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WHY WHITE MICE? IMPROVING BIOLOGICAL LITERACY THROUGH ANIMAL HISTORY

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INTRODUCTION

Throughout this paper 'animals' is used for 'non-human animals' to avoid undue repetition.

The Problem

The undergraduate biology experience is fraught with so-called "weeder" courses that inundate biology students with information about the foundation of life sciences. Those that are unable to grasp the concepts are weeded from the discipline, and those that remain form a core understanding of study of life in these courses. Students then carry this knowledge through to upper level classes adding upon this foundational knowledge and forming attitudes towards biology that will eventually inform their future career and research (Dowling 2003, Southard et al. 2017, Wiggens et al. 2021). Animals are one such foundational aspect. In my experience, animals have cropped up in every biology class, whether explicitly or implicitly, from cell biology to global environmental issues. In each instance, these animals serve as the canvas for biology understanding. Their bodies are dissected to understand the systems necessary for life, their behavior is analyzed to understand decision pathways, and they are used as replacements for inquiries about human health.

As crucial as these animals are to scientific advancement, they are often not explicitly discussed in undergraduate biology courses. One of the very first biology classes I took was "Principles of Biology." In this class I used the *Campbell Biology: Concepts & Connections* textbook, in which animal stories are utilized at the beginning of almost every chapter to illustrate specific biological principles (Reece et al. 2018). This practice accurately portrays the diversity of life and the importance of understanding animal bodies; however, these anecdotes do not delve into the history of how researchers uncovered the information they're illustrating, nor why it's important for the student to know these details. In one instance, *Campbell Biology* uses a bowerbird to introduce the idea of speciation. The language in this introduction is highly anthropomorphized, or describes non-humans as having human-traits, using language like "He's a fabulous decorator" (Ibid., p 280). While this helps students understand the behavior of the bird and gives the bird an individualised presence, it can skew how students interpret data (Betz et al. 2019). There is no discussion about why this style of anthropomorphism was used or what the impact is. The *Brock Biology of Microorganisms* textbook has a section on the mouse models utilized for microbiome research, providing students with information on why mice were chosen for this study and their limitations (Madigan et al. 2018, p. 744). However, this discussion lacks information about the history of the model and the impact on the individuals, not to mention it appears rather late in the book.

Anthropomorphism and modelling such as this are convenient and widespread, but reductive practices common in biology. Anthropomorphism suggests that animals have

experiences and thought processes similar to humans. There have been arguments that this habit will create assumptions or generalizations by students, but that isn't necessarily true (McGellin et al. 2021). Some even suggest that anthropomorphisms could help create a sense of evolutionary continuity that puts humans back in the animal evolution timeline (Crist 1996). The scientific community often rejects these perspectives as unscientific and underdeveloped systems (Wynne 2004, 2007). However, to avoid the reductive aspect of anthropomorphism, some biologists suggest a critical approach that incorporates psychology and linguistics into biology (Karlsson 2012). What makes it "critical" is recognizing the shortcut anthropomorphism is and the complexities that exist in using it. Unfortunately, this is precisely what is missing in undergraduate biology classes. Often animals feel very integrated into biology classes because of the discussion of classical experiments and the use of animals as examples (like the textbook example) or models, but they are only tools in this aspect. Models used in classes help students learn about the complexities of an individual organism and improve student understanding, but they inherently focus on pieces of the organism (ie, systems of interest) (Wilson et al. 2020). Furthermore, for these models to be effective, they need thorough explanations—describing artistic choices, keys, and labels—which is often missing. This is especially important as students often enter biology classes from a variety of demographics and backgrounds that heavily influence their perceptions and attitudes towards animals (Morrison et al. 2021).

Though many of my biology classes lacked a thorough discussion of the widespread impact and importance of animals, several individual professors have taken initiative to introduce students to animal history. Much of the supporting information for this project originally came from research done by the 2019-2020 Behaving Like Animals (BLA) Praxis Lab. The BLA Praxis lab focused on understanding how humans and animals relate to each other. We explored how animals are seen and used in society from working animals to zoos, and how animals are connected to humans from neurobiology to social patterns. We met with butchers, farmers, pharmaceutical researchers, vets, and psychologists. In this class I began to see just how limited my view of animals was—a view I had expected to be expanded in my biology classes. After spending a semester exploring every aspect of our animal connections, we created a project that focused on animal shelters and helping others learn a small part of what we had learned. We created a video, a publication, and a community art piece to help convey our revelatory experience. These and other resources are housed on our Behaving Like Animals website. Through the Office of Undergraduate Research Program, I received funding to continue researching aspects of human-animal relationships beyond the Praxis Lab.

The History

Dogs, cats, birds, all kinds of exotic animals appear in countless stories, and have been a part of human history since we first started painting on cave walls 50,000 years ago (Wei-Haas 2018). For thousands of years, humans have used and interacted with non-human animals in many capacities. Initially, these interactions were in the dynamic of hunter and prey, but, beginning with dogs around 30,000 years ago, humans began domesticating animals for specific use (DeMello 2012). This snowballed into the diversity of animal relationships we have today, including, but not limited to, pets, service animals, the meat industry, hunting, rodeos, zoos, and lab animals.

There have been debates—particularly since the anti-vivisection debate in 1875—about the purpose of animal bodies in science (Bernard 1957, Bates 2017). Though the idea of studying animal bodies to understand more about human bodies had already circulated for centuries, vivisection in particular started around 160 C.E. when Galen experimented with many species of animal, from pigs to cows, to baboons, in lieu of illegal human experiments (Conner 2017). The anti-vivisection debate occurred when the scientific world was exploding with new ideas and

practices. Culturally, the publication of *Introduction to the Study of Experimental Medicine*, an 1865 argument for animal experimentation and vivisection by French physician and physiologist Claude Bernard, was sandwiched between the publications of *Frankenstein* by Mary Shelley in 1818 and *The Island of Dr. Moreau* by H.G. Wells in 1896. Charles Darwin had published *On the Origin of Species* not one year before *Experimental Medicine*. Gregor Mendel was working on his pea breeding studies at the same time that Darwin and Bernard were doing their work. The Industrial Revolution, starting in mid-18th-century Britain and proceeding into the 19th century, revolutionized science, as instruments improved and became easier to produce and scientific topics became more accessible and commonly discussed (Research Guides 2021). The world was thinking about human existence in a new philosophical and scientific light and wondering how to reconcile previous thinking and current experience. This produced works concerned with experimentation, the qualities of life, and animalistic tendencies. As we saw how we came from animals and how we could use them to understand ourselves, we began thinking about how we might learn more about the nebulous idea of how "life" works. Scientists needed a way to see the truth of how biological systems worked, rather than make assumptions based on simple observations.

Eventually, this concern with life, both in scientific and ethical aspects led to the formation of groups like the Royal Society for the Prevention of Cruelty to Animals in 1824 (Our History [date unknown]). Not long after, America followed suit with the American Society for the Prevention of Cruelty to Animals in 1866, and eventually the well-known Animal Liberation Front (ALF) and the People for the Ethical Treatment of Animals (PETA) groups formed in 1976 and 1980 (History of the…[date unknown]; Santoro [date unknown]). These are groups that are actively fighting against all animal experimentation and for humane animal treatment. While treatment of animals is important, in these debates the history of the animals is often left out.

History is an important tool to understand how the sciences function today, but history is traditionally the history of humans—animals are accessories (Cassidy et al. 2017, Mason Dentinger and Woods 2018). Animals as independent beings with a valuable role in society have been overlooked, even by those attempting to advocate for them. Animals are used and referenced in undergraduate biology research and education, and many studies appreciate that, but do the students know the background of these animals and why they were chosen for such studies? Our classrooms today focus on how these animals function, but less on how they came to function that way and why it is important to understand them. Often, particularly in cell and molecular biology classes, minute, yet vital systems are discussed in great detail. This limits the study of biology by disconnecting these systems from the larger organism or ecosystem they are affecting (Gallagher et al. 1999, Westgarth-Smith 2003). This issue of reductionism has benefitted biology learning in the past, but ultimately leaves today's researchers lacking understanding of the complexity of biology (Van Regenmortel 2004). It is valid to focus of pieces of importance when needed, for how are we to know how the whole works if we do not study the individual parts? But, can we not learn from both the entire organism *and* its biological minutiae?

The Science

Animals are particularly prolific throughout the scientific world, especially biology, as their bodies have been used to make some of the most groundbreaking discoveries, such as when Rhesus monkeys were used to develop the polio vaccine (Blume and Geesink 2000). As such, these scientific animals are often present as model organisms. According to Leonelli and Ankeny, "Model organisms are usually defined as non-human species that are extensively studied in order to understand a range of biological phenomena, with the hope that data, models and theories generated will be applicable to other organisms, particularly those that are in some

way more complex than the original" (2013). In the medical sciences it has become the pattern and expectation that doctors leave the hospital and go to the lab to look for answers, whether physically or through colleagues (Bernard 1957, p 146). Over and over, case studies have shown that animal experimentation is key to medicinal and general biological discovery (Francione 2007; Ringach 2011).

The use of animals has allowed us to learn more than ever before about how biological bodies work, but it also has led to some ill-formed assumptions about the simplicity of animals and the experiments in which they're involved. This often leads to animals becoming simply objects of research, rather than individual living beings. Animals aren't neutral spaces like a test tube or petri dish. Nor are they the perfect physiological parallel for human biology. The act of experimenting on animal bodies requires careful consideration. While there are multitudinous reasons why animal models *do* work for the purpose of furthering biological understanding, there are still inherent differences between species and their biological functions. In discussing the usefulness of animals in medical experimentation, Claude Bernard noted in 1865, "[A]mong all the animals on which physiologists and physicians may experiment, some are better suited than others to the studies depending on [the area of research]…" (pg 123). Researchers today affirm that certain organisms are more suited to particular studies, but that has become less and less of a crucial point of introductory biological research. How can we draw connections between species if we do not understand each species in its entirety, both within and without the laboratory? Continued pioneering efforts must be founded on rational and reasonable experimentation where animal bodies are studied as both models *and* individuals—more than scientific tools. If researchers can make this shift in understanding, it must then be applied to the teaching of biology.

The Solution

I believe that by providing undergraduate biology students with a brief overview of animals in history and science, we will help them become more critically thinking researchers that will find ways to improve and expand on the current animal models and assumptions. If animal history is indeed absent from biology teaching, students would show a lack of knowledge initially, and via the intervention, should experience a shift in thinking. The surveys aim to show the lack of information about animal bodies in all levels of biology classes and propose that filling in that information will change students' perceptions of animals and how we can ethically utilize them in science. By presenting new information that may "irritate" students' morals about animal research, they are presented with an opportunity to develop more rigorous ethics around animal research that they didn't have previously. This concept of a productive struggle can set up students to be more receptive to new perspectives as professors integrate animal history into their curriculum (Livy et al. 2018).

Through survey data these missing connections will be assessed through a brief educational intervention (Groves et al. 2009). The historical stories and importance of animal modeling will be presented as a short lecture format during regular class time (Wilson et al. 2020; Bohlscheid and Davis 2012; Walker et al. 2008). The lecture will focus on specific cases of animals in science and history including the thalidomide failure, the polio vaccine, and Laika the dog (Shanks et al. 2009; Gray 1998).

METHODS & RESULTS

The Presentation

Through a literature review and synthesis of research around animal history, ethics, and experimentation, this project aimed to create suggestions and resources for a module on animal

history and animals in science to be implemented in future biology classes. These resources make animals central actors, focusing on animal agency, and bringing a broader understanding into biology classes. To inform this push to improve biology understanding, a condensed version of the research done to support the module was created in the form of a 20 minute intervention to participating biology classes. The expected learning outcomes of this intervention (and the later module) are that the students will:

- Be able to articulate arguments for and against animal experimentation and be able to think critically about proposals for the use of animal bodies for science;
- Be able to identify where animals have been used in their education (current and past biology classes) as models, experiments, and analogies;
- Be able to connect biological pathways and common examples to their corresponding whole animal utilizing the ideas of reductionism vs holism;
- Understand the importance of studying animals as individuals and become familiar with animal history.

The slides covered topics such as the history of human-animal relationships, anthropocentrism and anthropomorphism, animal rights, model organisms, and examples of animal research. The information and graphics placed on each slide were chosen to help connect animal history topics with topics students were likely already familiar with, such as political cartoons and scientific diagrams. The presentation focused on creating an intervention that was both detailed and concise, utilizing images and short definitions to help students start thinking about animals and ethics in a new light, guided by their own reaction to the information presented. With each slide, I tried to connect the topic to things students may already be familiar with or interested in, such as political cartoons, short-format video, and pop culture references. This helped me show how pervasive animals are in individual lives and society as a whole.

The Survey

Before the intervention presentation a pre-survey was given to gauge undergraduate students' current knowledge of animal history and to establish a baseline, similar to other education evaluation surveys (Bohlscheid & Davis 2012). This was designed with the goal to reveal where current teaching may be falling short. A post-survey addressed whether or not the intervention had the desired effect in changing students' perceptions of animals and biological concepts, and was intended to help inform the creation of an animal history module.

Google Forms was used to disseminate the survey and collect responses. The pre-survey consisted of 13 questions, with a majority of the questions being Likert-scale responses—the scale was 1-5 with 1 = disagree, 2 = somewhat agree, 3 = neutral, 4 = somewhat agree, and 5 = agree (See Figure 1 in Appendix). One attention check question was randomly inserted and asked participants to select a specific number on the Likert scale. At the beginning students were asked to provide their uID so their pre- and post-surveys could be paired.

The surveys were open for 7 weeks during the Spring 2021 semester. Within that period there were 42 responses on the pre-survey and 44 responses on the post-survey. After pairing the surveys, removing duplicates, and eliminating unpaired responses (where a student completed only a pre-survey or only a post-survey) I was left with 33 responses that showed students' perceptions both before and after they viewed the presentation.

Results

Responses from the surveys were organized and analyzed in Excel. Pre- and post-survey answers were compared to find any shifts in attitudes towards animals after receiving information through the presentation. Each question was analyzed with a Paired t-Test and three questions returned a statistically significant p-value. These questions were #1 In my academic

and personal experience, I most often see animals portrayed as: [Tools for scientific inquiry.; Important aspects of global culture.; Cohabitants of Earth.]; #6 I experience moral conflict around animal experimentation or other use of animal bodies (working animals, animal products, pets, etc) [Likert scale]; #8 Animals have independent roles to play in history that are not subject to human needs and narratives [Likert scale].

One of the main takeaways from the student responses was the presence of cognitive conflict. Particularly in Question 6, students had a broad span of disagreement across the statements and a general positive shift in the post-survey, suggesting that students felt *more* conflict after learning more about animal bodies in science. The initial responses did not follow a regular distribution, with "Somewhat Disagree" and "Somewhat Agree" tying for the most responses, with "Agree" following, and "Disagree" receiving the fewest responses. After viewing the presentation, roughly 27% of the participants changed their answer, mainly in a positive direction with three students shifting from "Somewhat Disagree" to "Somewhat Agree", three students shifting from "Somewhat Disagree" to "Neutral", and two students shifting from "Somewhat Agree" to "Agree". All the students at either end of the scale (strongly disagree or agree) maintained their position from pre- to post-survey, but there was quite a bit of movement in the intermediate answers.

In Question 1 after viewing the presentation the general trend was for students to abandon the more passive idea of animals as "cohabitants", to the idea of animals as "Important aspects of global culture" (2) and even more to the idea of animals as "Tools for scientific inquiry" (3). This change in perspective appeared in about 18% of the group.

The results for Question 8 showed that students agreed more with the statement than predicted in the pre-survey, but there was still room for perspective shifts. A majority (54.5%) of students "Agree[d]" with the statement in the pre-survey, but nearly three-fourths (72.7%) of the participants "Agree[d]" with the statement in the post-survey. Roughly 30% of the participants changed their answer, one of the highest percentages of change within the surveys. Only one student changed negatively, but their final answer was still affirmative with "Somewhat Agree".

In the post-survey there were several questions that hadn't appeared in the pre-survey and allowed for students to give feedback on the content and style of the presentation, as well as write short-answer responses. These answers reiterated the idea of cognitive conflict found in the Likert scale responses, as well as showed students' positive reaction to many details of the presentation. The combination of cognitive conflict, yet engagement with the presented material suggests this project may be an example of productive struggle. Productive struggle is the idea that working through and struggling with difficult material leads students to form creative problem solving skills and gain a deeper understanding of the topic. This doesn't suggest giving students difficult material at every turn in an effort to help them learn, but find ways to help them connect with cognitively challenging material easily (such as with popular culture connections and easily readable slides)(Guzman et al. 2019).

DISCUSSION

Students are aware of the animals in their life to a certain extent, as was noted by students in their short answer responses. However, to what extent were they conscious of all the complexities surrounding animal research? The results of this project were expected to show the gap in undergraduate understanding of animal bodies in science, as well as informing professors about which teaching materials may help fill that gap in knowledge. I found that there is a plethora of information that is useful to students beyond the animal exposure that is common in undergraduate biology courses.

I expected that this high number of first year students would help show that students are coming into the subject of biology with little or limited knowledge about animal bodies, rights, and relationships. Rather, it seems that in their inundation with new biological topics, they have recently been exposed to animal models and experiments. However, many of the first year students reflected positive changes in their perception—defined as a shift toward thinking of scientific animals as important individuals. Third year students contributed to many (if not a majority) of answers that essentially claimed, "I knew some of this already but still thought it was good/important information." This was less what I expected from students, based on my belief that they were not receiving information about animal history, however, it helped me see how students were interacting with the information and showed that they still appreciated exposure. It seems likely that this could be because upper class students have more academic experience, having had several biology classes where these issues may have been brought up.

The Biology Connection

I believe that by providing undergraduate biology students with exposure to and opportunities to engage with animal history they will become more critically thinking researchers that will find ways to improve and expand on the current animal models and assumptions. More information about these important players in biology will only increase our scientific knowledge, furthering areas like physiology, behavior ecology, human and veterinary medicine, as well as help students simply connect with biology more (Chamany et al. 2017). Critical topics like anthropomorphism in research affect every level of biology, from large mammal camera trap research to microbial mats. Students noted that "[professors] talked about the animals as if they were human and had some level of cognitive thought process." While this helps students connect with animals, it can create issues in treating animals like humans and skewing the results of experiments. Creating awareness in students of how we have been and continue to interact with animals has crucial implications for research quality and ethics. One researcher, Emma Robinson, tickles rats in an attempt to better understand this critical model organism. She says,

> It is really hard not to anthropomorphise or use indirect measures of affect to monitor feeling in animals….We developed an objective affective bias test that could link the number of rat vocalisations to their subsequent affective state…. How do you ask an animal whether they like something or not?...The important part of our work is what it might mean going forward for animal welfare. We will stop assuming what is good for a rat from a human point of view and be able to ask the rat exactly what it likes and dislikes. (Rozenbaum 2020)

This approach makes strides toward finding ways that humans can do the research that has become so vital to our societies, while still respecting the individuals we are asserting our dominance over. In the meantime, the rest of us can help respect animals by understanding why they are so important for science. Students need to be aware of this experimental history during their undergraduate experience, because they are the researchers of tomorrow.

Suggestions for Curriculum

One of the goals of this project was to provide professors with resources for teaching animal history based on feedback from students. As has been shown in the results of this study, some information regarding animal history causes cognitive conflict. Teaching this information, on top of already challenging scientific material, can be difficult for students and professors. Cognitive load theory suggests that when presenting challenging information, professors can design their teaching so as to minimize student effort to understand inherent instructional material and manner in which the instruction is provided, and maximize effort in just processing the information and creating mental models (Guzman et al. 2019). Some ways to do this can be

found by analyzing other successful biology courses, such as those with active learning environments, where rather than just lecturing and evaluating, students are asked to actively participate and guided into higher performance (Walker et al. 2008). Insight on how to teach a large level biology course can come directly as input from students on what information they feel they need in upper-division courses (Tanner 2011). As Smith et al. (2005) stated, "...we need to transform our classes from instructor-led courses to dynamic student-centered learning arenas that engage our students in research-oriented learning."

To create this kind of classroom that helps support young researchers, particularly in becoming understanding and effective global scientists, students can integrate information on animal history and bodies in several meaningful ways. Using multimedia in lectures can be an effective method for creating variety and appealing to different learning styles (Koseoglu and Efendioglu 2015). The different information presentations, such as gifs and models, were cited frequently by students in the post-survey as something that helped them engage and connect with the topics in the presentation (see Table 2). Similarly, students can be invited to connect class subjects to experiences they're having in other classes and outside of academics. When introducing new concepts, utilize models and explain why those models were developed and the pros and cons of the chosen representations. When discussing classical experiments, briefly (e.g., one slide) introduce the model organism and the history of the choice of that organism—several websites and other resources can help provide information and visuals about these organisms. During these discussions of animal bodies, avoid anthropomorphizing language without explanation. Instead, facilitate conversation around how animals are presented and discussed in the context of relevant course material and in-class communication. As Bernard (1957) said, "science would never progress if we thought ourselves justified in renouncing scientific methods because they were imperfect; in this case, the one thing to do is to perfect the methods" (p. 126).

At the beginning of this project, I assumed that students see animals as tools for research. I had this idea that animals are test tubes—reduced versions of a laboratory bench—that drove me to focus on their individual histories and value. However, it may be necessary to start even earlier with how the life sciences ended up with standardized model organisms. The results of this study showed that students are generally aware of animals being utilized in science, but there may still be a gap in understanding why these animals are being utilized. From my experience, students are given two different ways of looking at animals: animals with names and personality (i.e., charismatic megafauna), and model organisms that are standardized in science. However, even in model organism situations, these individuals vary and affect the research. Individual histories affect research. Though model organisms are "standardized", they still end up with their own personalities. Just as there is a movement in the scientific community to view scientists as individual, human researchers, heightening the sense of scientific organisms as individuals helps people connect with and understand the research being done. As Claude Bernard said, "Physiologists and physicians must never forget that a living being is an organism with its own individuality" (Bernard 1957, p 88).

So, what needs to happen to better prepare students to be educated and understanding researchers? I believe it requires a shift in perspective on every level. Thus, in this, I agree with Henry Beston (2003):

> We need another and a wiser and perhaps a more mystical concept of animals. We patronize them for their incompleteness, for their tragic fate of having taken form so far below ourselves. And therein we err, and greatly err. They are not brethren, they are not underlings, they are other nations, caught with ourselves in the net of life and time, fellow prisoners of the splendour and travail of the earth.

APPENDIX

To view the presentation: https://uofu.box.com/s/canxqgk8wpgs612s7zqg4qa2pfqbjxze

Figure 1.

Pre-survey

- How were you directed to this study? [BIO 5350; BIO 1610; BIO 1620; Biology Newsletter; Other…][If you selected "Biology Newsletter", which biology class(es) are you currently in?]
- What year are you in school? [1st year; 2nd year; 3rd year; 4th year; 5th+ year]

Pre- and Post-survey

- In my academic and personal experience, I most often see animals portrayed as: [Tools for scientific inquiry.; Important aspects of global culture.; Cohabitants of Earth.]
- Animals are often used as examples to explain biological concepts in my education. [Likert]
- Animals or animal models are present in my academic life (research, literature, visualizations, etc). [Likert]
- Animals play a role in my personal life (pets, food, hunting, etc). [Likert]
- Animal research and experimentation is ethical when used to improve human welfare. [Likert]
- I experience moral conflict around animal experimentation or other use of animal bodies (working animals, animal products, pets, etc). [Likert]
- Animals are adequate models for humans: [Only in medical contexts.; Only for very generalized comparisons.; In any context.; Animals are not adequate models for humans.]
- Animals have independent roles to play in history that are not subject to human needs and narratives. [Likert]
- Particular animal species are suitable for particular biological problems. When learning about animal experimentation, information about why the species was chosen is provided. [Likert]
- Anthropomorphism is giving animals (or objects) human characteristics, and is often used to explain the behavior of or ideas about animals in human terms or emotions. Is anthropomorphizing animals a viable tool for scientific research (both human and animal research)? [Yes, No, Other…]
- Anthropomorphizing animals or systems (e.g. ecological niches, biochemical pathways, etc) helps me understand the concept I am studying. [Likert]

Post-survey

- My view of animals has changed after viewing this presentation [Likert]
    - How or why did your view change/not change? [LA]
- This information helped me understand the current information I am learning in my biology class(es). [Likert]
- This presentation was engaging and presented information that was new to me. [Likert]
    - Why or why not? [LA]
- Have you had any professors that you felt discussed animals in an inclusive and thorough manner? [Yes; No]
    - If yes, what did they do that you appreciated? [LA]

Table 1.

Question 12 Short Answer			
Big Category	Definition	Frequency	Quotes
Personal view	The participant feels some kind of personal connection to animals or experienced a shift (or non-shift) in personal perspective toward animals.	32%	“I'm fascinated by biology and paleontology, and I'm interested in how animals fit into our philosophy and ethics...so I've thought a lot about many of these topics already. That's why this presentation didn't really change my view.” (189)
Social view	The participant mentions the attitude or view of society towards animals.	13%	"The video did provide me with some more insight into where some of our societal views of animals stem from, however!" (129)
Previous experience	The participant has had prior experience, whether previous ideology or educational experience, with the information presented.	31%	"Much of the info I have known from previous classes or studies." (101)
Scientific connection	The participant focuses on the scientific aspect of animals and animal history, whether their use, the conflict, or the benefits.	15%	"I had never thought about why we place such high regard on certain animals (e.g. Laika) but not on all other animals that have been just as important to research." (173)

Conflict	The participant is or has experienced feeling unsure or conflict around the topics of the presentation.	9%	"I'm more conflicted about animals in research even thought they are 'lesser forms of life' because they are still part of society." (167)
Outlier			"I had not considered the subconscious moral conflict that I had when it came to studies done directly on humans." (199)

Table 2.

Question 14 Short Answer			
Category	Definition	Frequency	Quotes
Clear	Students found the presentation easy to understand and provided clear information.	14%	"It presented points in a digestible way when comparing and contrasting the way we view and work with animals." (199); "I loved the...digestible explanations of new concepts." (183)
Design	The presentation and/or information was visually or intellectually well designed and increased enjoyment and understanding.	18%	"Engaging? Definitely. It was well-researched and well-presented." (189); "I liked the presentation because it had great visual and little words on the slides." (159)
Relatable	The delivery of the presentation helped students connect to the information and	9%	"The presenter was relatable and entertaining, while also doing a great job

	presentation.		in a concise way." (147); "Great narration as well." (159); "Humor was good." (140)
Examples	Participants appreciated specific examples or details, such as case studies or history.	18%	"I thought the case studies were interesting and I didn't know much about them." (101); "I liked learning the history [of] animal testing." (126)
Novel	The information was new, provided a new perspective, or pointed out something the participant hadn't considered before.	23%	"Even though I knew a lot of the information I still learned new info." (115); "Because it did present a new perspective of which I had not thought of." (169)
Previous experience	The participant has had previous experience with the information, whether through old ideologies or educational experiences	18%	"I felt like I knew the basics of a lot of what was talked about. I had heard about thalidomide several times before, but I did not know it was involved in animal testing discussions." (141)
Outlier			"Because I have many pets and want them to know me." (131)

Table 3.

Question 15 Short Answer			
Big Category	Definition	Frequency	Quotes

Inclusive	Animals were a consistent part of the curriculum and assigned value.	17%	"My current bio 1620 professor has done a really good job including animals. And you can tell she has a lot love for them which helps a lot." (154)
Respect	Animals were spoken of as equals and treated with respect and discussed in an honest and serious manner.	46%	"...I feel as though the professors for those classes have really made an effort to educate their students about the value of animals beyond just human benefit. They talk about the animals in a way that shows they exist outside of the human sphere, giving us more equal footing in some sense." (129)
Details	Professor went beyond the regular description of animals; used examples, stories, and/or expounded on history.	37%	"A previous professor gave background on why a specific animal was chosen for a study, and the effects of the study on the animal for the rest of their life instead of ignoring their well-being." (183)

Figure 2.

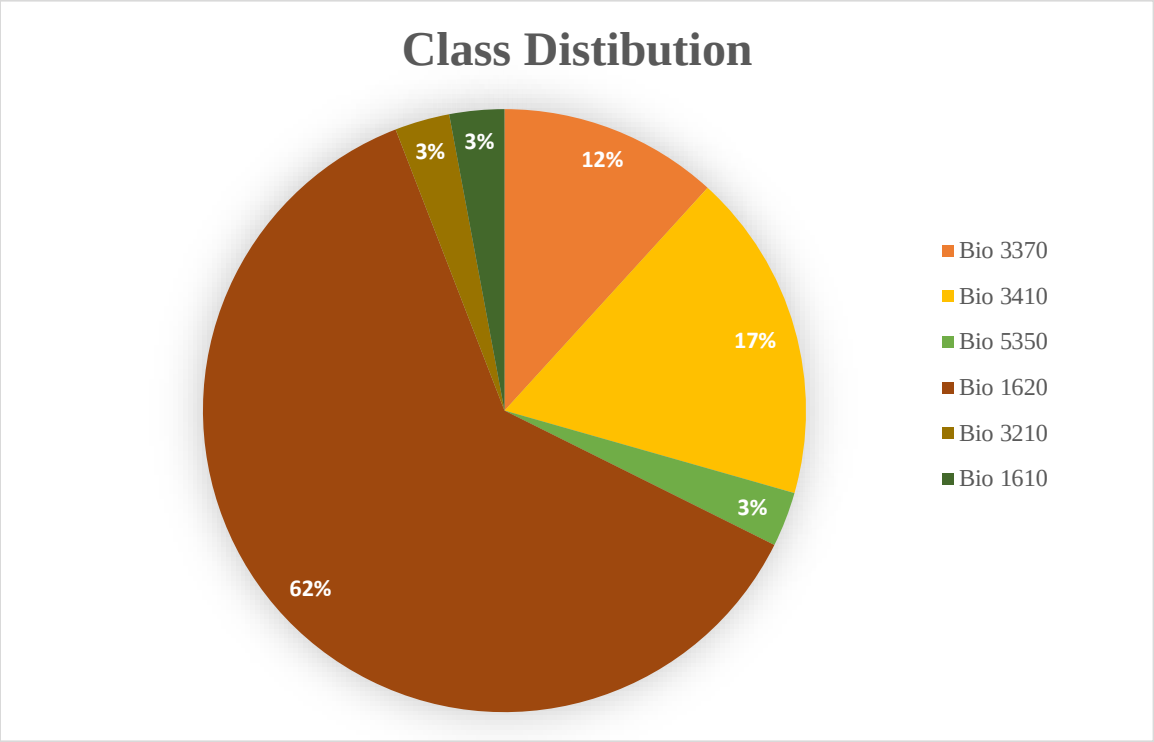

Figure 3.