

Evaluation of Educator & Student Use of & Attitudes toward Dissection & Dissection Alternatives

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ABSTRACT

Animal dissection has been routinely practiced in American biology classrooms for decades. With technological advancements, more states adopting student choice measures, and increased awareness about ethical concerns surrounding dissection, many useful dissection alternatives have been developed. To understand the current use of animal dissection and alternatives, and attitudes toward the practices, a nationwide survey of middle and high school biology teachers (n = 1178) and students (n = 500) was conducted. Most teachers (84%) and students (76%) reported using dissection in their classrooms, although nearly half of educators indicated that dissection is decreasing at their school. Educators cited student performance as the main factor driving their decision to use dissection or alternatives and reported conducting dissection exercises because of student interest. Most teachers had an interest in using alternatives, although only 36% used them in place of dissection. More than a third of biology students preferred the use of alternatives over animal specimens, yet most did not request dissection alternatives. Enabling students to opt in to dissection exercises rather than opt out, as is the current practice, and educating teachers and students about student choice and the advantages of dissection alternatives are suggested strategies to reduce animal use in education, in line with the “3 R’s” principle.

Key Words: Dissection; alternatives; education; student choice.

○ Introduction

Animal dissection has been used for biology instruction in American classrooms since the 1920s and became more widely practiced with the establishment of the Biological Sciences Curriculum Study in the 1960s (Orlans, 1988; Hairston, 1990). Since that time, multiple animal species have become regular candidates for dissection, and students often participate in multiple dissections as part of their precollege science education (Oakley, 2013). Statistics on the number and species of animals used for dissection are not maintained in the United States, and estimates of these statistics are decades old. Some sources

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suggest that 10–12 million animals are used for dissection exercises annually in this country (Rosenberger, 1998).

Although dissection is prevalent in the United States, it is not practiced globally. Schools in five countries – Argentina, Israel, the Netherlands, Slovak Republic, and Switzerland – do not conduct dissections, and the practice is rare or being phased out in other countries, including England, Germany, Sweden, and India (Oakley, 2013). The idea of opting out of dissection exercises in American schools has been steadily gaining popularity since 1987, when Jenifer Graham, a high school sophomore, went to court because her grade was lowered after she refused to dissect a frog in her biology class (*Jenifer Graham v. Board of Trustees of the Victor Valley Union High School District*). This led the State of California to pass a law in 1987 mandating that students who object to dissection be given an alternative without penalty. Today, 15 states and Washington, D.C., have adopted student choice policies or laws giving students the choice to opt out of dissection. In addition, four states have general policies that allow students to opt out of any classroom activity with the consent of parents or guardians, and three states have advisories, legislative resolutions, policies, or agreements whereby local school districts retain control over curriculum (see <http://www.navs.org/education/states-with-student-choice-laws>).

Advancements in technology have led to the development of a variety of commercially available, interactive virtual dissection alternatives that provide students with three-dimensional views of animal organs, background information about the specimen being viewed, and anatomical comparisons of animals and humans. Many of these virtual programs are designed to work on tablets, laptops, desktops, and interactive white boards. Several are available for free or for a nominal fee (see <http://www.bioleap.org>). Other alternatives, including 3-D models, videos, and diagrams, are also available to biology educators. Although many of these models have been criticized for not providing the same kind

Table 1. Percentage of educators who agreed or disagreed with the following statements regarding the use of dissection and dissection alternatives.

How much do you agree or disagree with each of the following statements?	Agree	Disagree	Neutral
Dissection is the best way to teach anatomy and/or physiology.	70	12	18
Dissection is no longer necessary to teach the life sciences.	21	60	19
Alternatives are as good as dissection for teaching anatomy/physiology.	21	54	25
I have ethical concerns about animal dissection.	18	62	20
Technology will make animal dissection obsolete.	20	59	20
The use of dissection in biology education is an important tradition.	56	22	22
Students should be required to participate in animal dissection.	29	45	27
The science faculty at my school generally supports dissection alternatives.	48	13	38

of “hands-on” experience as dissection, alternatives have been shown to provide interactive learning experiences and serve as effective learning tools.

Several studies have compared the efficacy of student learning when using animal dissection or alternatives. In general, studies that examined student learning with animal dissection versus alternatives concluded that alternatives can be used to meet most learning objectives and that students using non-animal alternatives have been found to perform *as well as or better than* students using animal models (van der Valk et al., 1999; Predavec, 2001; Lalley et al., 2010; DeHoff et al., 2011; Monsour, 2011; Oakley, 2013; *Animalearn*, n.d.). One review of >30 published studies comparing how well students from precollege to medical-school levels learned with alternatives versus animal specimens concluded that there was “solid support for the replacement of traditional learning methods” involving animals with alternative approaches (Balcombe, 2003).

In addition to being effective teaching tools, alternatives offer many other benefits. They are less expensive than traditional animal dissection and require less class time for preparation and cleanup, giving students the ability to work at their own pace and repeat virtual dissections numerous times, which can increase their ability to retain information (Oakley, 2012). Many virtual alternatives include detailed background information on specimens as well as built-in self-assessment, further enhancing students’ learning experiences and enabling them to gauge whether they have met the learning objectives of the exercise (van der Valk et al., 1999; Oakley, 2013).

With more dissection alternatives available than ever before, we carried out a survey of precollege biology teachers and students to acquire current data about classroom practices and attitudes related to animal dissection and dissection alternatives. Such information is critical for identifying obstacles that may hinder the use of dissection alternatives and will help develop effective strategies to implement the “3 R’s” principle – reduction, refinement, and replacement of animal use – in education.

○ Methods

A survey of biology teachers and students was commissioned to understand the current state of affairs regarding dissection and alternatives in the United States, because few current data exist. Names and e-mail addresses for 16,137 biology teachers were obtained

through the Market Data Retrieval database. Participants were asked to respond to an online survey with multiple-choice questions that assessed demographic information and current use of and attitudes about animal dissection and alternatives. A total of 1178 teachers (710 female, 373 male, and 95 unspecified individuals) completed the survey, representing a response rate of 7.3%. Responses were received from educators in 49 states and Washington, D.C. The majority (93%) taught at public schools, and 96% had taught one or more biology classes within the past 2 years. They reported teaching grades 5–12, and most had taught at the high school level. Their teaching experience ranged from <1 year to >12 years.

Names and e-mail addresses for 12,678 biology students were obtained through the Survey Sampling International (SSI) database. Participants were asked to respond to an online survey with multiple-choice questions about their views on dissection and alternatives. A total of 500 students (249 female and 251 male) completed the survey, representing a 3.9% response rate among students in qualifying households. Responses were received from students in 46 states. The majority (82%) reported being enrolled in public schools, and all had taken a biology course within the past 2 years. Students were currently in grades 7–12, and the majority were high school students (77%).

Despite the survey response rate being somewhat low for students, the diversity of the sample (geographically and otherwise) provides confidence that the findings are representative. The quality of the student sample is reinforced by the lack of any obvious indication of bias and the absence of missing data in the responses. Although both data sets remain subject to some degree of nonresponse bias, our confidence in the results is high because of other indications of quality and representation. Assuming a normal distribution, the teacher survey results had an error margin of $\pm 3\%$, and the student surveys had an error margin of $\pm 4\%$, both at a 95% confidence level. Teacher and student sample populations are distinct, meaning that participants were not necessarily from the same classroom or school.

○ Results

Our research indicated that animal dissection continues to be a common practice, with 84% of educators reporting use of dissection as a teaching tool at any point during past school years, a figure slightly higher than the 75–79% reported in other studies (Oakley, 2012).

Teaching experience influenced participant response: teachers with >12 years of biology teaching experience were more likely to have used animal dissection (88%) than educators with <7 years' experience (72%). Consistent with educator findings, the majority of students polled (76%) indicated that they dissected an animal in their biology course.

Dissection continues to be a prevalent practice in American classrooms, in part because of the strong viewpoints biology educators hold about the practice and concerns they have about alternatives. Over half of educators (56%) viewed dissection as an important tradition in biology education. The majority of educators (70%) considered dissection the best way to teach anatomy and physiology. Most educators (60%) disagreed with the statement that dissection is no longer necessary to teach the life sciences. The majority of educators did not believe that alternatives were as good as dissection for teaching anatomy and physiology (54%) and did not believe that technology will make dissection obsolete (59%) (Table 1).

To better understand the types of animals that are commonly used in dissection exercises, teachers and students were asked about their use of dissection specimens. Teachers reported frequent or occasional use of frogs (59%), fetal pigs (57%), and earthworms (47%), among other specimens, during the past 2 years, consistent with the top three animal specimens previously reported (King et al., 2004) (Figure 1A). Students commonly dissected frogs (78%), earthworms (31%), and fetal pigs (24%) (Figure 1B).

Next, we examined the use of dissection alternatives as teaching resources. Seventy percent of educators reported using alternatives in some capacity, with 36% using them *in place of* animal dissection and 34% using them *in conjunction with* animal dissection. Sixteen percent of educators did not use alternatives at all, and 14% used neither dissection nor dissection alternatives (Figure 2A). Of the educators who have used animal dissection as a teaching tool, 67% indicated that they would be interested in using dissection alternatives. Educators viewed the cost savings of alternatives (49%) and time saved by using alternatives versus traditional dissection (33%) as the most important factors for replacing animal dissection with an alternative method (Table 2). Educators were also asked about factors that influenced their decision to use animal dissection or alternatives. Table 2 shows that the most important factors driving this decision were student performance, curriculum requirements, preferences of students, and a personal belief that dissection is necessary. The least important factors were opinions of fellow science teachers and expectations of parents and school administration. The main reason biology teachers indicated they would continue using dissection is because their students want to dissect animals (67%). Other reasons involved concerns about alternatives being inadequate (42%) and concerns about the performance of students using alternatives (41%).

Educators and students were asked about the availability of alternatives at their schools. The majority of educators (71%) indicated that they had access to web-based programs, and over a third of educators reported having access to computerized software programs and 3-D models (Figure 2B). Although students reported having the same top three alternatives available at their schools, the rank order was slightly different, with 62% having access to computerized software programs, 38% to 3-D models and 34% to web-based programs (Figure 2B). Educators ranked all available alternatives as useful but identified web-based programs, computerized software programs, and interactive CDs and DVDs as the top "very useful" alternatives (Figure 2C).

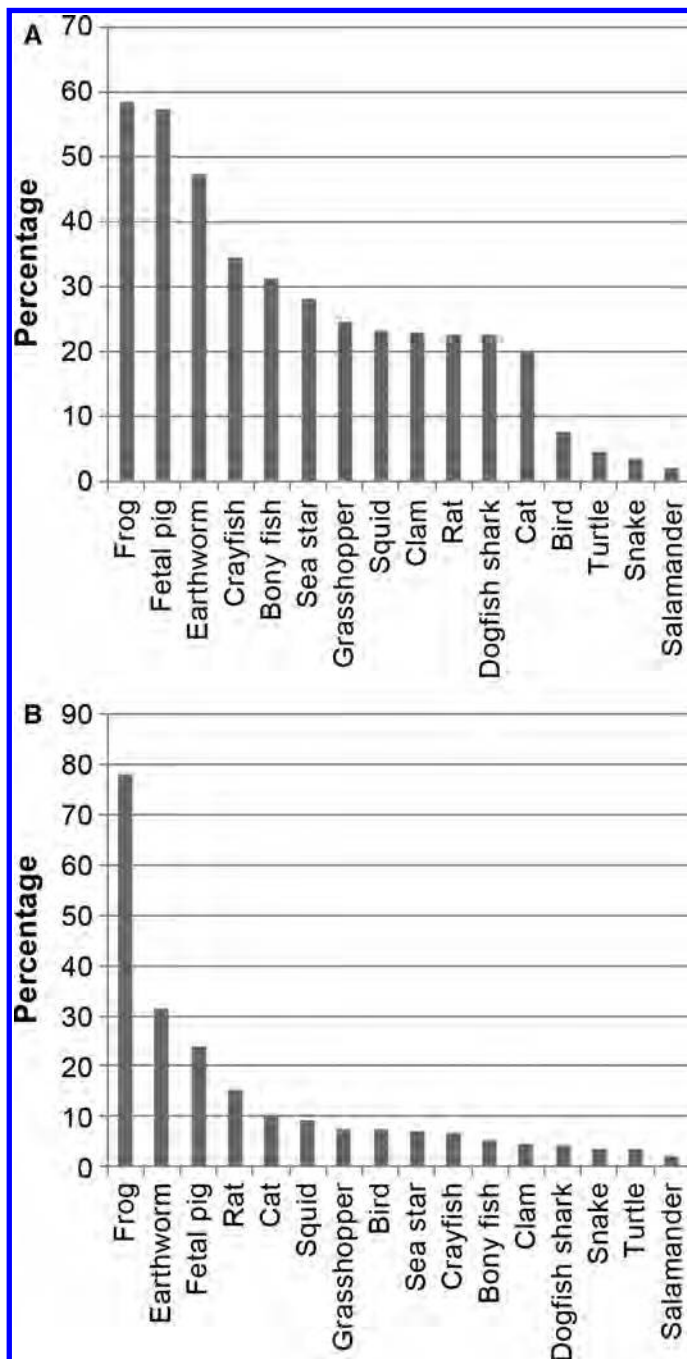


Figure 1. Prevalence of animals commonly used as dissection specimens in precollege biology education. (A) Percentage of teachers who have regularly or occasionally used animal species for dissection specimens during the past 2 years, among the teachers who practice dissection (n = 986). (B) Percentage of students who have dissected animal species shown (n = 500).

Just 10 years ago, videos and charts were the most frequently utilized alternatives, reflecting the impact of technology on biology education (King et al., 2004). Despite the availability of alternatives, when we asked students whether their teachers or schools actually offered alternatives to animal dissection, the greatest segment of

Table 2. Percentage of educators who ranked the importance of the following statements regarding the use of dissection and dissection alternatives.

How much do each of the following factors influence your decision to use either animal dissection or alternatives to dissection?	Important	Not Important	Neutral
Expectations of school administration	30	40	30
Expectations of parents	22	42	36
Curriculum requirements	58	19	23
Opinions of fellow science teachers	22	50	28
Preferences of students	48	25	27
Performance of students	69	12	19
Personal belief that dissection is necessary	45	27	28
How important to you personally are each of the following reasons that teachers give for continuing animal dissection in biology classes?	Important	Not Important	Neutral
The school curriculum requires the use of animal dissection.	29	42	30
Parents demand that their children have the opportunity to dissect.	15	50	35
Biology students want to dissect animal specimens.	67	13	20
The dissection alternatives that are available are inadequate.	42	23	36
Concern about performance of students who use alternatives.	41	25	34
How important to you personally are each of the following reasons that teachers give for replacing animal dissection with an alternative method?	Important	Not Important	Neutral
Dissection is a source of unnecessary animal suffering.	21	53	27
Dissection poses risks to students (e.g., toxic chemicals or sharp instruments).	30	43	27
Alternatives are less time-consuming than dissection.	33	39	27
Alternatives are less expensive than dissection.	49	24	27
Alternatives are just as good as dissection as teaching tools.	27	43	30

respondents did not know (38%), 34% responded “yes,” and 28% responded “no.”

Next, we assessed trends in the practice of animal dissection in schools. Nearly half of the educators (48%) reported no change, while 45% said that dissection is decreasing and 5% indicated that the practice is increasing. Two percent of respondents did not know how the practice was changing in their schools.

Student choice policies guarantee students in grades K–12 the right to choose not to participate in animal dissection and ensure that students have access to an alternative. When we asked educators about student choice policies at their schools, 38% said their school had a student choice policy, 42% said their school did not, and 20% did not know. Years of teaching experience influenced responses: teachers with less experience were more likely to be uninformed about student choice policies than those with greater experience (32% vs. 15%, respectively). Interestingly, only 53% of educators in states with student choice policies or laws responded that their school had such measures. Twenty-nine percent of educators in those states said their school did not have a policy and 18% did not know, which indicates that information about student choice is not widely disseminated among educators. [Note: This data set does not include Michigan, whose student choice policy was enacted after completion of the survey.]

Of the educators who use dissection as a teaching tool, 88% permitted their students to use an alternative instead of animal dissection if requested, in line with 82.8% previously reported (King et al., 2004). Yet 9% of educators in states with student choice policies or laws, including those at public schools for whom the policies apply, did not permit their students to use alternatives.

When asked their personal opinion on requiring student participation for animal dissection, 45% of educators did not believe that students should be required to participate, while 29% believed participation should be required (Table 1). Students expressed similar viewpoints: 49% disagreed that students should be required to participate in animal dissection, and 23% agreed that participation should be required (Table 3). The majority of students (68%) felt they should have a choice to opt out of dissecting animals.

Next, we wanted to determine the prevalence of students who requested the use of dissection alternatives. The majority of educators (90%) indicated that <5% of their students had requested an alternative during the past 2 years. Only 6% of educators reported that 5–10% of students had made this request. Fourteen percent of student respondents indicated that they had refused to dissect an animal or asked to use a dissection alternative.

We wanted to better understand student preference toward animal dissection and alternatives. Nearly half of students (48%)

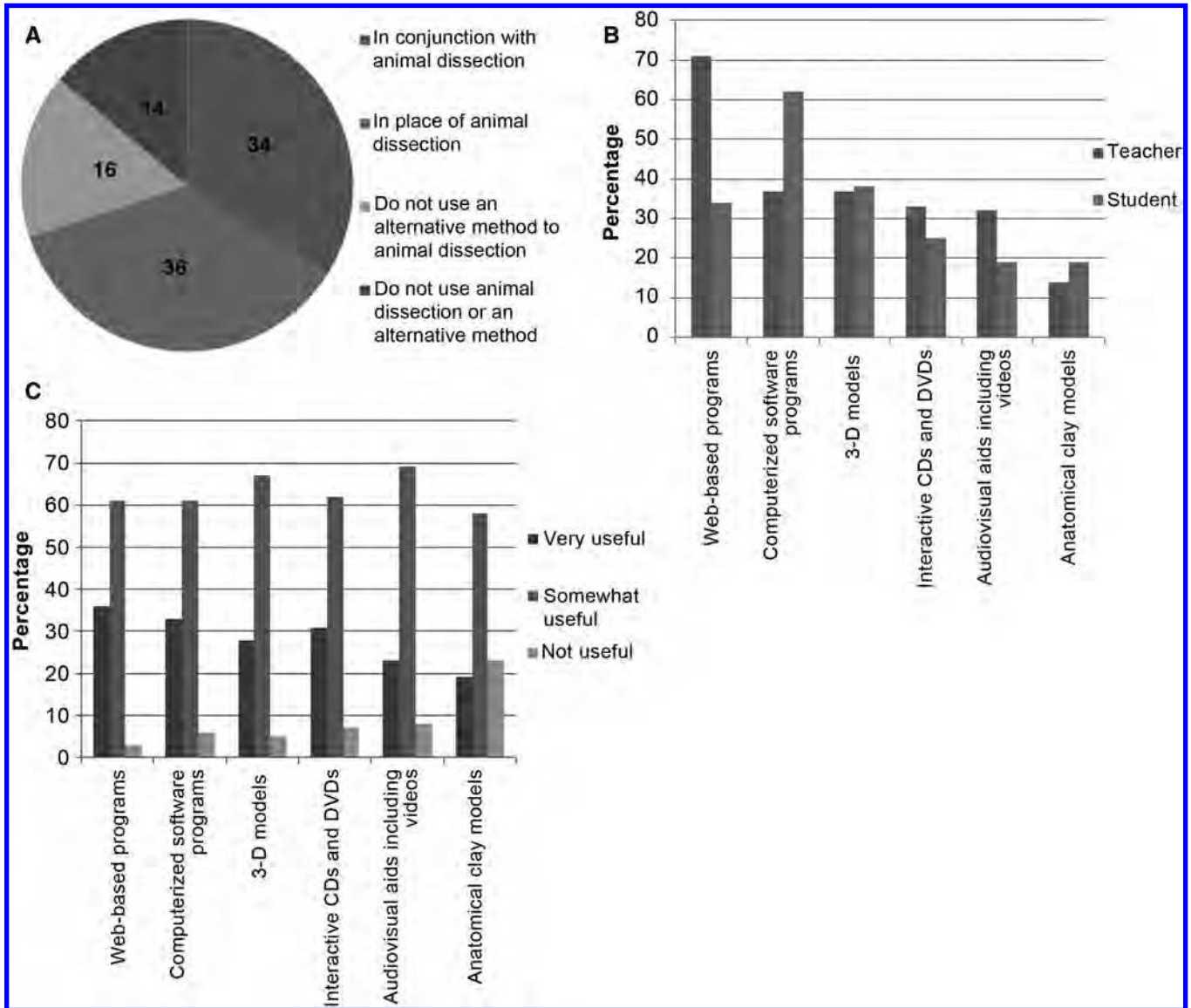


Figure 2. Use of dissection alternatives in precollege classrooms. (A) Percentage of teachers indicating how, or whether, they use dissection alternatives in their classrooms ($n = 1178$). (B) Availability of dissection alternatives in precollege American classrooms according to educators ($n = 1178$) and students ($n = 500$). (C) Educators' perceived usefulness of available alternatives ($n = 1178$).

Table 3. Percentage of students who agreed or disagreed with the following statements regarding the use of dissection and dissection alternatives.

How much do you agree or disagree with each of the following statements?	Agree	Disagree	Neutral
I have ethical concerns about animal dissection.	29	46	25
I am more interested in science because I dissected an animal.	30	45	25
Students should have a choice to opt out of dissecting animals.	68	17	15
I would like biology education to be more computer-based.	34	40	26
Dissection has been an important part of my education.	36	38	26
Students should be required to participate in animal dissection.	23	49	28
I am concerned about being exposed to toxic chemicals or sharp instruments.	32	44	24

indicated that they would not prefer to use an alternative, 37% would prefer using an alternative, and 15% did not know. When asked their thoughts about their classmates' preferences on this matter, 37% of students thought their classmates would prefer to use an alternative, 38% thought their classmates would not prefer to use an alternative, and 25% were not sure.

○ Discussion

In 1959, Russell and Burch described the “3 Rs” principle, encouraging the reduction, refinement, and replacement of animal use in science (Russell & Burch, 1959). After the definition of the 3 Rs was adopted by the U.S. Office of Technology Assessment in 1986, the National Association of Biology Teachers published a manuscript for educators with information about the 3 Rs and described materials and teaching strategies to implement the 3 Rs of animal use in education (Hairston, 1990). Since that time, several dissection alternatives have been developed that offer the potential to replace the use of animals in dissection exercises. Despite this, our study revealed that the use of animals for dissection remains prevalent. We believe that more can be done to apply the 3 Rs principle in education and investigated why the practice of dissection persists at such high levels.

Teachers continue to hold strong opinions about the benefits of dissection and have concerns about the effectiveness of alternatives. One reason they may hold these views is the stance that some science educational organizations have about dissection and alternatives (Oakley, 2013). It is important to note that the National Science Teachers Association (NSTA) updated their policy on dissection in 2008 to reflect greater support for alternatives, acknowledging the development and improvement of alternatives and enabling teachers to decide for themselves whether animal dissection or the use of alternatives is most appropriate for their students (NSTA, 2008). Support of alternatives as replacements to animal dissection from science educational organizations, and broader dissemination of information about them, would likely encourage more educators to use alternatives in place of animal dissection.

It is possible that many educators do not have issues with dissection if they are using “ethically sourced” animals, such as cats euthanized at animal shelters or fetal pigs that are byproducts of the food industry. However, it should be noted that frogs – the most commonly used animals for dissection exercises – are harvested and killed specifically for biological study (Carolina Biological Supply, 2015). The use of alternatives to frog dissection alone would significantly reduce animal death and be an effective way to incorporate the 3 Rs principle in education.

With regard to the 3 Rs principle, we were encouraged to find that 45% of educators reported a decrease in dissection at their schools. Although our survey did not ask about specific reasons for the decrease, preliminary results from a small follow-up survey with educators suggested a number of contributing factors, including curriculum changes, lack of funding, use of fewer dissection specimens among students, and increased use of alternatives. Results from this preliminary study also revealed that the majority of educators (59%) feel that information about dissection alternatives is not widely disseminated; therefore, more effort to inform educators about alternatives may lead to a further decrease in animal use.

Our survey revealed that nearly half of students (48%) are interested in animal dissection and would not prefer using an alternative.

It also revealed that 37% of students would prefer using alternatives in place of dissection – but that the majority of those students do not request the use of alternatives. What can be done to address the needs of both groups of students? One strategy may be to change the current “opt out” practice. Requiring students who want to dissect to opt in rather than have students who want to use alternatives opt out would make it easier for students who want to use alternatives to be able to do so, enabling a further reduction in animal use (van der Valk et al., 1999).

It is possible that lack of awareness about dissection alternatives and their availability among the student population may be contributing to the low percentage of students requesting their use. Our survey revealed that 38% of students did not know whether dissection alternatives were available to them. Educators should be encouraged to have an open dialogue with students about the availability of alternatives prior to conducting dissection exercises, as this may contribute to a reduction in animal use.

Our study also identified a general lack of awareness about student choice policies among educators. On average, 20% of educators did not know about student choice policies at their school. Only 53% of educators in states with student choice policies knew about this policy, whereas 29% said that their school does not have a policy and 18% did not know. It is clear that many educators are not aware of prevailing policies or how to implement them. Efforts to inform educators about student choice policies and available dissection alternatives may also contribute to a reduction in animal use in education.

○ Conclusions

With the availability of innovative dissection alternatives, more can be done by the educational community to reduce the number of animals used in dissection exercises. Greater support of alternatives by teacher organizations and more widespread dissemination of information about alternatives and student choice policies would better educate students and teachers about this important issue. Providing educators (1) comprehensive information about studies that have examined student learning with alternatives versus dissection, (2) the cost of alternatives and where they can be borrowed or purchased, and (3) curriculum guides that incorporate alternatives may change educators' perceptions about alternatives and encourage their use. Also, simple changes to current policies, such as asking students to “opt in” to dissection rather than “opt out,” or merely informing students of the availability of alternatives, may have a significant impact on the number of animals used in education. Additionally, more should be done to introduce legislation that mandates student choice in states that currently lack such policies.

Acknowledgments

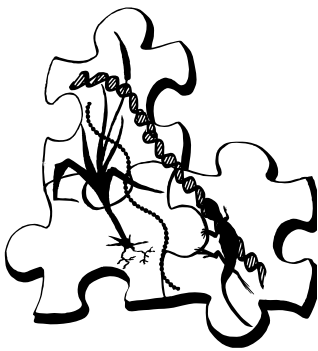
We thank members of the National Anti-Vivisection Society staff for helpful comments on survey design and the manuscript and survey participants for their feedback.

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