it is no longer practiced in primary and secondary schools in The Netherlands, Switzerland, Argentina, Slovak Republic, and Israel, and is rare in schools in Sweden, Germany, and England (Balcombe, 2001; Waltzman, 1999).

Research regarding teachers‟ use of dissection alternatives is sparse, making it difficult to gain a clear picture of the popularity of alternatives. The limited research to date suggests teachers mainly use alternatives as supplements, rather than substitutes, to conventional dissection. This is demonstrated in King et al.‟s study (2004), where teachers reported using charts, videos, 3D models, CD-ROMs, and other computer-based resources, but only 31.4% agreed that alternatives were as good as dissection for teaching anatomy and/or physiology. Similar findings were noted by Almy et al. (2001), who found that teachers were split on the validity of computer simulation as a pedagogical tool, even though 78.1% of the teachers in the study who offered dissection also reported offering alternatives.

Many variables can influence a teacher‟s decision to use alternatives, either in lieu of traditional dissection or in conjunction with it. In considering the factors that increase teachers‟ likelihood of using a virtual dissection alternative, Cockerham (2001) found that a teacher‟s

attitude toward virtual dissection, their previous experience using a virtual dissection, and their intention to use a real animal dissection were all positively related to their likelihood of using a virtual dissection. Other variables that may influence a teacher‟s decision to use alternatives include their access to them, perceptions of their effectiveness, willingness to explore new modes of learning, attitudes toward animals and technology, preparedness to teach biological science, and available resources, budgets, time, and supports (Hart et al., 2008). With limited research in this area, more data is needed to understand why teachers continue to dissect and what impressions they hold of alternatives.

Research Participants and Design

This research was part of a larger doctoral study on animal dissection (Oakley, 2011). The results in this paper were obtained through a two-phase data collection process conducted over a four-month period in 2010, involving surveys and interviews with teachers who were teaching, or had previously taught, senior level (Grades 9-12) science and biology courses in Ontario, Canada. The participants were recruited through the Science Teachers‟ Association of Ontario and invitational emails sent to school boards and teachers in the province. In total, *N*=153 teachers (98 female and 55 male) participated in the study. Their teaching experience ranged from 1 to 37 years, although the majority (59.7%) reported they had been teaching science and/or biology between 1-10 years in Ontario.

In the first phase of the research, participants completed a 30-question online survey investigating their use of, and attitudes toward, dissection and dissection alternatives. The majority of the survey questions (26 in total) were closed-ended, featuring checklists and Likert scales, along with open-ended comments fields so that respondents could elaborate upon their answers. The remaining four questions were open-ended. The numerical data reported in this paper were taken from an analysis of survey questions asking teachers whether they used dissection (and why), whether they used alternatives and what types of alternatives they used

(and why), and the benefits and concerns they associated with each instructional method. The narrative data—including the descriptions of each theme and supporting quotations—were selected from comments shared in the open-ended questions and comments fields on the survey, as well as select passages from the transcripts of nine interviews conducted in the second phase of data collection.

The nine teacher interviews were facilitated by a question at the end of survey that asked participants if they would be willing to participate in a follow-up discussion about their experiences; of the 153 teachers who completed the survey, 64 volunteered to be interviewed. Twelve individuals were selected for the interview based on gender diversity (6 males and 6 females were selected) and diversity in responses on their surveys pertaining to dissection practices and use of dissection alternatives. The goal of the interviews was to obtain more depth of information regarding individual teachers‟ perspectives, but due to the time commitments associated with conducting, transcribing, and analyzing interview data, conducting more than this number did not seem feasible. Of the 12 individuals selected, 9 (4 female, 5 male) agreed to be interviewed. All interviews were conducted following a semi-structured interview guide; the average length of the recorded interviews was 25 minutes.

Following the data collection via the surveys and interviews, all data were analyzed separately and in tandem. I analyzed the survey data using descriptive statistical analysis techniques (calculating percentages and counting the number of times themes were mentioned), and used line-by-line content analysis techniques to determine the salient themes in the interview transcripts. The two sets of data were then analyzed together. In this paper, I draw from the combined pool of closed- and open-ended survey data (phase 1) and interview data (phase 2) to provide a picture of teachers‟ practices and perspectives concerning animal dissection and use of dissection alternatives.

Results

Teacher Practices and Perspectives: Dissection

It was clear that the majority of teacher participants found unparalleled value in traditional dissection, as 87.5% either agreed or strongly agreed with the statement, "Real animal dissection is important to the teaching of biology," and more than half (56.3%) agreed or strongly agreed that "there are no substitutes for real animal dissection." Further, the majority of participants—94.1% (144 of 153 teachers)—reported conducting dissections in their classes. While the research survey focused exclusively on secondary school (Grades 9-12) dissections, some teachers indicated that they also conducted dissections in other grades and courses, including Grades 2, 4, 7, and 8, and in non-biology classes including health, forensic science, environmental studies, chemistry, physics, and at science clubs and camps.

Teachers cited a range of animals and animal parts dissected in class. The dissected specimens and number of teachers who reported using them for classroom dissections were as follows: fetal pigs (122), cow parts (e.g., hearts, kidneys, lungs, brains, uteri, eyes, and other "plucks") (118), frogs (85), worms (81), perch (66), sheep parts (65), rats (62), pig parts (52), grasshoppers (36), crayfish (26), cats (16), dogfish sharks (15), starfish (12), chicken parts (8), pigeons (8), mice (5), snakes (3), turtles (3), clams (2), minks (2), mudpuppies (2), squid (2), and many others cited a single time. The vast majority of teachers who conducted dissections reported purchasing the animals and parts from biological supply companies (98.6%), although some also reported obtaining them from supermarkets (26.4%), slaughterhouses (22.2%), and breeders and dealers (2.1%). One teacher reported using road kill and another said she obtained animal donations from a trapper.

The teachers predominantly spoke of the benefits of dissection but also reported having concerns with it. Tables 1 and 2 outline these findings, parsed into themes and ordered by the frequency each theme was cited among those who identified benefits (n=133) and drawbacks (n=129) to animal dissection as a pedagogical technique.

Table 1

Teacher-Reported Benefits of Animal Dissection

Pedagogical: solidifies student knowledge of structure, function, placement, and interconnections of organs and systems; reinforces concepts covered in class/curricular materials; provides the most authentic/memorable/"best" way to learn about anatomy and physiology (74)
Realism: conveys reality and complexity; demonstrates similarities and differences between organisms (including those of the same species); allows for comparisons to the human body; "3D model" (i.e., actual animal) looks completely different than diagrams (62)
Experiential: provides hands-on learning; allows students to develop manual dexterity and experience with equipment, lab safety skills (58)
Student engagement/enjoyment: dissection is an exciting, one-of-a-kind experience that interests students and promotes desire for further studies in biology (58)
Ethics and respect: an opportunity for students to develop respect and admiration for life; loss represented by the death of an animal can teach about ethics (23)
Future learning: supports the development of students considering further biological or medical studies; prepares students for future dissections (14)
It is part of the curriculum and supported by the Ministry (8)

Table 2

Teacher-Reported Concerns with Animal Dissection

Health and safety: students' safety in the lab; proper ventilation in the room; exposure to formalin; proper disposal of specimens; bacteria levels (46)
Pedagogical: classroom management (e.g., dealing with immature students; ensuring proper respect is shown to specimens); students' learning and retention; addressing and evaluating students who refuse to dissect (30)
Costs (23)
Ethical: ensuring animals are not caught from wild populations (e.g., not contributing to the declining frog population); concerns about the humane killing of animals; is it necessary or justified to kill animals for this purpose? (21)
No concerns whatsoever (8)

Benefits of dissection. The primary benefit of dissection, as expressed by 74 teachers, was its pedagogical value. For many teachers, having students work with an actual animal and

observe real-life interconnections between organs and systems was seen as the best possible way students can learn. “It is an ideal way for students to see the ‚real deal,‘” one teacher wrote, adding that “when the students are studying pictures all the time, they expect to see cartoon figures during dissections” (TQ #117, May 2010, p. 1). In the related category of “realism,” 62 teachers indicated that the reality conveyed by dissection cannot be matched by alternatives. Comparing dissection to virtual alternatives, many suggested simulations are “overly perfect” and unable to showcase abnormalities or variations from one specimen to the next. One teacher explained that when students first study images, and then proceed to an actual dissection, they are often surprised:

> They can‘t identify structures, because what the structures look like virtually and what they look like in reality, is different. [With a virtual dissection] you don‘t get the opportunity to look [at] what‘s in the stomach. And you don‘t get the opportunity to see if there was a pregnant female, and what that looks like. There are all these sorts of surprises to doing a dissection. (TI #6, June 2010, p. 3)

These “surprises,” along with the hands-on nature of dissection, were cited as benefits only a physical dissection can provide. The fact that dissection is a kinesthetic experience that allows students to develop motor skills was also considered a strong benefit: “There are skills that they learn, like manipulating instruments … there‘s a high degree of safety involved with scalpels … and a delicacy of hand-eye coordination is required,” one teacher explained (TI #1, June 2010, p. 1).

A common thread running through the responses was that many students enjoy the unique experience of dissection and that this enjoyment connects to enhanced student learning. With 58 participants citing student engagement as a key benefit of dissection, it is evident teachers believe students enjoy the process. Some noted that student interest could translate into dissection becoming a “selling feature” for students to pursue advanced-level biology courses. Comparing interest levels between physical and virtual dissection, some reported that the latter

was less interesting to students—even those who dreaded dissection in the first place. One teacher explained:

> It [dissection] is one of the most memorable experiences for students. I have known a number of students who went from dreading the dissection (and wanting alternatives) to taking Grade 12 biology BECAUSE they discovered that they enjoyed the REAL dissection experience. (TQ #15, May 2010, p. 4)

Ethics was one of the more complex benefits—and drawbacks—that teachers associated with dissection. While many agreed that alternatives can alleviate ethical problems associated with the killing of animals, 23 teachers positioned dissection as a unique opportunity for students to engage with ethical issues surrounding respect for life, mortality, death, and dying. In the comments section of the survey, four teachers commented that students today are too divorced from the reality of animal death: "Many students have no firm link to reality—their information is digital; few have caught …[or] cleaned a fish; their meat comes on Styrofoam. This is real," one wrote (TQ #71, May 2010, p. 2). Another shared an anecdote of how a classroom dissection may have contributed to instilling an ethic of respect in his students:

> I had several of my returning students discuss the action they took in removing earthworms from the roadway in front of their house and putting them back onto the grass during a good rainfall. They credited their learning and the opportunity to learn about earthworms" importance to the ecosystem and their ability to "feel," and they felt that by putting them back onto the grass they had reduced their suffering. Sweeeet eh? (TQ #9, April 2010, p. 4)

Another cited benefit of dissection was that it could be helpful in preparing students for further studies in biology. One teacher explained: "Even though students may be able to successfully meet curriculum expectations when alternatives are provided, those that will be studying biology in university will be at a disadvantage if they have never performed a dissection in high school" (TQ #44, May 2010, p. 4).

Finally, eight teachers expressed belief that dissection is supported by the provincial Ministry of Education, based on it being included in the Grade 10 and Grade 11 curricular documents (although the curricula state that students are to perform a traditional dissection *or* use a computer simulation or other type of alternative) (Ontario Ministry of Education, 2008a, 2008b). One teacher noted that dissection guides are also included in Ministry-approved textbooks and because of this he felt supported, and even encouraged, by the Ministry in his decision to dissect.

Concerns with dissection. Teachers expressed several concerns with dissection, the most common pertaining to health and safety. Forty-six respondents wrote that ensuring safe classroom practices was paramount and that they were most concerned with the possibility that students could harm themselves with scalpels, pins, or splashes from chemical solutions. Concern about chemicals and proper ventilation in the rooms was also expressed: several teachers mentioned they had health concerns about exposure to the formalin solution. While some teachers indicated they are now using formaldehyde-free specimens in classroom dissections, others continue to use formalin-preserved animals. One teacher wrote:

> I‟m concerned for not only the health of my students, but for myself. For example, I had three classes of Grade 11 biology dissecting for three days, plus two lunch periods. To me this seems like a lot of exposure [to formalin] in such a short time. (TQ #7, April 2010, p. 2)

The second most commonly cited concern involved classroom management issues and misbehaving students who deliberately mutilate, abuse, or otherwise disrespect the animals‟ bodies. “When I used to teach dissection in Grade 10, sometimes there would be really bad behaviour in, you know, chopping off an organ or saying, „Oh, let‟s cut the head off now,‟” one teacher explained (TI #6, June 2010, p. 3). This connected to concerns about whether students were gaining sufficient value from the dissection to make it worthwhile. Given the delicacy and

complexity of the procedure—and the fact that one wrong cut can mean the process is compromised—some teachers stressed the importance of guiding students through the procedure maturely so that it would not become, as one teacher put it, "a slap-dash cutting job." Teachers who cited concerns in this category also wanted to ensure students showed proper respect for the animals, and some expressed concern that dissection could be interpreted as communicating the opposite. One teacher noted that her main concern was that dissection could lead to "kids feeling that it is okay to hurt or „dissect" other animals that they come across… frog in ponds, et cetera" (TQ #76, May 2010, p. 2).

Pedagogical concerns were also expressed about student learning and retention, and the difficulties that can arise when students refuse to dissect. One teacher described his main concern as "students not willing to participate even as a helper/observer, despite having the requirement in the course description" (TQ #105, May 2010, p. 2). Another referenced the difficulty of "giving any students who have an objection to dissection a meaningful alternate project" (TQ #22, May 2010, p. 2). Finally, others worried about the impact dissection could have on students who were opposed to it for animal rights or other reasons. One teacher summarized her primary concern as: "Turning some kids off science because they think it is gross!" (TQ #76, May 2010, p. 2).

Cost and declining budgets were cited by 23 teachers as a concern. Some explained that they attempt to moderate costs by partnering students or having them work in small groups, although this was seen as a less-than-ideal arrangement because it meant not all students could take an active role in dissecting. Other strategies for mitigating costs included using slaughterhouse "plucks" (animal parts) or, in the case of one teacher, having students pay for the animal they were going to dissect.

Ethical concerns were expressed by 21 teachers. In particular, teachers mentioned having concerns about two of the most commonly dissected animals—fetal pigs (e.g., some questioned whether pigs are bred for the purpose of supplying fetal pigs to schools), and frogs (some

acknowledged the declining amphibian populations and noted they had stopped dissecting frogs as a result). Other concerns related to whether animals came from wild populations, and for those perceived to be "grown in a lab" (e.g., mice), whether they were raised and killed humanely. Finally, some questioned whether the ethical costs of killing animals justified the activity in the first place. Noting that dissection is not necessary for students' success in high school biology, one teacher asked, "Is it wrong for animals to be killed just so we can use them as lab specimens?" (TQ #45, May 2010, p. 2).

Teacher Practices and Perspectives: Virtual and Other Dissection Alternatives

Among the 153 teacher participants in this study, 125 reported using alternatives in their classroom, predominantly as supplemental teaching aids in conjunction with physical dissection (77.4%) and/or in lieu of dissection for students who choose not to dissect (71.8%). In response to the question of which alternatives they used, teachers cited CD-ROMs or computer programs (80%); charts, posters, textbook diagrams, and/or overheads (76.8%); 3D anatomical models (67.2%); videos (56.8%); and "other alternatives" (21.6%). "Other alternatives" included written assignments, websites, field trips and virtual field trips, dissection picture cards, and other creative teaching strategies, such as asking students to build 3D models out of clay or asking them to create a board game illustrating their understanding of anatomy and physiology.

Similar to the findings on dissection, teachers identified both benefits and drawbacks to using alternatives. Tables 3 and 4 summarize the reported benefits and drawbacks, as well as the frequency each theme was reported, among the teachers who responded to the questions (n=124).

Table 3

Teacher-Reported Benefits of Virtual and/or Other Dissection Alternatives

Supplemental teaching aid to physical dissection: alternatives allow students to become familiar with the intricacies of dissection *before* they dissect; provide a model of a properly dissected organism; offer additional information for students to extend their knowledge; allow for the viewing of specimens not normally dissected in class (96)
Provide an alternative learning option for students who do not want to dissect (e.g., for ethical, religious, or cultural reasons) or who cannot attend classes due to extenuating circumstances (92)
Reusable: alternatives can be re-used year after year and revisited at a later date during the school year (68)
Costs: it is less costly to use (some) dissection alternatives than to dissect (58)
Environmental footprint: dissection alternatives leave less of an environmental footprint (46)
Ethics: dissection alternatives do not involve taking an animal life (38)
Time savings: less time is needed for set-up/ clean-up (2)
Alternatives alleviate teacher discomfort with dissection (1)

Table 4

Teacher-Reported Concerns with Virtual and/or Other Dissection Alternatives

Pedagogical: alternatives are not pedagogically comparable to physical dissection—they lack realism; do not showcase diversity within a species; cannot capture the fascination of examining a real specimen; provide a less effective educational experience; are not hands-on or experiential (86)
Availability of school resources: limited or outdated school resources (i.e., computers) make it difficult to use alternatives (64)
Lack of information/teacher professional development opportunities to assist in the selection of appropriate alternatives and their use (21)
Costs: some alternatives are expensive/have to be renewed year after year; budget limitations (21)
Student disinterest (10)
Ethics: alternatives may desensitize students; there is no opportunity to develop an ethic of appreciation toward animal life (6)
Teacher discomfort with students spending time on computers: students are sufficiently “wired” (2)

Benefits of alternatives. Ninety-six teachers reported that the primary benefit of alternatives comes from using them as a supplemental teaching aid. Many of the teachers who commented in this category spoke of the value of using alternatives prior to a real dissection to familiarize students with the intricacies of the procedure and to facilitate deeper learning. One teacher explained:

> I use the computer simulations to prepare the kids better for the dissections … I use it as a pre-dissection tool, as well as a dissection tool, because it sets the kids up for learning much more deeply about of the actual dissection itself. (TI #3, June 2010, p. 2)

Many teachers also considered alternatives beneficial in providing non-dissecting students with a way to learn. Opinions were unevenly split, however, as to whether the alternatives were pedagogically adequate in this regard: in the survey, only 32.3% agreed that alternatives could provide a "pedagogically sound way for students to learn." One teacher opined: "I consider [alternatives] a better-than-nothing for those opting out entirely … There are some excellent virtual dissection programs out there, but they don't come close to being realistic as far as I am concerned" (TQ #133, May 2010, p. 2). Others, however, expressed confidence that alternatives can adequately meet curricular demands:

> I feel that it should be the student's right to decide if they would like to have that experience [of dissection] or learn through an alternative means. Whether they learn through the dissection or through an alternative, the curriculum expectations can still be met and achieved. (TQ #72, May 2010, p. 4)

Teachers also indicated that a benefit of alternatives is that they can be re-used year after year: "Less time is required for teacher set-up and no storage is required when using computer/models, etc.," one teacher noted (TQ #88, May 2010, p. 2); another simply cited the "ability to revisit at a later time/date" as a benefit (TQ #89, May 2010, p. 3). In some instances, the re-usability of alternatives was also connected to the benefit of them being more cost-effective, in the long run, than conducting a physical dissection.

Given that several teachers expressed ethical concerns with dissection, including its impact on wild animal populations (see Table 2), it is not surprising that 46 teachers reported that alternatives have a lighter environmental footprint and 38 found benefit in the fact that alternatives do not involve taking an animal life. As one teacher wrote, "I feel that killing animals/plants etc. for the sole purpose of a high school dissection is not valid. I am concerned

especially about frog dissections and the amphibian populations in general" (TQ #40, May 2010, p. 2).

Finally, the time savings associated with using alternatives was cited as a benefit by two teachers, and one teacher noted that alternatives provide a viable option for *teachers* who do not want to dissect. "If a teacher is uncomfortable teaching it, they should not feel that they have to," one teacher wrote, adding that "it needs to be a choice, both for the teacher—whether or not to be offering that kind of opportunity to their students—and again to the students, if the teacher does choose to offer it" (TI #7, June 2010, p. 4).

Concerns with alternatives. Pedagogical drawbacks topped teachers‟ list of concerns with dissection alternatives. Some of the commonly cited concerns were that alternatives lack realism, fail to showcase diversity among species, are not hands-on in the same way as physical dissection, and do not capture the wonder students feel when dissecting a real animal. Some teachers suggested these drawbacks lead to a less valuable experience for students: "The relationship the student has with the animal is valuable," one teacher suggested, "and the whole aspect of life/death and respect for life is valuable" (TI #6, June 2010, p. 2). Another wrote that virtual alternatives can compromise student learning: "Their quality simply isn‟t high enough to be an „alternative‟ ... and the knowledge retention by students following that route is nowhere near as good as what is experienced with dissections" (TQ #15, May 2010, p. 2). A third teacher said that virtual simulations lack excitement and are overly leading:

> The simulations for me are boring. I mean, they‟re good training tools, but they‟re no different than the textbook. They take you through the process in a more hands-on way, but it still isn‟t hands-on. It‟s like an oracle or something telling you what‟s going to happen. (TI #3, June 2010, p. 3)

Sixty-four teachers indicated that limited or outdated resources in their schools made it difficult for them to use alternatives, particularly computer-based ones. One teacher explained:

"We have tried a number of programs in the past … and found that our computer systems were too dated to run them, or if they ran, they were very unsatisfactory as an educational experience (rated by teachers and students)" (TQ #81, May 2010, p. 2). Another noted that "providing alternatives is a hassle as many schools do not have computers in the science rooms (students are not supervised if sent out) and finding alternatives that consistently work is very time-consuming" (TQ #77, May 2010, p. 4). It can be particularly time-consuming for teachers who lack professional development opportunities to help them in the selection and use of quality alternatives, as 21 teachers noted.

While many teachers considered alternatives more cost-effective than conducting a traditional dissection, 21 listed costs as a drawback. Although there are no costs associated with using the Ontario Ministry-licensed software *Froguts* that is available to all teachers in this research sample (OSAPAC, 2011), other alternatives, such an anatomical models, may be cost-prohibitive. One teacher, who disliked the lack of physicality associated with virtual dissection programs, wrote that "models instead of computers would be best, so that students still get a hands-on approach. I looked into those and they were around $300 each! Impossible to get a class set" (TQ #34, May 2010, p. 4). Others indicated that the need for computer upgrades or a lack of computers in the first place made alternatives too costly.

Student disinterest in alternatives was referenced by 10 teachers, some of whom labelled the alternatives "disappointing" or "boring" for students. Others (6) wrote that students" lack of emotional involvement with alternatives meant they could not develop an ethic of appreciation toward life. One teacher stressed that biology, as the study of life and death, *should* involve using real organisms for dissection to help students develop respect alongside skills and technique. Expressing his feelings toward virtual simulations, he wrote:

> They are not equivalent to actually dissecting an organism—the sensory experience is completely different. I also find that students demonstrate delicacy when dissecting as they realize that they are handling an actual organism which can be easily damaged. They

show respect for living things (I appreciate the irony here, since these are dead things!). (TQ #69, May 2010, p. 3)

Finally, two teachers explained that they did not want to teach using computers, and for that reason disliked alternatives. One teacher said she believed students spend enough time (or too much time) on computers already: "I personally do not enjoy using computers in the class. The students are wired enough and I prefer not to have to battle with the equipment," she wrote (TQ #133, May 2010, p. 2).

Discussion

More than 20 years ago, scientist and animal advocate Orlans (1988) argued it is time for teachers to "take a hard look at the use of dissection in the classroom, to review its history, to analyze its pros and cons, and to become familiar with educationally sound alternatives" (p. 37). The results of my research suggest educators *do* attribute pros and cons to dissection, holding mixed impressions of it. Yet despite this seemingly balanced perspective—and despite the fact that teachers associated a higher number of benefits with alternatives than with dissection (comparing Tables 1 and 3)—the predominant classroom practice of teachers in this sample was to use dissection as a primary teaching method and to use alternatives as supplemental teaching aids or options for students who do not dissect. With 94.1% (144 of 153 teachers) reporting conducting dissections in their classes and 56.3% of these (81 of 144) agreeing that "there are no substitutes for real animal dissection," it is evident the teachers in this study strongly favoured traditional dissection.

Madrazo (2002) writes that ethics are at the heart of the dissection debate, guided by the question of whether or not killing animals for an educational activity is justified. The findings of this research suggest that the ethics of dissection cannot be characterized in simplistic, polarized categories of "right" or "wrong," however. As participants articulated, ethical benefits and drawbacks can be associated with both dissecting *and* using alternatives (see Tables 1, 2, 3, 4).

For example, teachers characterized dissection as an opportunity to develop an ethical orientation toward animals *and* a problematic activity involving the unethical killing of animals; similarly, alternatives were described as both an ethical means to avoid killing animals *and* a technology that can hinder students from developing an ethic of appreciation toward animal life. That the ethics of dissection can be argued both ways complicates the assumption that teachers who dissect do not care about the ethical implications of the practice.

In spite of this, the issue of ethics remained low on teachers‟ lists of concerns with dissection. The animals‟ deaths (and whether they were humanely killed) ranked only fourth of their concerns, following concerns about student health and safety, classroom management, and costs (see Table 2). Given the low ranking of ethical concerns, it would appear that teachers are not engaging very deeply with the ethical dilemma dissection presents, including the reality that alternatives can alleviate the killing of animals. As Balcombe (2000) writes, there is an ethical question underlying the justification of killing animals to learn how they work, even if this is thought to be the best way to teach.

This ethical question gains momentum from a set of principles created to guide the ethical use of animals in science and education: the tenet of the “Three Rs,” introduced over 50 years ago by scientists William Russell and Rex Burch (Russell & Burch, 1959). The Three Rs guideline is an animal welfare initiative that pertains to the *replacement*, *reduction*, and *refinement* of harmful animal use in science and education. Today in Canada and internationally, the Three Rs are a recognized part of the culture of animal-based science and considered important from an ethical standpoint, given that research involving animals can cause them suffering, pain, distress, and death (Canadian Council of Animal Care, 2010; King, 2004; Robinson, 2005). An application of the Three Rs would likely lead to the full replacement of animals used in classroom dissections. The Canadian Council of Animal Care (2010) supports this in writing that:

> [T]he use of animals in science is acceptable ONLY if it promises to contribute to understanding of fundamental biological principles, or to the development of knowledge that can reasonably be expected to benefit humans, animals or the environment. Animals used for educational purposes are not being used to discover, prove or develop new ideas or techniques, but rather to demonstrate principles which are already well-known or to learn manual skills and techniques. Thus, before engaging in any discussions on the use of animals for the purposes of teaching, efforts should initially focus on finding a replacement alternative. (para. 1)

Overwhelmingly, the teachers in this study did not consider alternatives as adequate replacements for dissection. Although teachers did identify several benefits to using alternatives, they generally characterized them as inferior substitutes. The expressed belief that alternatives do not measure up pedagogically (see Table 4) is a possible reason why teachers are not shifting toward humane science education practices, such as those outlined by the Canadian Council of Animal Care. If so, this may be indicative that teachers lack knowledge of the scholarly research showing that student learning with virtual dissection programs can be comparable to a traditional dissection, particularly in terms of student knowledge acquisition and student ability to identify animal anatomy (HSUS, 2008; Kopec, 2002; Lalley et al., 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001). The overall conclusion of comparative research is that dissection alternatives can and do work, but the findings of this study suggest teachers continue to believe alternatives cannot measure up to a traditional dissection.

There are other reasons, beyond negative attitudes toward alternatives, why teachers may continue to dissect. Some participants reported experiencing barriers to the adoption or use of alternatives in the classroom, including limited or outdated technological resources, a lack of professional development to help them in the selection and use of quality alternatives, and budgetary constraints hindering their ability to purchase alternatives. These issues must be considered and addressed by schools, as they reflect institutional barriers to humane science.

Additionally, teachers need to be involved in discussions of humane science practices and why they are desirable, ethically progressive, and in keeping with international guidelines for animal-based research. These conversations should occur as a part of teacher education training and via professional development opportunities that familiarize pre-service teachers with dissection alternatives.

The overall finding of this study is that teachers continue to see conventional dissection as the best way students can learn, characterizing it as a hands-on practice that heightens student interest and demonstrates the complexity of biological organisms. It is undeniable that alternatives are not "the same" as conducting a traditional dissection, but this does not mean they are less pedagogically effective, and an important question remains as to whether dissection is ethically justified. From the standpoint of international guidelines for animal-based research, school-based dissections are not justified, and teachers need to consider this reality. This research demonstrates that the dissection debate is far from resolved in educational contexts, but in exploring teacher attitudes toward dissection and alternatives, a deeper picture emerges about the barriers and opportunities for moving toward more humane science practices.

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Dissection and Choice in the Science Classroom: Student Experiences, Teacher Responses, and a Critical Analysis of the Right to Refuse

Abstract: Choice in dissection has been characterized as an issue that intersects with teacher freedoms and student rights, sometimes resulting in a struggle between the two. This study investigated the experiences of former students (*n*=311) and teachers (*n*=153) in Ontario, Canada to determine (a) whether students are being offered a choice between participating in a dissection and using an alternative, and (b) the impressions students and teachers hold toward choice-in-dissection policies. Surveys and subsequent interviews with both groups revealed that teachers do not always offer choice. Further, while the majority of the student sample reported that they were in favour of choice policies, less than half of the teachers supported their implementation. A consideration of these findings from a critical pedagogy standpoint highlights power dynamics and a privileging of traditional dissection in the classroom. It is argued that choice policies are progressive and necessary to decentre dissection as the "best" way to learn.

Keywords: animal dissection, objection to dissection, choice policies, secondary school science education, critical pedagogy

Introduction

Animal dissection has come under considerable criticism in the past decades. With an estimated 10-12 million animals killed per year for dissections in American schools alone (Rosenberger, 1998), dissection raises deep questions about the ethics of harmful animal use in educational contexts. As a result, some have called for it to be discontinued at the classroom

level and replaced with alternative ways of learning (Balcombe, 2000; CCAC, 2010; Jukes & Chiuia, 2003; Marr, 2001; Nobis, 2002).

The controversies associated with dissection, and the fact that some students do not want to dissect for personal, ethical, cultural, or religious reasons, suggest that granting students choice in dissection is an important pedagogical practice. And, at first glance, it would appear that a pedagogy of choice is gaining popularity. One important indicator comes from the development of student choice policies that give students the right to opt out of dissection and use an alternative instead. These policies are currently legislated in five Canadian school boards (Vancouver School Board, Burnaby School District #41, Central Okanagan School District #23, Toronto District School Board, and South Shore District School Board) and in 10 American states (Florida, California, Pennsylvania, New York, Rhode Island, Illinois, Virginia, Oregon, New Jersey, and Vermont), while school districts in five other American states have passed resolutions that encourage teachers to provide alternatives to dissection (in Massachusetts, New Mexico, Maine, Maryland, and Nevada) (AAVS, 2011; Duncan, 2008; Frogs Are Cool, 2011; Kramer, 2007). A second indicator comes from the numerous dissection alternatives now available, including computerized virtual dissections, anatomical models, films, websites, and plastinated specimens, all of which implicitly support choice (Jukes & Chiuia, 2003; Smith & Smith, 2004). These developments suggest choice must exist, at some level, in at least some of today"s science classes.

I began to wonder, however, how consistently choice is being offered while investigating student responses to dissection and encountering a common narrative of students "going along" with dissection, even though they did not feel right about it (see for example Balcombe, 1997; Barr & Herzog, 2000; Solot & Arluke, 1997). This led me to question whether teachers are offering choice to students and whether that choice is being presented in a way that allows students to freely choose whether or not to dissect, without negative consequences. Aware that many teachers regard traditional dissection as the "best" way to learn and that dissection

continues today as much as (if not more than) it did 50 years ago (Hart, Wood, & Hart, 2008), I wondered how its privileged position connected to student choice.

This study examined teachers‟ practices, and former students‟ experiences, regarding choice in dissection. Drawn from a larger doctoral study (Oakley, 2011), this paper outlines statistical and narrative responses of former students (*n*=311) and teachers (*n*=153) in Ontario, Canada regarding (a) whether students are being offered a choice between participating in a dissection and using an alternative, and (b) the impressions students and teachers hold toward choice-in-dissection policies.

I approached the research from a standpoint of critical pedagogy, understood as teaching and learning practices aligned with developing students‟ critical consciousness (Freire, 1970; Giroux, 2001; McLaren, 1998). Recognizing that education is never politically neutral and always communicating particular ideologies that may re-entrench (or challenge) existing systems of inequality and power relations, critical pedagogy allows for a nuanced exploration of classroom dynamics while ensuring attention is given to political and axiological positions that stand outside of authoritative curricular norms. Schools are places in which political visions are constructed but they are also arenas of conflicting ideologies, and the controversies associated with dissection and choice showcase this struggle. In selecting this critical lens, I sought a starting point that did not assume dissection is the best way to learn, but rather that multiple possibilities for student learning exist and should be honoured.

Research Context and Design

The research was conducted over a six-month period in 2010 in Ontario, Canada. In Ontario, the Grade 10 science and Grade 11 biology curricula state that students are to conduct a physical dissection *or* a computer-simulated dissection to achieve designated learning outcomes (Ontario Ministry of Education, 2008a, 2008b). Based on this wording there is implied choice in the curricula, but the wording can be interpreted as meaning the choice is for teachers to make,

for students to make, or for both to make. In light of this ambiguity, I sought to gain insight into how Ontario curricula are being enacted and experienced.

Two sample populations participated in this study. The "student" sample (n=311) was comprised of former high school students: individuals aged 18-30, who had completed some or all of their high school science and biology classes in Ontario, and who were asked to reflect back on their schooling experiences in relation to dissection and choice. The teacher sample (n=153) was comprised of science and biology teachers who were teaching, or had previously taught, high school science or biology in Ontario. These two sample populations are separate and distinct groups—i.e., the student participants were not necessarily in the classrooms of the teacher participants—and as such, the results from the two groups do not speak to a shared experience. However, given that all participants reported on their experiences in Ontario high school science and/or biology classes, a picture emerges of some of the practices and perspectives within this geographic region. The findings cannot be generalized to other regions, however, given that curricular requirements differ by province and country.

I collected data in statistical and narrative forms. Statistical data was collected through two online surveys: a 25-question survey created for students (advertised via communications bulletins in Ontario universities, email advertisements, and word of mouth), and a 30-question survey created for teachers (advertised through the Science Teachers‟ Association of Ontario‟s newsletter and invitational emails sent to school boards and teachers in the province). Both surveys began with qualifying questions to ensure the participants formed part of the targeted demographics, then proceeded to ask participants to share their perspectives and experiences with animal dissection, objection to dissection (if applicable), and choice in the classroom. The questions were primarily in closed-ended formats, using checklists, "yes" or "no" (or other) answers, and five-point Likert scales. The descriptive statistics reported in this paper (see Tables 1 and 2) were analyzed by calculating percentages and frequencies of responses from the closed-ended questions.

To complement the statistical data, I collected narrative data through open-ended survey questions and comments fields, and through interviews with select individuals from the two sample populations. The interviews were facilitated by a question at the end of the surveys that asked participants if they would be willing to participate in a follow-up interview. From the pool of willing participants, I selected 12 students and 12 teachers to interview. The goal of the interviews was to obtain more depth of information regarding individuals‟ experiences and perspectives. Of the 24 individuals selected, 8 from the student sample (5 female, 3 male) and 9 from the teacher sample (4 female, 5 male) agreed to be interviewed.

The interviews were conducted by telephone, using a semi-structured interview guide. Participants were asked to share their experiences regarding choice in the classroom, including whether and how it was offered, and how they felt about choice-in-dissection policies. All interviews were transcribed and coded using line-by-line content analysis techniques, and the emergent themes were analyzed in relation to the descriptive statistics. This paper shares statistical and open-ended results from the combined pool of survey and interview data.

Findings

Dissection was found to be a common practice, according to the student and teacher groups, but it was also one marked by student objection and varied opinions on the necessity of offering students choice. Tables 1 and 2 outline statistics emerging from the surveys, providing a picture of some practices and perspectives pertaining to dissection, objection to dissection, and choice within the research samples.

Table 1 *Statistical Findings from Student Survey: Dissection, Objection, and Choice*
Percentage of students who reported being offered dissection in secondary school science classes: 94.8%
Percentage of students who agreed or strongly agreed that all students should experience a real animal dissection: 23.2%
Percentage of students who reported that their teacher held a classroom discussion on the ethics of dissection: 28.9%
Percentage of students who reported harbouring objections to dissection: 24%
Percentage of students who reported that their teachers gave them a choice to opt out of dissection: 60.8%
Percentage of students who agreed or strongly agreed that schools should have choice policies in place: 86.7%

Table 2 *Statistical Findings from Teacher Survey: Dissection, Objection, and Choice*
Percentage of teachers who reported using dissection as an instructional technique in secondary school science classes: 94.1%
Percentage of teachers who agreed or strongly agreed that all students should experience a real animal dissection: 57%
Percentage of teachers who reported holding classroom discussions with students on the ethics of dissection: 86.3%
Percentage of teachers who estimated objection rates to be between 1-5% in a typical class: 86.3%
Percentage of teachers who reported that they verbally advise students that they may opt out of dissection: 73.7%
Percentage of teachers who reported that student choice policies should be implemented in schools: 47.5%

The statistics suggest that while dissection is a common experience to both groups, the teacher group valued dissection considerably more than the student group. This was evidenced by more than half of the teachers (but less than a quarter of students) agreeing that all students should experience a real animal dissection. There was also a considerable discrepancy between the two groups" reported experiences with classroom discussions on the ethics of dissection: only 28.9% of the student sample reported that their teacher held a discussion on the ethics of dissection, whereas 86.3% of teachers reported holding such a discussion as part of their practice.

The data also revealed higher numbers of student objectors than teachers estimated. Among the teachers who reported offering dissection (144 of 153 teachers), 86.3% estimated objection rates to be between 1-5% in a typical classroom. Among the student sample a different finding emerged: 24% of the students who had been offered dissection reported that they harboured objections to it (71 of 295 students). However, harbouring objections to dissection did not necessarily translate into students *voicing* their opinions to their teachers: those who reported having objections were asked the follow-up question, "Did you inform your teacher that you did not wish to dissect?" and here only 54 of the 71 students (76%) said "Yes." Hence, there was a drop-off in which nearly a quarter of students who had objections did not speak about them.

More than half of the student sample (60.8%) reported being given the choice to opt out of dissection, and a higher percentage of the teacher sample (73.7%) indicated they offered choice in the classroom. Teachers were, however, less likely than students to support the implementation of a choice policy, which was defined in this study as "a written and openly declared policy that guarantees the right of students to refuse to participate in classroom activities and demonstrations that they find objectionable on the basis of personal, moral, ethical, or religious convictions, and ensures they have access without penalty to alternative learning methods, models, and approaches") (cf. Cunningham, 2000). Whereas 86.7% of students agreed or strongly agreed that schools should have policies to protect students‟ right to choose, only 47.5% of teachers supported their implementation.

Open-Ended Survey and Interview Data Analysis

The data emerging from the open-ended survey responses and interviews provided a more nuanced understanding of participants‟ experiences and perspectives. The following sections highlight participants‟ voices, speaking to themes of choice and choice policies.

On Choice in the Classroom

Whether students were offered a choice between dissecting and using an alternative was framed as a yes-or-no question on the teacher and student surveys. The open-ended data identified, however, that the ways teachers offer choice can differ dramatically: what counts as choice is not consistent from one classroom to the next. For example, while the statistical data showed a pattern of almost three out of four teachers saying they offer students choice (Table 2), five clear sub-themes emerged from the open-ended survey data elucidating how, or whether, choice was offered. These themes were: (a) that the "choice" or "alternative" some students were offered was to observe other students dissecting, (b) that some teachers offer choice conditionally, (c) that some teachers offer choice freely and provide an alternative for students to use, (d) that some teachers do not offer choice at all, and (e) that some teachers connect choice to grades.

The most commonly discussed theme in the open-ended data was that the "choice" students were offered involved pairing with another student, or joining a group of students, to watch them dissect. One student wrote of her classroom experience: "There was not really an alternative [offered] … if we did not want to dissect then we could join a group and just watch. But there were no alternatives like a CD" (SQ #258, March 2010, p. 2). Another noted that: "If we didn't want to dissect the animal we had to watch our other two group members do the project and instruct them what they were supposed to do" (SQ #117, March 2010, p. 2). Similarly, several teachers indicated that the "alternative" they offered students was to observe a dissection without hands-on participation. One teacher outlined her process of organizing dissections as follows:

> They [the students] usually work in groups of three … I always say, "Is there anybody here who is really excited about dissecting?" and they'll put up their hands. And then I'll say, "Is there anybody here who is really nervous about it?"—and I'll say, "Okay, look at the people who just put up their hands. Pair up with them," and separate them out that

> way. And what normally happens is I will have a few students that are like, "Oh, Mrs. [name], I don't know if I can do this, it's kind of gross, or I really don't believe in this." And I always have a discussion with them before we start the dissection, about how wonderful it is for them to have the opportunity to work on an animal, and how special that is, and how they should really respect the fact that this animal's life was given up for them to work on it. … I do tell students that they will have opportunity to voice their concerns to me, but I am pretty explicit—I do say, it is mandatory to take part in the dissection. It is not mandatory to pick up a pair of scissors and a scalpel and do any of the sectioning yourself, but it is mandatory to be part of a group. (TI #2, June 2010, pp. 1-2)

The second most commonly cited theme was that choice was offered to students conditionally. Some students and teachers explained that dissecting and using an alternative were not considered equal options in the classroom, and that students needed to provide justifiable reasons for not wanting to dissect. One student wrote: "We were told we didn't have to [dissect], but only for religious reasons or if your family were vegetarians or something... Not wanting to, or being squeamish wasn't an excuse" (SQ #140, March 2010, p. 2). Another wrote that in his class, opting out of a dissection was only allowed if a student felt ill:

> I do remember something about, like, if you're not comfortable, or if you feel sick, you don't have to participate or you can leave. But it was definitely not around spiritual or personal beliefs. It was more around actually physically getting sick. (SI #5, May 2010, p. 1)

Mirroring the student data, some teachers explained that students must provide a justifiable reason for not wanting to dissect. "I tell kids that if they have ethical, moral, religious, or other reasons they believe would prevent them from participating to come talk to me. We've always worked out some sort of compromise (e.g., being a hands-off observer)," one teacher wrote (TQ #69, May 2010, p. 2). Another outlined his process of asking students to gather information to defend their position if they do not want to dissect:

> I‟m always encouraging the kids … to question, to be skeptical as a good scientist should be, and to always ask questions and be informed. … I tell them, “If you have concerns, voice them. Ask questions. Be inclusive. Your opinion is valid and important, and you need answers.” … And often, if they have a belief that‟s very strong and opposite from what information I‟ve given them [about the value of dissection], I tell them, “Fantastic. Go and find me some reliable information to back up what you‟re saying, and show it to me and I‟ll gladly read it and we can talk about it.”… And on occasion I‟ve had kids do that, and then it gives another opportunity to show them how sources may not be reliable; or if they are reliable, are they applicable; and it keeps on going from there. (TI #1, June 2010, p. 4)

The third scenario outlined by students and teachers was that choice was clearly offered, without negative consequences, and an alternative was made available. One student wrote: “If people did not feel like participating my teachers were always accommodating. … [I]f it was a conflict of interest [to dissect] classmates were given models and visuals to aid in their learning process” (SQ #151 March 2010, p. 2). Similarly, some teachers indicated that offering choice was an important part of their pedagogy. One teacher who offered choice proactively explained that she gives students in her class several options:

> Students are allowed to opt out completely by not being in the room and being in the library on a computer, where they do virtual dissections or explain their dilemma through a thoughtful persuasive essay, or they may choose to observe others completing the dissection. They have complete choice of their level of involvement. (TQ #9, April 2010, p. 2)

The fourth most commonly cited theme was that choice was not offered at all. With 39.2% of students reporting they were not offered choice in the classroom and 26.3% of teachers saying they do not offer choice (Tables 1 and 2), several participants referenced this theme. One student explained:

> There wasn't an option. I went and asked my teacher. The thing is, where I was, at least at the time anyway, it was up to the teacher whether or not you could opt out. My sister went to the same school, and she had a different teacher, and they let people opt out, but I had the teacher that I had, and I went and asked and they said, "No, you have to participate." So everybody in our class had to do it. (SI #6, May 2010, p. 1)

Among the teachers who discussed their reasons for not giving choice, some expressed that they viewed conventional dissection as part of the curriculum and therefore saw no reason to offer choice. "If they don't want to dissect, take another course," one teacher wrote (TQ #20, May 2010, p. 4), while another opined that giving choice is a poor idea because "if you are taking a senior biology class, you should have to use dissection since it will be done at most universities. It is part of science research" (TQ #127, May 2010, p. 4). Some added that the choice outlined in the curriculum (that students will either conduct a physical or virtual dissection) was their choice to make as teachers. "Due to a teacher's *loco parentis* I believe it is OUR choice and the Ministry of Education to make the decisions for the science curriculum," one teacher commented (TQ #18, May 2010, p. 4).

Finally, complications around the interpretation of choice emerged from narrative data revealing that some teachers connected marks to student choice. Some students commented that their participation in a dissection was implicitly or explicitly tied to their grades: "[My teacher] told me I would lose 15% of my mark for not participating" one student wrote (SQ #222, March 2010, p. 4). Another noted that:

> I was told that if I took the alternative I would be marked harder and that she [the teacher] would purposely make it a harder assignment because she wanted us to do the actual dissection…. [she] made it known that it would be harder for me to receive a good grade if I chose the alternative. (SQ #196, March 2010, p. 4)

Two teachers in the study also indicated that they marked students differently based on whether they participated or used an alternative. One wrote: "I use the dissection as their FCA

[final course assignment], therefore if they decide not to do it, then they only lose 10% of their overall mark" (TQ #106, May 2010, p. 4). Another indicated that the alternative he offered was a particularly difficult assignment, and one that "most [students] really don't want to do. I don't make it a pleasant assignment, very specifically, especially at the senior levels" (TI #5, June 2010, p. 2).

On Student Choice Policies

The patterns in the narrative data pertaining to student choice policies largely reflected the statistical data, in which most students (86.7%) saw a place for choice policies in the classroom but slightly less than half of the teachers (47.5%) were in favour of their implementation (Tables 1 and 2). The majority of the open-ended student data outlined students' reasons for wanting choice policies, often connected to their classroom experiences and the reality that not every student was given choice unconditionally and some were not given a choice at all. The teacher data set was much more mixed, with many teachers explaining that they saw choice policies as unnecessary classroom legislation.

Several students commented that choice should be understood as a student's right, motivated by ethical or other reasons. "There are so many different variables that might affect a student's personal reasons [for not wanting to dissect] and whether they feel comfortable in the classroom," one student explained, adding that: "If people just find it gross, or if they find it unethical, then they should have the right to abstain from it" (SI #2, May 2010, p. 3). Others suggested choice policies were important to ensure that students who choose not to dissect are not punished for their decision: "It is not right to penalize them for them for not wishing to take part in this cruel practice (killing animals for dissection use). Now that it is 2010 there should be alternatives [made available]" (SQ #256, March 2010, p. 4).

Others framed choice policies as legislation that can ensure it is not uncomfortable or prohibitive for students to opt out of dissection. One student commented that since classroom

dynamics differ considerably, choice policies are especially important in classrooms where students may find it difficult to broach the topic with their teacher:

> I think it [student choice] should be a legal policy, because the classroom-to-classroom basis can change. If you have a really intimidating teacher, then you‟re not going to approach them about it, or you‟re less likely to approach them about it, so making it a legal policy ensures that students won‟t be affected by approaching their teacher. (SI #3, May 2010, p. 3)

Not all students saw value in choice policies, however. Among those who commented on their reasons for believing choice policies should not be implemented in the classroom, responses ranged from believing teachers will give options (sometimes based on personal experiences) to the opinion that choice policies should be "common sense" and are not necessarily "legal" in nature. One student explained:

> I think it shouldn‟t really be a legal thing. I think it should be made aware in any situation that like, the student does not have to do anything they don‟t want to, and that should be basically a given. It shouldn‟t have to be a legal thing, but it should just be common sense. (SI #8, May 2010, p. 3)

Less than half of the teachers reported that they saw value in adopting student choice policies, but among those who did, opinions were expressed that choice policies could help teachers open up a class conversation about why dissection is a controversial practice. One teacher wrote:

> Students need to be encouraged to be critical thinkers who question things—they should not blindly accept any idea presented to them. A student choice policy encourages this skepticism and challenging of norms, which is the basis of scientific progress. Hand in hand with this comes the skill of logically justifying beliefs, which is what students are encouraged to do when they question and challenge the status quo. (TQ #69, May 2010, p. 4)

Other teachers indicated that choice policies equate to respecting students‟ reasons for not wanting to participate in a dissection. “Students should never be forced to do something they find morally, ethically, religiously or personally objectionable,” one teacher wrote in support of choice policies, adding that: “Discussion [of choice policies] should allow a learning opportunity about other points of view” (TQ #83, May 2010, p. 5). Another teacher indicated that choice policies are relevant because student learning can be achieved in various ways, so there is no need to push a student to dissect if he or she is opposed to it:

> I find nothing problematic about the policy. You can bring a horse to water ... If the student doesn‟t want to engage, then so be it. I am always open to what is win/win and [if] a student [is] genuinely interested in learning, there has never been a problem finding a workable compromise. (TQ #133, May 2010, p. 4)

Of the teachers who did not agree with choice policies, some wrote the policies are unnecessary because students who object will speak their minds. “Quite frankly, the students who have objections are generally comfortable in speaking out” (TQ #5, April 2010, p. 4), one teacher wrote, while others suggested that students *should* undergo the process of speaking out against a curricular practice they are opposed to, as a goal of education is to develop critical thinkers who can express their perspectives. Some argued that policies usurp a teacher‟s responsibility to discuss the controversies associated with dissection and could in fact negate a classroom discussion about ethics and choice. “The whole concept of making it into a policy, to me, just eliminates my role as a teacher. Like, I‟m not allowed then to give the students opportunities to even present their agreement or disagreement?” one teacher asked (TI #5, June 2010, p. 4).

Another theme emerging from the teacher data was concern that choice policies would lead to too many students objecting without making an informed decision, as they might latch on to their first reaction—e.g., that they find dissection “gross”—and opt out because of it. One teacher wrote that “giving them options is not always productive to their education or their

development as scientists, good citizens, environmental stewards. They may choose not to participate in certain activities which are actually going to benefit them in ways they don‟t understand" (TI #1, June 2010, p. 6). Another characterized choice policies as:

> … a double-edged sword. Students‟ freedom of conscience must be respected, but, there are a LOT of students who don‟t WANT to do it but not for a defensible reason. An open "student choice" policy would be disastrous since it would essentially allow students the lazy way out. Life is not always easy and if students do not have the experience of facing up to challenges they‟re going to leave high school unprepared for adult relationships and decisions. (TQ #15, May 2010, p. 4)

The diverse perspectives surrounding choice policies demonstrate that students and teachers had different viewpoints on the issue of choice, and that within the teacher group in particular, there was no consensus on whether choice policies are relevant or necessary.

Discussion

A pressing concern from this study‟s findings is that not all students are explicitly offered choice in dissection, some are offered it only conditionally, and some are denied it altogether. These varied realities point to a need for standardized practices via choice-in-dissection policies. Choice policies are a progressive form of legislation that ensure that students who do not want to dissect are treated consistently and fairly, and that teachers are prepared to respond to those who object (Duncan, 2008; Kramer, 2007). A primary recommendation emerging from this study is thus for teachers to adopt formalized choice policies in their classrooms.

A formalized choice policy includes three components: (a) written and verbal components: students are informed verbally (e.g., through class discussion) and in writing (e.g., via a passage included in a course syllabus) that they do not have to dissect, that there is no penalty for choosing alternatives, and that a comparable alternative is available to them; (b) no demand on students to obtain parental consent to substantiate their choice; and (c) no expectation

on teachers to dissect, as the choice applies to both students and teachers (Balcombe, 2001; Duncan, 2008). In other words, choice must be communicated clearly to students (and teachers) and offered freely without conditions or negative consequences; further, a viable alternative must be made available. This "alternative" should not be for students to observe others dissecting, but for them to use an alternate way of learning to achieve the curricular learning outcomes.

Although choice policies can mean extra work for teachers in terms of selecting and procuring alternatives, there are multiple benefits to their adoption. One obvious benefit is that choice policies demonstrate respect for students' varied ethical, cultural, and religious backgrounds, ensuring their perspectives are honoured and not silenced in the classroom. As some teachers in this study noted, choice policies can provide an opportunity to open up class conversation about the controversies associated with dissection and the reasons why some people choose not to dissect. In doing so, they can offer a "teachable moment" to expose students to some of the proven alternate ways of learning about animal anatomy and physiology, without relying on killing animals. As numerous studies have shown, students can learn equally, and sometimes better, from performing a virtual dissection than from conducting a real one (Balcombe, 2003; Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001).

Choice policies are also consistent with progressive interpretations of the Ontario curriculum. Currently, the curriculum indicates that students are to perform either a physical dissection *or* a computer-simulated dissection; a literal interpretation of this wording would suggest that choice should be a regular pedagogical offering (Ontario Ministry of Education 2008a, 2008b). Further, the framework document intended to guide Canadian curricula, the *Common Framework of Science Learning Outcomes,* explicitly supports a differentiated teaching approach to scientific decision-making and encourages teachers to engage students in ways of learning that allow them to respond to socioscientific issues that are ethically complex and involve multiple solutions (CMEC, 1997). Given the ethical, social, pedagogical, and health and

environmental controversies associated with dissection (see Oakley, 2009), a one-style-fits-all practice is not in keeping with a differentiated teaching approach. Rather, it is a replication of traditional models of teaching that see the teacher as the ultimate authority figure who decides how, what, and when students learn, while students are positioned as "vessels" to be filled with the uncontestable knowledge of the teacher (Freire, 1970).

Choice policies model the reality that not all students respond to dissection in the same way. They also communicate to student objectors that their values have relevance in the scientific world and that a commitment to avoiding harmful animal use is laudable. As Kramer (2007) writes, choice policies open up the door to a new generation of scientists who, from their earliest learnings and first exposure to animal-based research, "approach science as an intrinsically humane process that neither wastes nor abuses animal life" (p. 286). This approach is also in keeping with commitments from the international scientific community toward the "Three Rs" of *replacing, reducing,* and *refining* harmful animal use in scientific and educational contexts (Russell & Burch, 1959; Hart et al., 2008; King, 2004; Smith & Smith, 2004). The adoption of choice policies would bring schools in line with the most progressive ethical standards of the scientific community.

From a critical pedagogy standpoint, choice policies support a classroom in which the power of the teacher is mitigated in favour of an environment where the teacher and students co-construct meaning together. As Kincheloe (2005) writes, "any time teachers develop a pedagogy, they are concurrently constructing a political vision" (p. 9), which speaks to the nature of education as intimately bound with politics and power. In this research it was evident that some teachers wield power by deciding how the dissection curriculum will be enacted, but choice policies can mollify these power dynamics by respecting students‟ perspectives and encouraging them to come to a critical consciousness by making choices based on their value systems. With the teacher acting as facilitator, students can engage with the various political positions that

surround dissection and practice skepticism by asking if dissection is the only, or best way, for them to learn.

Ultimately, choice policies are a middle-of-the-road approach. They do not impede on teachers‟ freedom to continue offering dissection, but ensure that students with ethical, cultural, or religious objections are given alternate and equivalent ways to achieve curricular goals. The findings of this research point to the importance of choice policies, given students‟ uneven classroom experiences and teachers‟ varied practices. Without a standardized approach in place, it is likely that choice will continue be offered haphazardly, with conscientious teachers incorporating it into their teaching while others eschew it or offer it only conditionally. The need for choice policies is evident, as the policies equate to respecting students as moral agents and treating them fairly and consistently. After all, why should some students have the right to refuse dissection, while others do not?

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Concluding Thoughts on the Research Articles and Directions for Future Writing

As discussed at the beginning of this chapter, a significant amount of data was collected for this study, much more than could be addressed or summarized in three research articles. Writing for particular journals meant that the conventions of each journal (e.g., pertaining to length and style) needed to be followed and the specific audiences of each journal kept in mind, which influenced the choices I made and the directions I pursued. Of course, making choices that lead writing in one direction means other possibilities are left unaddressed. In this final section of the chapter, I briefly discuss salient themes in the data that were *not* addressed in the articles but that represent directions for future research and writing. I also include some of the "raw" data from the student and teacher questionnaire—a 14-item Likert scale from each—that is not analyzed but included as a data set that illustrates participants" attitudes and could be the focus of future writing.

One of the prominent themes in the data that deserves further exploration is gender. Clearly, there is a gendered focus to this study, given the previously discussed realities that (a) opposition to animal-based research is rooted in feminist histories (e.g., Buettinger, 1997; Lansbury, 1985; Rose, 1995), (b) contemporarily, females object to animal-based research, including dissection, more so than males (Hagelin, Carlsson, & Hau, 2003; Phillips & McCulloch, 2005; Pifer, 1994; Plous, 1996), and (c) there was a significant gender skew in this research, as 249 of the 311 student participants and 98 of the 153 teacher participants were female. In considering these factors, it is evident that this study could be framed within feminist literatures that outline, for example, the masculinist bias pervading the science tradition and what a feminist science might entail (e.g., Birke, 1999; Haraway, 1988; Harding; 1991), as well as the enduring linkages between women and animal advocacy (e.g., Gaarder, 2011).

A feminist approach to this research would involve analyzing gender as a theme in the data. This theme was evident in several participants" comments. For example, one student wrote: "I … was intimidated to object [to dissection] because I thought I would be labelled as weak or

„girly‟" (SQ #36, March 2010, p. 2). Another opined that "there‟s definitely gender dynamics playing out" during classroom dissections, and added that for him, these dynamics made it difficult to understand the nature of his participation: "I don‟t know if I was doing it authentically or doing it to fill a [gendered] role," he explained (SI #5, May 2010, p. 3). Other students referenced gender in relation to student misbehaviour and animal mutilation. One student wrote: "Students (namely boys) were not given instruction on the appropriate behaviours when dissecting the pig—therefore leading to them cutting out eyeballs, treating the fetal pig‟s body in [a] disrespectful manner" (SQ #135, March 2010, p. 2). Another noted that during a frog dissection in her class, "some of the boys were … ripping the parts out and were throwing them around and laughing" (SI #1, May 2010, p. 2).

Teachers, as well, referenced gendered dynamics, especially in relation to the disproportionate number of female objectors. In this study, 83.6% of teachers reported that more than half of all objectors in their classrooms were female, and 43.1% of teachers estimated that females comprised 91-100% of all objectors. These, and other gender-related themes in the data, could be explored to further an understanding of how science, animal dissection, and animal advocacy remain gendered practices.

A second theme in the data worth exploring is teachers‟ experiences with dissection alternatives. I address this in a limited way in the second research article ("Science Teachers and the Dissection Debate: Perspectives on Animal Dissection and Alternatives"), but a more detailed exploration of *how* teachers are using alternatives, and *what* alternatives they are using and why, could be generative. For example, although a dominant finding of this research was that most teachers continue to use dissection as a primary instructional technique, not all teachers use dissection, and the often-subjugated perspectives of those who choose not to dissect are important to examine. How do teachers who do not dissect meet curricular outcomes? Why do they choose not to dissect? What are their experiences in the context of a science education culture in which traditional dissection is often favoured? Exploring these and other related

questions would be in keeping with the theme of resistance that characterizes the first research article I wrote ("I Didn't Feel Right About Animal Dissection: Dissection Objectors Share Their Science Class Experiences"), and could outline practical possibilities for teachers who do not want to dissect.

In this research, teachers discussed their use of mainstreamed alternatives such as virtual dissection software and 3D anatomical models, but some teachers also referenced using less conventional alternatives, such as conducting field trips (or virtual field trips) for students, using dissection picture cards, and asking students to build 3D anatomical models out of clay or create a board game illustrating their understanding of anatomy and physiology. Investigating these possibilities further could also be topical from a humane education standpoint, given the humane goal of replacing consumptive animal use in the classroom.

A third theme that is evident, yet not addressed in this study, concerns the "haunting presence of the animal" (Connie Russell, personal communication, 2011) that underlies this research. Animals are centrally and corporeally embedded in the controversies of dissection, and as such they are integral stakeholders in this discussion. While this research is rooted in the human community and focused on human responses and resistance to dissection, the "dissection debate" cannot be fully taken up in exclusion of a consideration of animals. Buyukmihci (1991) highlights this in writing that "one must keep in mind that there always is a third, interested and unwilling participant in this scenario: the non-human animal who is to have her or his life destroyed" (p. 3).

In Chapter 2 I sought to bring animals into the conversation through a brief discussion of ways they are procured and "prepared" for dissection. The research responding to these histories is quite limited, however, as is information from biological supply companies regarding the procurement of animals. Nonetheless, in future writing I would like to include animals more explicitly, perhaps by employing a posthumanist perspective (e.g., Castricano, 2008; Pedersen, 2010; Wolfe, 2010) or by considering the interspecies dynamics at play between humans and

other animals in dissection practices. I have situated this study within humane education and critical pedagogy frameworks that encompass animals in visions of social and educational justice, yet I recognize that the animals are, paradoxically, "missing" from the discussion at the same time. To this end, a possible direction for future writing would be to revisit the data through an approach that recognizes and honours animals' centrality in the research.

Finally, there was a considerable amount of data collected for this study that was not reported upon in the three research articles in this chapter. As such, there is an opportunity to analyze this data, descriptively and inferentially, in future writing. For example, the following Likert scale data, taken from the student and teacher questionnaires respectively, offer insights into the perspectives of both sample populations in this study. These charts follow in their "raw" format as examples of data ripe for further analysis.

Student Questionnaire Likert Scale Results

Student Questionnaire

Please indicate the strength of your agreement with the following statements, using the five-point scale where **1=strong agreement** and **5=strong disagreement** with a particular statement.

	1 (strong agreement)	**2**	**3**	**4**	**5** (strong disagreement)	Rating average	Response count
(a) I find dissection interesting.	34.8% (105)	21.9% (66)	16.6% (50)	11.6% (35)	15.2% (46)	2.51	302
(b) All students should experience a real animal dissection.	8.6% (26)	14.6% (44)	27.9% (84)	18.9% (57)	29.9% (90)	3.47	301
(c) Students should have the right to refuse to perform dissections based on personal, ethical, cultural, religious, or environmental beliefs.	79.5% (241)	8.6% (26)	4.3% (13)	3.6% (11)	4.0% (12)	1.44	303
(d) I am opposed to animal dissection due to personal, ethical, cultural, religious, or environmental beliefs.	14.9% (45)	13.6% (41)	20.9% (63)	18.5% (56)	32.1% (97)	3.39	302
(e) A student who does not dissect should still be able to pass the course if the student is willing to do alternative work.	83.1% (250)	9.6% (29)	3.3% (10)	1.3% (4)	2.7% (8)	1.31	301
(f) Schools should have policies to protect students' right to choose whether or not to dissect.	71.4% (215)	15.3% (46)	8.3% (25)	4.0% (12)	1.0% (3)	1.48	301
(g) The objectives of dissection can be met with either a real or virtual dissection.	44.0% (133)	26.2% (79)	20.5% (62)	7.0% (21)	2.3% (7)	1.97	302
(h) Students who perform a real animal dissection will have a better knowledge of animal anatomy and physiology than those who use an alternative.	14.6% (44)	23.3% (70)	25.9% (78)	16.9% (51)	19.3% (58)	3.03	301

(i) Students who perform a real animal dissection will be better prepared for post-secondary studies in biology.	17.9% (54)	21.2% (64)	28.8% (87)	13.2% (40)	18.9% (57)	2.94	302
(j) Alternatives should be used in place of real dissection.	28.1% (85)	17.2% (52)	30.4% (92)	17.2% (52)	7.3% (22)	2.58	303
(k) I am concerned about where classroom lab animals come from.	34.8% (105)	23.8% (72)	20.9% (63)	11.6% (35)	8.9% (27)	2.36	302
(l) Animals should not be killed for school dissections.	50.2% (151)	14.0% (42)	18.6% (56)	8.3% (25)	9.0% (27)	2.12	301
(m) Watching another person dissect is an acceptable alternative for students who do not wish to dissect.	28.7% (87)	27.4% (83)	23.4% (71)	8.6% (26)	11.9% (36)	2.48	303
(n) Animal dissection should not be taught in high school.	13.2% (40)	6.0% (18)	22.5% (68)	23.8% (72)	34.4% (104)	3.60	302

Teacher Questionnaire Likert Scale Results

Teacher Questionnaire

Please indicate the strength of your agreement with the following statements, using the five-point scale where **1=strong agreement** and **5=strong disagreement** with a particular statement. NA=not applicable to your teaching experience.

	1 (strong agreement)	**2**	**3**	**4**	**5** (strong disagreement)	**N/A**	**Rating average**	**Response count**
(a) Real animal dissection is important to the teaching of biology.	50.0% (72)	37.5% (54)	6.9% (10)	2.8% (4)	2.8% (4)	0.0% (0)	1.71	144
(b) There are no substitutes for real animal dissections.	29.2% (42)	27.1% (39)	18.8% (27)	16.7% (24)	8.3% (12)	0.0% (0)	2.48	144
(c) All students should experience a real animal dissection.	27.8% (40)	29.2% (42)	22.2% (32)	12.5% (18)	8.3% (12)	0.0% (0)	2.44	144
(d) Dissection interests my students.	74.3% (107)	20.1% (29)	4.2% (6)	0.0% (0)	1.4% (2)	0.0% (0)	1.34	144
(e) Dissection is too expensive and/or time-consuming.	4.2% (6)	7.6% (11)	20.8% (30)	29.9% (43)	36.1% (52)	1.4% (2)	3.87	144
(f) I am concerned with where classroom lab animals come from.	15.3% (22)	27.8% (40)	16.7% (24)	18.8% (27)	21.5% (31)	0.0% (0)	3.03	144
(g) I am concerned about what dissection may teach students about the value of animal life.	9.8% (14)	16.8% (24)	11.2% (16)	27.3% (39)	34.3% (49)	0.7% (1)	3.60	143
(h) Alternatives should be used in place of real animal dissection.	3.5% (5)	6.3% (9)	25.7% (37)	25.7% (37)	37.5% (54)	1.4% (2)	3.89	144
(i) The objectives of dissection can be met with either a real or a virtual dissection.	9.9% (14)	19.7% (28)	19.0% (27)	28.9% (41)	22.5% (32)	0.0% (0)	3.35	142

(j) Students who perform animal dissections can better meet the curricular outcomes than students who use an alternative.	18.2% (26)	25.2% (36)	28.7% (41)	18.9% (27)	8.4% (12)	0.7% (1)	2.74	143
(k) Animal dissection should not be taught in high school.	1.4% (2)	1.4% (2)	10.5% (15)	14.7% (21)	69.9% (100)	2.1% (3)	4.54	143
(l) Assuming available resources, I would consider using a virtual dissection as a substitute for real animal dissection.	8.3% (12)	22.2% (32)	18.1% (26)	23.6% (34)	26.4% (38)	1.4% (2)	3.38	144
(m) Dissection alternatives interest my students.	2.1% (3)	17.4% (25)	31.9% (46)	28.5% (41)	18.1% (26)	2.1% (3)	3.44	144
(n) Dissection should not be part of the curriculum.	2.1% (3)	1.4% (2)	10.4% (15)	14.6% (21)	70.1% (101)	1.4% (2)	4.51	144

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CHAPTER 4

RECOMMENDATIONS EMERGING FROM THIS STUDY

Nine recommendations emerged from this study, targeted toward the research stakeholders: teachers, schools, school boards, school trustees, curriculum developers, Faculties of Education, Ministries of Education, students, researchers, humane educators, humane societies, and other animal advocacy organizations. These recommendations emerged from the analysis of the research data and, in some instances, ideas uncovered in the literature review or revealed through the theoretical framework. Some of the recommendations are discussed in the scholarly articles in Chapter 3; this chapter outlines them individually and brings them together here. All recommendations are offered in the spirit of helping to inform classroom protocol and policy surrounding animal dissection, objection to dissection, and student choice.

1. Teachers Should Understand Objection as a Student's Right

Student objection to dissection has been legally contextualized as a student‟s right, grounded in freedom of religion or a comparable compelling reason such as a student‟s ethical orientation toward animals (Beauchamp, Orlans, Dresser, Morton, & Gluck, 2008; Kramer, 2007). Examples of American legal cases where students challenged mandatory dissection in schools reveal that students have grounds for making a claim against their schools, and plaintiffs can and do prevail in such instances (Kramer, 2007). Although no legal precedent regarding choice in dissection has been set in Canada, it is possible that a student could successfully pursue legal protection if his or her right to refuse dissection was not honoured. Given that five Canadian school boards have adopted legislation to guarantee a student‟s right to choose, it is probable a student‟s objection to dissection would be upheld as her or his right if grounded in ethical, cultural, or religious reasoning.

Regardless of legal precedent, it is important for teachers to honour student objection and understand it as intertwined with students‟ identities and worldviews. The research revealed that a not-inconsiderable number of students in this study reported objecting to dissection (71 of 295 students who were offered it, or 24%). These individuals characterized their objection as based in reasons described as: personal (80.3%), animal rights (71.8%), ethical or moral (60.6%), environmental (33.8%), religious (4.2%), and cultural (4.2%). For most students, then, objecting to dissection and wanting to opt out was not, as some teachers suggested, a route for "lazy" students to avoid work. In addition, the nature of this study‟s research design, in which students were asked to reflect back on their classroom experiences, confirmed that many of the students who objected were not simply "going through a phase." On the contrary, many contextualized their objection as part of their identity and part of a worldview that has remained consistent or deepened over time in relation to issues of animal rights, cultural or religious worldviews, and/or environmental concerns.

Educators therefore need to take student objection to dissection seriously. Respecting students as moral agents means honouring the choices they make about dissection and providing choice in the first place. The need to respect students‟ reasons for objecting is paramount, and given that alternatives can be used to achieve curricular outcomes, there should be no classroom struggle between students and teachers in this regard. Teachers should consider that students who object to dissection are often conscientious people who are thinking critically and challenging the status quo, and they can demonstrate the value of this perspective through the provision of alternatives and choice.

2. School Boards Should Adopt Student Choice Policies

A student choice policy is a policy that supports:

> the right of students to refuse to participate in classroom activities and demonstrations… that they find objectionable on the basis of personal moral, ethical, or religious

> convictions… [and] to have access without penalty to alternative learning methods, models, and approaches that do not involve the caging and confinement, manipulation, or death of an animal. (Cunningham, 2000, p. 192)

Following the suggestions of Balcombe (2000) and Duncan (2008), a model choice policy includes three components: (a) written and verbal components—students are informed verbally (e.g., through class discussion) and in writing (e.g., via a passage included in a course syllabus) that they do not have to dissect, that there is no penalty for choosing alternatives, and that a comparable alternative is available to them; (b) no demand on students to obtain parental consent to substantiate their choice; and (c) no expectation on teachers to dissect, as the choice applies to both students and teachers. Put another way, choice should be made very clear to students (and teachers) in science classes, and students should be allowed to make the decision on their own without having to justify or "prove" their reasoning to their teacher.

At present, choice policies are distributed unevenly across Canada. Five school boards have adopted legislation to protect students' right to choose: Vancouver School Board (Vancouver, British Columbia), Burnaby School District #41 (Burnaby, British Columbia), Central Okanagan School District #23 (Kelowna, British Columbia), Toronto District School Board (Toronto, Ontario), and South Shore District School Board (South Shore, Nova Scotia) (Frogs Are Cool, 2011). In other Canadian school boards there is no legislation in place, meaning it is up to teachers to determine how and whether to offer choice. This research demonstrates that leaving the matter to teachers' discretion is problematic, however, because not all teachers offer choice explicitly and some deny it altogether. This was supported by findings from the student data (in which 39.2% of students said they were not given an option to not participate in a dissection) and the teacher data (in which 73.7% of teachers indicated they *do* advise students verbally that they may opt out of dissection; by extension, 26.3% of teachers do not explicitly offer choice). Further, the data revealed that what counted as "choice," and when choice was awarded, varied significantly from one classroom to the next. The uneven practices in relation to

choice highlight the need for standardized practices and, specifically, for school boards to adopt and legislate choice policies.

3. Secondary School Science Education Should Adhere to the Principle of the Three Rs

The Three Rs principle, pertaining to the *replacement*, *reduction*, and *refinement* of harmful animal use in scientific and educational contexts, forms the basis of progressive, humane science practice. Introduced by Russell and Burch in 1959, the Three Rs principle has been accepted internationally as a humane guideline for animal use in science and education (Hart, Wood, & Hart, 2008; King, 2004; Smith & Smith, 2004). Schools should not be exempt from the Three Rs but rather should embrace possibilities for replacing, reducing, and/or refining techniques related to harmful animal use. This would communicate a positive message of accountability to students while bringing schools in adherence with the most progressive principles of the scientific community.

An application of the Three Rs would likely lead to the replacement of harmful animal use in classroom dissections. The Canadian Council of Animal Care supports this in writing that "animals used for educational purposes are not being used to discover, prove or develop new ideas or techniques, but rather to demonstrate principles which are already well-known or to learn manual skills and techniques"; therefore, "before engaging in any discussions on the use of animals for the purposes of teaching, efforts should initially focus on finding a replacement alternative" (CCAC, 2010, para. 1). Replacement alternatives could refer to non-animal ways of learning (e.g., virtual dissection software or other computer-based resources, 3D models, charts, films) and/or ethically sourced animal cadavers obtained from educational memorial programs that sell the bodies of animals that have died of natural causes (EMP, 2011). Several studies have shown that using virtual alternatives can be comparable or even superior to traditional dissection in school-based contexts (Kopec, 2002; Lalley, Piotrowski, Battaglia, Brophy, & Chugh, 2010; Maloney, 2005; Montgomery, 2008; Youngblut, 2001); therefore, student learning need not

suffer if alternatives are used.

Teachers who choose not to replace animal dissection could focus on *reducing* the number of animals used and *refining* their practices to avoid harmful animal use. Reducing the number of animals used in the classroom could be achieved by (a) arranging students in small groups to share a cadaver, (b) reserving dissection for those who have made a commitment to pursuing the life sciences in post-secondary education, or (c) having one dissection per class (e.g., the teacher modelling a dissection). The practice of reducing the number of animals used was mentioned by many teachers in this research, albeit primarily for budgetary reasons. Teachers could further consider modes of reducing animal use through adherence to the Three Rs principle. They could also consider refining their practices to minimize animal cruelty and harm—again, this could be achieved by using replacement alternatives or ethically sourced animal cadavers.

Orlans (1993) writes that within the scientific community, animal experiments are not all equally justified. Some factors to consider in judging the validity of the research include infringements to the animal (including death), the purpose of the experiment (e.g., to obtain original knowledge, to test products, for pedagogical purposes), the competency of the experimenter, the quality of facility and resources where the work is done, the application of the Three Rs, and public accountability. In considering classroom dissections against this criteria, it is evident this is one area of animal-based research that could be replaced, reduced, and refined with humane practices. In the spirit of humane science, teacher should consider why a transition to alternatives is ethically sound and in keeping with the most progressive principles of the scientific community.

4. The Science Classroom Paradigm Should Switch from Students "Opting Out" to "Opting In" to Dissection

Dissection is frequently framed as a "normal" classroom practice in which all students will participate, unless they opt out. This paradigm positions dissection as an uncontested part of the curriculum, while students who choose not to dissect are discursively framed as "objectors." Students who object must then negotiate with their teacher to obtain an "alternative" way of learning. This very language—of "opting out," "student objectors," and "alternatives"—highlights how dissection is characterized as a *de facto* classroom practice and objection is marked as a process through which students must advocate, on their own behalf, to secure a different, non-animal way of learning.

For many reasons, it is problematic to frame dissection as the norm, particularly for students who do not want to dissect. It is clear from this research that the process of objecting was, for some students, intimidating or uncomfortable as they tried to step outside of the curriculum presented to them. Some worried they would be viewed as "troublemakers" by their teachers; others reported that their perspectives were marginalized or belittled. For some objectors, the onus was on them to explain their position, creating an uneven classroom dynamic in which the students who did not want to dissect were effectively singled out in a way that their dissecting peers were not. Student objectors who expressed their concerns to teachers also reported experiencing a wide range of teacher responses, including pressure to participate, the request to join another group of students and observe a dissection, the choice to use a dissection alternative, warnings of compromised grades, and being asked to find their own alternative. These varied responses demonstrate that when dissection is framed as a "normal" practice and no standardized protocol is in place for objection, classroom experiences are mixed, along with teacher responses to those who object.

A reversed classroom paradigm in which students who want to dissect "opt in" to the practice—rather than students who *do not* want to dissect having to "opt out"—would mean

there is no expectation on students to dissect. This would eliminate the above-listed problems experienced by students who have undergone the process (successfully or not) of "opting out." A reversed paradigm would also work to guarantee students' right to object to dissection (recommendation 1) through standardized classroom procedures involving student choice (recommendation 2), and could contribute to an adherence to the Three Rs (recommendation 3), as it could result in a reduction in the numbers of animals used.

The language of "alternatives to dissection" also reinforces physical dissection as the normal, original practice against which non-dissecting ways of learning are measured. At present, the ways in which dissection is discursively positioned as a dominant practice is evidenced by the language used: students must "opt out" of dissection and ask for an "alternative" way of learning. Having students "opt in" to dissection following a class discussion, or for them to pick from two (or more) "equal choices" in learning (Tim Battle, Alberta SPCA, personal communication, 2010), would represent small linguistic shifts that would avoid positioning dissection as the norm and student objectors as a fringe minority, while explicitly recognizing that there is more than one valid way that students can learn.

5. Curriculum Developers Should Provide Direction in Curricular Documents Pertaining to Dissection Practices

At present, the pan-Canadian *Common Framework of Science Learning Outcomes* (CMEC, 1997) and the Ontario Grade 10 science and Grade 11 biology curricular documents (Ontario Ministry of Education, 2008a, 2008b) do not provide teacher guidance regarding classroom dissection practices, processes for addressing objection, or the implementation of choice. The current wording in the curricula state that students will conduct a laboratory or computer-simulated dissection, or use a mounted anatomical model, to meet particular learning outcomes, but teachers are on their own to interpret what this means vis-à-vis classroom protocol. This study found that teachers are interpreting the curriculum in diverse ways. Some

interpret it as meaning they must offer choice to students, while others believe the curriculum is communicating that the decision of teaching methodology is theirs to make.

That teachers have disparate practices in relation to student choice points to a specific need in Ontario for curriculum developers to clarify the wording to communicate explicitly that (a) choice must be part of teachers‟ classroom practice, and (b) dissection alternatives must be made available. Other areas to be addressed in curricular and resource documents include discussion of the ethical, cultural, religious, and environmental concerns associated with dissection, the proven efficacy of virtual alternatives, and guidelines for developing and implementing student choice policies (see recommendations 1, 2, and 3).

6. Faculties of Education Should Provide Training with Dissection Alternatives to Science Teacher Candidates

Some of the teachers who participated in this study indicated they received no training with dissection alternatives in their teacher education programs, and thus had no exposure to alternatives prior to becoming a teacher. For those who have been teaching two or more decades, this is not surprising, given that technological alternatives such as virtual dissection programs were in their infancy in the 1980s and 1990s and were largely unsophisticated at that time. Today, however, a proliferation of sophisticated virtual dissection programs and other types of alternatives have come to market. The existence of these alternatives, combined with the reality that most teachers who dissect experience student objection, highlights the need for science teacher candidates to receive training with alternatives. Balcombe (2000) suggests that teachers continue the tradition of dissection by primarily teaching the way they were taught; if this is the case, a shift toward the incorporation of dissection alternatives in the classroom requires a shift in teacher education programs as well.

In Ontario, a logical starting point for science teacher candidates would be to train with the virtual dissection software *Froguts.* This is the software for which the Ontario Ministry of

Education has an all-school site license (OSAPAC, 2011). Beyond this, other alternatives including low-tech and no-tech options (e.g., films, slides, and 3D anatomical models) could be explored.

Addressing dissection alternatives in teacher training programs could help to dispel the myth that technological alternatives are pedagogically inferior, a belief expressed by more than half of the teachers in this study. An exploration of alternatives could also open dialogue about the dissection debate and its associated controversies, as well as discussions of classroom protocol for responding to student objectors (recommendation 1), implementing student choice policies (recommendation 2), and the relevance of pursuing humane science practices (recommendation 3). Equally important to address is the *culture* in science education departments, as 12.9% of the teachers in this study indicated there was an expectation in their schools or departments that they will dissect. Providing training with dissection alternatives could work toward interrogating this culture by taking a differentiated learning approach to scientific decision-making, as supported by the *Common Framework of Science Learning Outcomes* (CMEC, 1997). In sum, teacher candidates need opportunities to practice and train with dissection alternatives, and to discuss concerns with dissection and its contested place in the curriculum.

7. Teachers Require Institutional Support in Selecting, Procuring, and Using Appropriate Dissection Alternatives

In conjunction with the previous recommendation, science and biology teachers require support in selecting, procuring, and using alternatives in their classrooms. This research found that the institutional support teachers receive varies considerably, influenced by available budgets and technology, the presence or absence of professional development opportunities, and the culture of individual science departments. For some teachers, available supports and resources in their schools were insufficient: 51.6% of teachers reported that limited school

resources (e.g., computers) made it difficult for them to use alternatives, 16.9% indicated that there was a lack of information/professional development opportunities to help them in the selection of alternatives, and 12.1% indicated that there was a lack of information/professional development opportunities to help them learn how to use alternatives. Others cited declining budgets that made it difficult for them to purchase alternatives, or that their computer equipment was too outdated to use sophisticated software. These are obvious impediments to humane science practices.

Support from school boards and professional development initiatives spearheaded by the Ministry are needed to train teachers in the use of dissection alternatives and their efficacy. Teachers need to be aware of the various types of alternatives available, as well as the organizations, databases, and journals that provide reviews of them (e.g., InterNICHE, NORINA, *The American Biology Teacher*). Budgetary supports are also needed to ensure alternatives can be purchased; this could entail allocating a portion of science department budgets for the procurement of suitable alternatives (e.g., some of the funding that would otherwise be allocated to purchasing specimens for a traditional dissection). Given that alternatives can be re-used year after year, over time dissection alternatives can actually cost schools less (PCRM, 2004), which should be incentive for schools to invest. It should also be noted that teachers do not necessarily need to use technological alternatives: some creative possibilities that emerged from this research included asking students to create a board game of anatomy questions, or to re-create the anatomical systems of animals with modelling clay.

For some teachers, transitioning to alternatives or using alternatives in conjunction with traditional dissection is complicated because it requires an investment of their time and energy to find suitable alternatives, implement them in the classroom, and evaluate student performance with them. An institutional commitment and Ministry-level commitment is therefore necessary to ensure teachers are appropriately supported in pursuing humane science practices.

8. Researchers Should Contextualize Student Choice as an Intersecting Social Justice/ Science Education Issue

The literature supporting this research and the data collected in this study reveal that student choice, and the associated politics of animal dissection, intersect with issues of social justice and science education. Choice in dissection can be contextualized as a social justice issue because it implicates students‟ personal, ethical, and religious belief systems, their cultural values, their identities, and their enacted relationships with other species. Further, as practices emerging from and connected to science education, dissection and choice are conceptually linked with other areas of pedagogical research, including research related to teacher identity, the culture of science education, pre-service science teacher education, differentiated instruction, controversy in the classroom, curriculum development, and educational policy.

Researchers investigating animal dissection and choice may wish to focus on some of these intersecting variables while situating their research in a network of social, pedagogical, cultural, and political contexts. Multiple theoretical frameworks could be drawn upon to this end—for example, while this study was informed by humane and critical pedagogy theories, other frameworks such as posthumanism, poststructuralism, feminism, or critical animal studies (to name some possibilities) could also be productively employed. Hence, a recommendation emerging from this study is for researchers to remain open to the multi-faceted nature of this topic and to consider the diverse network of variables in relation to questions of dissection, objection to dissection, and student choice.

9. Continued Dialogue Is Needed Amongst Stakeholders Regarding the Politics of Animal Dissection and Responses to Student Objection

Given the many controversies and tensions associated with dissection, including the diverse experiences and perspectives reported by students and teachers in this research, it is evident further dialogue is needed among the stakeholders who are implicated in issues of animal

dissection and student choice. As noted at the beginning of this chapter, these stakeholders include students, teachers, science teacher candidates, schools, school boards, school trustees, curriculum developers, Faculties of Education, Ministries of Education, researchers, humane educators, humane societies, and animal advocacy organizations. Dialogue is needed amongst them to address each of the issues and recommendations summarized in this chapter, including student freedoms and the right to object to dissection (recommendation 1), the adoption of choice policies (recommendation 2), adherence to the principle of the Three Rs (recommendation 3), the politics of "opting in" versus "opting out" of dissection (recommendation 4), the need for explicit direction in curricular documents (recommendation 5), the need for education and training for science teacher candidates and current science teachers (recommendations 6 and 7), and further research that takes into account the complexities and intersecting variables related to these topics (recommendation 8).

In addition to these recommendations, the nonhuman animal must also be considered a stakeholder. As many participants in this research noted, it is deeply reductive to position animals as mere tools of the science lab who can be silenced or backgrounded by discourses that refuse to recognize their agency or subjectivity. Creating better democratic relations with animals needs to be part of the conversation as well, and from this, deeper questions about pedagogy and the hidden curriculum of dissection might flow. Deepening our appreciation of other animals as living, feelings beings who care about what happens to them—regardless of whether anyone else cares (cf. Regan, 2004)—raises important ethical questions about the validity of school-based dissections. To this end, perhaps the first question we need to answer in considering the politics of animal dissection is whether killing animals is necessary, worthwhile, or justifiable in this context.

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APPENDICES

APPENDIX A: STUDENT QUESTIONNAIRE

Invitation to Participate

Dear Potential Participant:

Thank you for your interest in this research study. I am inviting individuals, aged 18-30 who have completed high school science classes in Ontario, to participate in a survey investigating student opinions and experiences with animal dissection and objection to dissection. This study, entitled "Cutting Edge Controversy: The Politics of Animal Dissection and Responses to Student Objection," is being conducted as part of my PhD in Education at Lakehead University.

Your participation in this study will involve completing the following 25-question survey, which is expected to take 15-25 minutes of your time. The survey is comprised of questions pertaining to your experiences in high school science classes, as related to animal dissection and/or objection to dissection.

Please note that your participation in this research is entirely voluntary. You may decline to answer any question in the survey and you may withdraw from the study at any time. The information you share will remain completely anonymous for the duration of the study, and the results will be published only in collective form in my dissertation and any other material published after the completion of my study. Your completed survey will be accessed and analyzed only by myself, and will be securely stored at Lakehead University for a period of five years, after which time it will be destroyed.

Upon completion of this research, your name/email address will be placed in a draw to win an iPod Touch. Your contact information will be used only for the purpose of the draw, and will be kept separate from your completed survey. Should your name be drawn for the prize, you will be contacted through email to arrange delivery. If you have any questions or concerns regarding the study or your participation in it, please contact me at (807) 343-8701 or email me at <joakley@lakeheadu.ca>. You may also contact my supervisor, Dr. Constance Russell, at (807) 683-3315 or <crussell@lakeheadu.ca>, or Lakehead University's Research Ethics Board at (807) 343-8283.

Thank you for your consideration. Your participation in this survey is greatly appreciated.

Sincerely, Jan Oakley, PhD candidate, Lakehead University

Consent Form

By clicking "yes" below at the bottom of this page, you are indicating that you agree to participate in this study and that you understand the following:

1. You must be between the ages of 18 and 30 to participate, and have completed some secondary science classes in Ontario: Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or OAC (Ontario Academic Credit) Biology.
2. Participating in this study is voluntary and you can withdraw at any time for any reason.
3. You may choose not to answer any question.
4. There is no apparent risk to participating in this study.
5. Your identity will be protected and you will remain anonymous in any publication or public presentation of the research findings.
6. The survey will be stored at Lakehead University for five years, after which time it will be destroyed.

*** I agree to participate in this survey and understand the conditions outined above.**

◯ Yes

Demographic and Background Information

Please provide some background information to help provide a picture of the people who are completing this survey.

*** 1. This survey is reserved for individuals aged 18-30. Do you fall within this age group?**

- ◯ Yes
- ◯ No

Demographic and Background Information

Please provide some background information to help provide a picture of the people who are completing this survey.

*** 2. This survey is reserved for individuals who have completed some or all secondary school Science and/or Biology classes in Ontario. Did you complete some or all of the following classes in Ontario: Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology and/or OAC (Ontario Academic Credit) Biology?**

- ◯ Yes
- ◯ No

Demographic and Background Information

Please provide some background information to help provide a picture of the people who are completing this survey.

3. What is your gender?

- ◯ Female
- ◯ Male

Animal Dissection and the Curriculum

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

4. In which of the following classes was animal dissection offered to you? Note: Please answer this question based on whether dissection was offered, and NOT whether you actually participated in a dissection. Please check all that apply:

- [ ] Grade 9 Science
- [ ] Grade 10 Science
- [ ] Grade 11 Biology
- [ ] Grade 12 Biology
- [ ] OAC (Ontario Academic Credit) Biology
- [ ] none of the above (if none of the above, you will be redirected to question 15)
- [ ] other (please specify)

Experiences with Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science Science and Biology classes that you completed in Ontario.

5. In which of the following classes did you actually participate in an animal dissection? Please check all that apply:

- ☐ Grade 9 Science
- ☐ Grade 10 Science
- ☐ Grade 11 Biology
- ☐ Grade 12 Biology
- ☐ OAC (Ontario Academic Credit) Biology
- ☐ none of the above; I chose not to participate or did not attend class on the day(s) of dissection (if none of the above, you will be redirected to question 8a)
- ☐ other (please specify)

Experiences with Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

6. Which of the following did you dissect in Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or OAC Biology? Please check all that apply:

- ☐ frog
- ☐ rat
- ☐ mouse
- ☐ crayfish
- ☐ starfish
- ☐ cat
- ☐ worm
- ☐ other (please specify)
- ☐ fetal pig
- ☐ perch
- ☐ turtle
- ☐ mink
- ☐ cow's eye
- ☐ grasshopper

Experiences with Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

7. How many animals in total did you dissect in your secondary school experience (i.e., in Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or OAC Biology)?

- ◯ 1
- ◯ 2
- ◯ 3
- ◯ 4
- ◯ 5
- ◯ 6 or more

Experiences with Student Choice

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

8a. Did your science/biology teacher(s) ever hold a classroom discussion about the ethics of animal dissection?

- ◯ Yes
- ◯ No

If yes, please elaborate on the discussion in the space below.

8b. Were you ever given an option by your teacher to not participate in (opt out of) a dissection?

- ◯ Yes
- ◯ No (if no, you will be redirected to question 13)

Experiences with Student Choice

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

9. In which years were you given the option not to participate in an animal dissection (to opt out)? Please check all that apply:

- [ ] Grade 9 Science
- [ ] Grade 10 Science
- [ ] Grade 11 Biology
- [ ] Grade 12 Biology
- [ ] OAC (Ontario Academic Credit) Biology
- [ ] other (please specify)

Experiences with Student Choice

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

10. How did you receive the option from your teacher that you could opt out of an animal dissection? Please check all that apply:

- [ ] verbally
- [ ] it was written into the course outline or other student handout
- [ ] I spoke to the teacher about it
- [ ] other (please specify)

Experiences with Dissection Alternatives

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

11. Was an alternative to dissection (e.g., a CD-ROM or computer program, 3D anatomical model, video, chart, poster, or overhead) offered to you, to use as a learning method instead of participating in an animal dissection?

- ◯ Yes
- ◯ No (if no, you will be redirected to question 13)

Experiences with Dissection Alternatives

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

12. What type of alternative was offered to you? Please check all that apply:

- [ ] CD-ROM or computer program
- [ ] 3D anatomical model
- [ ] video
- [ ] chart, poster, and/or overhead
- [ ] other (please specify)

Experiences with Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

13. Which of the following best describes your experience in secondary school classes? Please check all that apply:

- [ ] I willingly participated in an animal dissection(s).
- [ ] I participated in an animal dissection but had mixed feelings about it, due to personal, ethical, cultural, religious, and/or environmental reasons.
- [ ] I used an alternative (e.g., CD-ROM or computer program, 3D anatomical model, video, chart, poster, or overhead) instead of participating in an animal dissection.
- [ ] I did not want to participate in an animal dissection and informed my teacher, and was given an alternative mode of learning.
- [ ] I did not want to participate in an animal dissection and informed my teacher, but was convinced to participate anyways.
- [ ] I did not participate in an animal dissection and was given a failing grade on the assignment.
- [ ] I skipped class on the day(s) of the dissection.

other (please specify)

Comments

14. Please share any comments you have about your classroom experiences with animal dissection, your experiences being offered an alternative, or your experiences using an alternative to dissection.

Views toward Animal Dissection and Dissection Alternatives

Please provide your views on animal dissection, regardless of whether or not you have participated in an animal dissection yourself.

15. Please indicate the strength of your agreement with the following statements, using the five-point scale where 1=strong agreement and 5=strong disagreement with a particular statement.

	1 (strong agreement)	2	3	4	5 (strong disagreement)
(a) I find dissection interesting.	◯	◯	◯	◯	◯
(b) All students should experience a real animal dissection.	◯	◯	◯	◯	◯
(c) Students should have the right to refuse to perform dissections based on personal, ethical, cultural, religious, or environmental beliefs.	◯	◯	◯	◯	◯
(d) I am opposed to animal dissection due to personal, ethical, cultural, religious, or environmental beliefs.	◯	◯	◯	◯	◯
(e) A student who does not dissect should still be able to pass the course if the student is willing to do alternative work.	◯	◯	◯	◯	◯
(f) Schools should have policies to protect students' right to choose whether or not to dissect.	◯	◯	◯	◯	◯
(g) The objectives of dissection can be met with either a real or virtual dissection.	◯	◯	◯	◯	◯
(h) Students who perform a real animal dissection will have a better knowledge of animal anatomy and physiology than those who use an alternative.	◯	◯	◯	◯	◯
(i) Students who perform a real animal dissection will be better prepared for post-secondary studies in biology.	◯	◯	◯	◯	◯
(j) Alternatives should be used in place of real dissection.	◯	◯	◯	◯	◯
(k) I am concerned about where classroom lab animals come from.	◯	◯	◯	◯	◯
(l) Animals should not be killed for school dissections.	◯	◯	◯	◯	◯
(m) Watching another person dissect is an acceptable alternative for students who do not wish to dissect.	◯	◯	◯	◯	◯
(n) Animal dissection should not be taught in high school.	◯	◯	◯	◯	◯

Views toward Animals used for Dissection

Please provide your views on animal dissection, regardless of whether or not you have participated in an animal dissection yourself.

16. Animals and animal parts used for classroom dissections are purchased/come from a variety of sources. Using the following five-point scale, where 1=strong agreement and 5=strong disagreement, indicate the degree to which you believe it is appropriate for schools to use the following sources for dissection materials.

	1 (strong agreement)	2	3	4	5 (strong disagreement)
(a) animals from breeders or dealers	◯	◯	◯	◯	◯
(b) unclaimed animals from pounds	◯	◯	◯	◯	◯
(c) animal parts from slaughterhouses	◯	◯	◯	◯	◯
(d) animal parts from supermarkets	◯	◯	◯	◯	◯
(e) animals purchased from fur farms	◯	◯	◯	◯	◯
(f) wild-caught animals	◯	◯	◯	◯	◯
(g) animals purchased from biological supply companies, which sell animals procured from some or all of the above sources	◯	◯	◯	◯	◯
(h) "ethically sourced animal cadavers" -- animals purchased from educational organizations that sell the bodies of animals that have died of natural causes, or the donated bodies of deceased pets	◯	◯	◯	◯	◯

Objection to Animal Dissection

This section of the survey asks questions pertaining to objection to dissection and the experiences of those who objected. Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

17. Did you personally object to animal dissection in your Grade 9 Science, Grade 10 Science, Grade 11 Biology, Grade 12 Biology, and/or OAC Biology classes?

- ◯ Yes
- ◯ No (if no, you will be redirected to question 23)

Experiences with Objection to Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

18. What was your reason for objecting to animal dissection? Please check all that apply:

- [ ] Personal reasons
- [ ] Ethical or moral reasons
- [ ] Animal rights reasons
- [ ] Cultural reasons
- [ ] Religious reasons
- [ ] Environmental reasons
- [ ] other (please specify)

Experiences with Objection to Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

19. Did you inform your teacher that you did not wish to dissect?

- ◯ Yes
- ◯ No (if no, you will be redirected to question 23)

Experiences with Objection to Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

20. When you informed your teacher that you did not wish to participate in an animal dissection, how did your teacher respond? Please check all that apply:

- [ ] the teacher provided an alternative for me to use
- [ ] the teacher requested that I find my own alternative
- [ ] the teacher convinced me to try dissection
- [ ] the teacher requested that I watch another classmate dissect, instead of performing the dissection myself
- [ ] the teacher gave me a failing grade for the dissection assignment
- [ ] the teacher gave me a failing grade for the course
- [ ] the teacher told me that not dissecting was not an option
- [ ] other (please specify)

Experiences with Dissection Alternatives

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

21. If you used an alternative to dissection, what kind of alternative was it?

- [ ] CD-ROM or computer program
- [ ] 3D anatomical model
- [ ] video
- [ ] chart, poster, and/or overhead
- [ ] I did not use an alternative
- [ ] other (please specify)

Experiences with Objection to Animal Dissection

Please answer the following question based on your experiences in Grade 9, Grade 10, Grade 11, Grade 12, and/or OAC Science and Biology classes that you completed in Ontario.

22. Please indicate the strength of your agreement with the following statements, using the five-point scale where 1=strong agreement and 5=strong disagreement with a particular statement. NA = Not applicable to your experience.

	1 (strong agreement)	2	3	4	5 (strong disagreement)	N/A
(a) I was supported by my teacher in my decision to not dissect.	◯	◯	◯	◯	◯	◯
(b) I was supported by my classmates in my decision to not dissect.	◯	◯	◯	◯	◯	◯
(c) I was supported by my school board in my decision to not dissect.	◯	◯	◯	◯	◯	◯
(d) The alternative I used instead of dissecting was appropriate for my learning.	◯	◯	◯	◯	◯	◯
(e) My experience using an alternative to dissection was positive.	◯	◯	◯	◯	◯	◯

Follow-up Interview Request

23. Would you be willing to participate in a brief follow-up interview, in person or by telephone, regarding your experiences with animal dissection and/or objection to dissection?

- ◯ Yes
- ◯ No (if no, you will be redirected to question 25)

Contact Information

* 24. Thank you for volunteering to be contacted for a follow-up interview, to discuss your experiences with animal dissection and objection to dissection. Please complete the following contact information so that you may be contacted for a follow-up interview.

Name:

Telephone:

Email Address:

Final Comments

25. Your participation in this survey is almost complete. If you have any final comments or experiences that you would like to share on the subject of animal dissection and/or objection to dissection, please record them in the space below.

Draw to Win an iPod Touch

Please enter your email address below, so that you may entered into the draw to win an iPod Touch. (Note that your email address will NOT be associated with your completed survey.) Should your name be drawn, you will be contacted by email.

Your email address

Thank you for your interest

Thank you very much for your interest and participation in this survey. Please click on the "Done" option below. You will then be redirected to Lakehead University's home page.

APPENDIX B: STUDENT INTERVIEW GUIDE

1. Why did you object to animal dissection?

2. Please share your story of objecting to animal dissection.

Prompts:

-How did you object?

-How did your teacher respond?

-How did your classmates respond?

-If applicable, how did the school administration respond?

-What happened next?

3. What were the outcomes of your objection?

Prompts:

-Were you given an alternative? What kind?

-How did you use it?

-How were you assessed?

4. What are your feelings about your experience objecting to dissection?

5. What, if any, recommendations do you have emerging from this experience?

Prompts:

-What recommendations do you have for teachers? For schools? For others going through an experience similar to yours?

6. A Student Choice policy has been defined as: "a written and openly declared policy that guarantees the right of students to refuse to participate in classroom activities and demonstrations that they find objectionable on the basis of personal moral, ethical, or religious convictions, and ensures they have access without penalty to alternative learning methods, models, and approaches."

What is your opinion on Student Choice policies?

7. Is there anything else you would like to add?

APPENDIX C: TEACHER QUESTIONNAIRE

Invitation to Participate

Dear Potential Participant:

Thank you for your interest in this research study. I am inviting present and former Ontario teachers, who are teaching or have taught senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics, to participate in a survey investigating their classroom practices and perspectives pertaining to animal dissection and student objection to dissection. This study is being conducted as part of my PhD in Education at Lakehead University.

Should you wish to participate in the study, please complete the following 30-question survey, which is expected to take 15-25 minutes of your time. This survey is comprised of questions about your opinions and classroom practices pertaining to animal dissection. As a present or former Ontario secondary science teacher, your perspective would be invaluable to this research.

Please note that your participation in this research is entirely voluntary. You may decline to answer any question in the survey and you may withdraw from the study at any time. The information you share will remain completely anonymous for the duration of the study, and the results will be published only in aggregate form in my dissertation and any other material published after the completion of my study. Your completed survey will be accessed and analyzed only by myself, and will be securely stored at Lakehead University for a period of five years, after which time it will be destroyed.

Upon completion of this research, your name/email address will be placed in a draw to win a $100 gift certificate from Chapters. Your contact information will be used only for the purpose of the draw, and will be kept separate from your completed survey. Should your name be drawn for the prize, you will be contacted through email to arrange delivery. If you have any questions or concerns regarding the study or your participation in it, please contact me at (807) 343-8701 or email me at <joakley@lakeheadu.ca>. You may also contact my supervisor, Dr. Constance Russell, at (807) 683-3315 or <crussell@lakeheadu.ca>, or Lakehead University's Research Ethics Board at (807) 343-8283.

Thank you for your consideration. Your participation in this survey is greatly appreciated.

Sincerely, Jan Oakley, PhD candidate, Lakehead University

Consent Form

By clicking "yes" below at the bottom of this page, you are indicating that you agree to participate in this study and understand the following:

1. You must be a present or former Ontario secondary school teacher, who is teaching or has taught senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics.
2. Participating in this study is entirely voluntary. You can withdraw at any time for any reason.
3. You may choose not to answer any question.
4. There is no apparent risk to participating in this study.
5. Your identity will be protected and you will remain anonymous in any publication or public presentation of the research findings.
6. The survey will be stored at Lakehead University for five years, after which time it will be destroyed.

*** I agree to participate in this survey and understand the conditions outined above.**

◯ Yes

Demographic and Background Data

Please provide some background information to help provide a picture of the people who are completing this survey.

1. Are you currently teaching, or have you previously taught, senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario?

- ◯ Yes
- ◯ No

Demographic and Background Data

Please provide some background information to help provide a picture of the people who are completing this survey.

2. What is your gender?

- ◯ Female
- ◯ Male

3. Have you conducted animal dissections as part of your teaching of senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario?

- ◯ Yes
- ◯ No (If no, you will be redirected to question 14)

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

4. In which of the following courses have you used animal dissection as a teaching method? Please check all that apply:

- [ ] Grade 9 Science
- [ ] Grade 10 Science (Academic or Applied)
- [ ] Grade 11 Biology (University Preparation or College Preparation)
- [ ] Grade 12 Biology (University Preparation)
- [ ] OAC (Ontario Academic Credit) Biology
- [ ] other (please specify)

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

5. Over how many years have you taught a secondary school science/biology course that involves animal dissection?

- ◯ 1-5 years
- ◯ 6-10 years
- ◯ 11-15 years
- ◯ 16-20 years
- ◯ 21-25 years
- ◯ 26-30 years
- ◯ 31+ years

If 31 or more years, please specify the number:

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

6. How many times do you estimate having conducted animal dissections as part of your teaching of secondary school science/biology classes?

- ◯ 1-10
- ◯ 11-20
- ◯ 21-30
- ◯ 31-40
- ◯ 41-50
- ◯ 51-60
- ◯ 61-70
- ◯ 71+

If 71 or more times, please estimate the number:

_____

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

7. Which of the following have been dissected in your classes? Please check all that apply:

- [ ] frogs
- [ ] rats
- [ ] mice
- [ ] crayfish
- [ ] starfish
- [ ] cats
- [ ] worms
- [ ] fetal pigs
- [ ] perch
- [ ] other (please specify)
- [ ] turtles
- [ ] minks
- [ ] cow eyes
- [ ] grasshoppers
- [ ] pigeons
- [ ] dogfish sharks
- [ ] cow hearts
- [ ] pig hearts
- [ ] sheep brains

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

8. Where do you obtain the animal specimens/material that you use in your classroom dissections?

- [ ] from biological supply companies
- [ ] from breeders or dealers
- [ ] from slaughterhouses
- [ ] from supermarkets
- [ ] from educational organizations that sell the bodies of animals that have died of natural causes, or the donated bodies of deceased pets

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

9. Why do you use animal dissection as a teaching method?

10. What is the most important thing you think your students learn from conducting an animal dissection?

11. What is the most pressing concern/concerns you have associated with conducting a classroom animal dissection?

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

12. How much discretion do you have within your school board regarding whether you use animal dissection as a teaching technique?

- ◯ none
- ◯ a little
- ◯ a considerable amount
- ◯ complete

Comments:

Teaching Practices: Animal Dissection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

13. Which of the following practices form part of your animal dissection teaching? Please check all that apply:

- [ ] I have a discussion about the ethics of animal dissection with students
- [ ] I explain to students where the dissection materials have come from
- [ ] I advise students verbally that they may opt out of dissection
- [ ] I include in course outlines or other written documents a written passage indicating that students may opt out of dissection
- [ ] none of the above
- [ ] other (please specify)

Teaching Practices: Dissection Alternatives

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

14. Do you use alternatives to animal dissection in your classroom, either in conjunction with animal dissection or in lieu of it? Alternatives to animal dissection include CD-ROMs, computer programs, 3D anatomical models, videos, charts, textbook diagrams, posters, and overheads.

- ◯ Yes
- ◯ No (If no, you will be redirected to question 19)

Teaching Practices: Dissection Alternatives

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

15. Which of the following alternatives do you use in your classroom? Please check all that apply:

- [ ] CD-ROMs or computer programs
- [ ] 3D anatomical models
- [ ] Videos
- [ ] Charts, posters, textbook diagrams and/or overheads
- [ ] other (please specify)

Teaching Practices: Dissection Alternatives

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

16. In what capacity are alternatives to dissection used in your classroom? Please check all that apply:

- [ ] In conjunction with animal dissection, as supplemental teaching aids
- [ ] In lieu of animal dissection for students who request alternatives
- [ ] In lieu of animal dissection for all students
- [ ] other (please specify)

Perspectives on Dissection Alternatives

17. Which, if any, of the following benefits do you associate with dissection alternatives?
Please check all that apply:

- [ ] cost benefits
- [ ] alternatives provide a pedagogically sound way for students to learn
- [ ] alternatives do not involve taking an animal life
- [ ] alternatives alleviate student concerns about animal dissection
- [ ] alternatives can be re-used year after year
- [ ] alternatives have a smaller environmental footprint than animal cadavers
- [ ] none of the above
- [ ] other (please specify)

Perspectives on Dissection Alternatives

18. Which, if any, of the following drawbacks do you associate with dissection alternatives?
Please check all that apply:

- [ ] alternatives are expensive
- [ ] alternatives are not pedagogically comparable to real animal dissection
- [ ] school resources (e.g., computers) are limited, making it difficult to use alternatives in lieu of animal dissection
- [ ] there is an expectation that I will conduct animal dissections
- [ ] there is a lack of information/professional development to help me in the selection of appropriate alternatives
- [ ] there is a lack of information/professional development to help me learn how to use alternatives
- [ ] none of the above
- [ ] other (please specify)

Views toward Animal Dissection and Dissection Alternatives

Please provide your views on animal dissection and dissection alternatives, regardless of whether or not you conduct animal dissections in your classroom.

19. Please indicate the strength of your agreement with the following statements, using the five-point scale where 1=strong agreement and 5=strong disagreement with a particular statement. NA=not applicable to your teaching experience.

	1 (strong agreement)	2	3 (neutral)	4	5 (strong disagreement)	N/A
(a) Real animal dissection is important to the teaching of biology.	○	○	○	○	○	○
(b) There are no substitutes for real animal dissections.	○	○	○	○	○	○
(c) All students should experience a real animal dissection.	○	○	○	○	○	○
(d) Dissection interests my students.	○	○	○	○	○	○
(e) Dissection is too expensive and/or time-consuming.	○	○	○	○	○	○
(f) I am concerned with where classroom lab animals come from.	○	○	○	○	○	○
(g) I am concerned about what dissection may teach students about the value of animal life.	○	○	○	○	○	○
(h) Alternatives should be used in place of real animal dissection.	○	○	○	○	○	○
(i) The objectives of dissection can be met with either a real or a virtual dissection.	○	○	○	○	○	○
(j) Students who perform animal dissections can better meet the curricular outcomes than students who use an alternative.	○	○	○	○	○	○
(k) Animal dissection should not be taught in high school.	○	○	○	○	○	○
(l) Assuming available resources, I would consider using a virtual dissection as a substitute for real animal dissection.	○	○	○	○	○	○
(m) Dissection alternatives interest my students.	○	○	○	○	○	○
(n) Dissection should not be part of the curriculum.	○	○	○	○	○	○

Experiences with Student Objection

Please answer the following question based on your experiences teaching senior biology courses (Grades 11/12/OAC) or Grades 9/10 science courses with biology topics in Ontario.

20. Have you had the experience of students objecting to animal dissection?

- ◯ Yes
- ◯ No (If no, you will be redirected to question 25)

Experiences with Student Objection

21. On what grounds have students objected to animal dissection? Please check all that apply:

- [ ] personal reasons
- [ ] ethical or moral reasons
- [ ] animal rights reasons
- [ ] cultural reasons
- [ ] religious reasons
- [ ] environmental reasons
- [ ] other (please specify)

Experiences with Student Objection

22. Please estimate the percentage of your students who have objected to animal dissection.

- ◯ 1-5%
- ◯ 6-10%
- ◯ 11-15%
- ◯ greater than 15%

If greater than 15%, please estimate the percentage:

23. Of the students who objected, what percentage do you estimate are female?

- ◯ less than 40%
- ◯ 41-50%
- ◯ 51-60%
- ◯ 61-70%
- ◯ 71-80%
- ◯ 81-90%
- ◯ 91-100%

Responses to Student Objection

24. How do you respond to students who object to animal dissection? Please check all that apply:

- [ ] I have a discussion with the student about his or her concerns, to see if they are valid
- [ ] I provide an alternative to the student, following a discussion
- [ ] I provide an alternative to the student, no questions asked
- [ ] I request that the student find his or her own alternative
- [ ] I ask the student to observe another person conducting the dissection, without participating himself or herself
- [ ] I advise them that dissection is a mandatory part of the course
- [ ] I assign a failing grade for the dissection portion of the curriculum
- [ ] other (please specify)

Responses to Student Objection

25. Please indicate the strength of your agreement with the following statements, using the five-point scale where 1=strong agreement and 5=strong disagreement with a particular statement. NA=not applicable to your teaching experience.

	1 (strong agreement)	2	3 (neutral)	4	5 (strong disagreement)	N/A
(a) Students should have the right to refuse to perform dissections based on personal beliefs.	◯	◯	◯	◯	◯	◯
(b) Students should have the right to refuse to perform dissections based on ethical or animal rights beliefs.	◯	◯	◯	◯	◯	◯
(c) Students should have the right to refuse to perform dissections based on religious beliefs.	◯	◯	◯	◯	◯	◯
(d) Students should have the right to refuse to perform dissections based on cultural beliefs.	◯	◯	◯	◯	◯	◯
(e) Students should have the right to refuse to perform dissections based on environmental beliefs.	◯	◯	◯	◯	◯	◯
(f) I am sensitive to students' reasons for not wanting to dissect.	◯	◯	◯	◯	◯	◯
(g) Students should proactively be given a choice between animal dissections and other methods of learning.	◯	◯	◯	◯	◯	◯
(h) A student who does not dissect should still be able to pass the unit if the student is willing to do alternative work.	◯	◯	◯	◯	◯	◯
(i) I am likely to provide an alternative to dissection to students who object.	◯	◯	◯	◯	◯	◯

Classroom Practices: Student Choice

26. A Student Choice policy has been defined as "a written and openly declared policy that guarantees the right of students to refuse to participate in classroom activities and demonstrations that they find objectionable on the basis of personal, moral, ethical, or religious convictions, and ensures they have access without penalty to alternative learning methods, models, and approaches."

Do you have a student choice policy in effect in your classroom?

- ◯ I have an openly declared policy in effect
- ◯ I have a written policy in effect
- ◯ I have a written and openly declared policy in effect
- ◯ I have neither a written nor an openly declared policy in effect

27. Do you think Student Choice policies, as defined in question 26 above, should be implemented in Ontario high schools?

- ◯ Yes
- ◯ No

Comments:

Comments

28. Your participation in this survey is almost complete. If you have any final comments or experiences that you would like to share on the subject of your classroom practices or perspectives pertaining to animal dissection and/or objection to dissection, please record them in the space below.

Follow-up Interview Request

29a. Would you be willing to participate in a brief follow-up interview, in person or by telephone, regarding your classroom practices and perspectives on animal dissection and student objection to animal dissection?

- ◯ Yes
- ◯ No (If no, you will be redirected to question 30)

Contact Information

* 29b. Thank you for volunteering to be contacted for a brief follow-up interview. Please complete the following so that you may be contacted for an interview.

Name:

Email Address:

Phone Number:

Option to Receive Summary of Research Results

30. Would you like to receive a summary of the research results upon completion of this project?

◯ No thanks.

◯ Yes, please send a summary of the research findings to the following email address.

Email address:

Enter Draw to Win a Chapter's Gift Certificate

Please enter your email address below, so that you may be entered into the draw to win a $100 gift certificate from Chapters. (Note that your email address will NOT be associated with your completed survey.) Should your name be drawn, you will be contacted by email.

Your email address:

Thank you

Thank you very much for your interest and participation in this survey. Please click on the "Done" option below. You will then be redirected to Lakehead University's home page.

APPENDIX D: TEACHER INTERVIEW GUIDE

1. What are your experiences as a former student, and pre-service science teacher, regarding animal dissection?

    Prompts:

    -How were you taught animal dissection?

    -Did you have experiences or instruction with dissection alternatives?

2. What are your attitudes today toward animal dissection and its place in secondary school science?

3. How do you teach curricular requirements pertaining to animal dissection?

    Prompts:

    -Why do you approach this teaching the way that you do?

    -Has your teaching approach changed over the years of your teaching? If so, what has prompted these changes?

4. What are your perspectives on alternatives to dissection (e.g., computer simulations, anatomical models, films of dissections)?

5. What are your experiences with classroom student objection to animal dissection?

    Prompts:

    -What is the frequency with which you experience student objection?

    -How do you respond to student objection?

    -Describe a scenario of student objection: how the student objected, what accommodations (if any) were provided, and how the matter was resolved.

6. What, if any, recommendations do you have emerging from your experiences with students who object to animal dissection?

    Prompts:

    -What recommendations do you have for teachers? For schools?

7. As a teacher, what are your feelings about student objection to animal dissection?

8. A Student Choice policy has been defined as:

“a written and openly declared policy that guarantees the right of students to refuse to participate in classroom activities and demonstrations that they find objectionable on the basis of personal moral, ethical, or religious convictions, and ensures they have access without penalty to alternative learning methods, models, and approaches.”

What is your opinion on Student Choice policies?

9. Is there anything else you would like to add?

APPENDIX E: COMMUNICATIONS BULLETIN TO RECRUIT STUDENT PARTICIPANTS

Subject: Participants Needed for Study on Animal Dissection Experiences

Message: Individuals aged 18-30 are invited to participate in a survey which investigates high school dissection experiences and perspectives on animal dissection, dissection alternatives, and objection to dissection. Participants must have completed some of their Grade 9, Grade 10, Grade 11, or Grade 12/OAC science and biology classes in Ontario.

The survey takes approximately 15-25 minutes to complete. All participants will be entered into a draw to win a 32GB iPod Touch.

To participate, please visit www.surveymonkey.com/s/dissection

APPENDIX F: COMMUNICATION TO EDUCATION OFFICERS AND/OR RESEARCH CHAIRS OF ONTARIO SCHOOL BOARDS TO RECRUIT TEACHER PARTICIPANTS

[sent by email]

Dear [Education Officer/Research Chair of Ontario School Boards]:

I am conducting a study as part of my PhD in Education at Lakehead University, investigating science teachers‟ perspectives and classroom experiences with animal dissection and objection to dissection. This study is entitled "Cutting Edge Controversy: The Politics of Animal Dissection and Responses to Student Objection."

I would like to invite secondary school science teachers in your [school/school district] to participate in this study. Their perspective would be invaluable to this research, and would entail anonymously completing an online survey, which is expected to take 15-25 minutes of their time. The survey is currently available online at www.surveymonkey.com/s/dissectionsurvey.

I am writing to request your assistance in inviting secondary school science teachers in your [school/school district] to participate. For your information, I have included a copy of the letter I have written to potential teacher participants, outlining the purpose of the study and what their participation would entail. **Would you be willing to forward on this request to applicable teachers in your school district, or would you share with me the email contact list of applicable teachers so that I might invite them myself**? Your assistance would be most appreciated in helping to ensure teachers‟ voices are adequately represented in this study.

If you have any questions or concerns, please contact me by email <joakley@lakeheadu.ca>, or telephone at (807) 343-8701. You may also contact my supervisor, Dr. Constance Russell, at (807) 683-3315 or <crussell@lakeheadu.ca>, or Lakehead University‟s Research Ethics Board at (807) 343-8283.

Thank you very much for considering of this request.

Sincerely,

Jan Oakley, PhD candidate, Lakehead University