Erin Larson:

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Erin Larson:

Welcome to Making Waves. I'm your cohost Erin Larson, and you're listening to part one of a four episode mini-series on education in freshwater science. In each episode, freshwater scientist will talk about an activity they've used in their class ranging from activities that take just a few minutes to entire modules of a course. We hope these will help everyone, from high school teachers through college instructors, get new ideas to use in their classes. In this episode I'll be talking with Whitney Beck, a PhD candidate at Colorado State University about an experiment she does over multiple lab periods with an upper level course.

Erin Larson:

Welcome to the podcast, Whitney, it's great to have you with us today.

Whitney Beck:

Thank you, I'm happy to be here.

Erin Larson:

Awesome. So I was wondering, to start with, if you could describe for us a little bit about the class context, where you've done the activity that you'll be describing for us? Is it like an upper level class? What type of university are you at, et cetera?

Whitney Beck:

Sure. So I'm at Colorado State University, which is a large public research institution and I instruct a stream ecology and biology lab. The students are mostly juniors and seniors and a lot of them are fish and wildlife majors, but we have some biology students mixed in as well. So it's about 25 students in the lab.

Erin Larson:

Awesome. And could you tell us a little bit about the activity that you do with these students? So how you prepare for it and then also how much class time it ends up taking?

Whitney Beck:

Yeah. So the activity I'd like to talk about today is a predator prey size selectivity experiment. So this involves using crayfish, which are the predators, and snails, which are the prey and incubating them together in quart-sized containers to see if larger versus smaller crayfish consume more or less larger versus smaller snails. So it's a pretty basic type of experiment, but I think the students really enjoy the hands on potential of it, and coming up with hypotheses they feel like they can understand ecologically what's going on and how it might translate to an aquatic ecosystem out in the field.

Whitney Beck:

So to prep for the activity, last year I actually went out and collected all of the crayfish and snails in October in Colorado-

Erin Larson:

Oh wow.

Whitney Beck:

Which is fairly difficult. I spent a lot of time with a kick net in the streams trying to find crayfish. I couldn't really see them to capture them and I had just forgotten that colder weather means they're not as active. So, that was challenging and I think this year we might end up ordering crayfish, but then for the snails, I had to go out to my advisor, Dr. Poff's house. He has a water fixture in his yard and we collected snails together and brought them back to the lab. So I think really the setup was just collecting these organisms, bringing them back to the lab, and then the students could work with them from there. But other than that no specialized materials, which makes it really simple.

Erin Larson:

Nice. And so it sounds like this was sort of a like half semester long activity, more or less, or how many class periods do you guys end up spending on this experiment?

Whitney Beck:

Yeah, so we worked with the crayfish and snails for three different class periods. Two of the class periods were the predator prey experiment where we set up the experiment one week, the students had to monitor snail deaths each day until the next class period the second week, and then the third week we actually reused the crayfish and snails to do excretion experiments where we put them in small vials, and beakers, and measured ammonium excretion, and related that to organisms size. So it was great to be able to use the organisms for multiple purposes.

Erin Larson:

Yeah, that's really cool. So it sounds like you'd sort of prepared the students for this activity beforehand and then do they have to do data analysis afterwards? What types of, do they write up a lab report? What types of assessment do you use for this activity?

Whitney Beck:

So to prepare for the activity, they first read a paper, Crowl, 1990. It's about drying streams and predator/prey relationships and how size plays into all of that. And then after the activity, they use the data as the basis for a lab report. So we spend about half of the lab where they can work in groups discussing the data, analyzing it in Excel. We use both regression and Chi square tests so they get exposure to how you can use multiple techniques to analyze datasets, and then they turn in individual lab reports. So that's the assessment and they're supposed to supplement the findings with background literature as well.

Erin Larson:

Awesome. So it sounds like a pretty complete view in some ways of scientific process from beginning to end for them.

Whitney Beck:

Yeah, and I think one interesting thing about this kind of experiment is there is a lot that can go wrong, which helps them prepare-

Erin Larson:

Yeah.

Whitney Beck:

For a career in research or post-grad careers. So we had crayfish that escaped from their quart-sized containers and we found them on the floor. And we had, sometimes it was hard to see if a snail was dead, like if a crayfish had pulled it out of its shell or if the snail was just really receded into its shell. Yeah, definitely some ambiguity in the process. So I think it was good for them to see mistakes and mishaps. So they understand the need to replicate experiments really strongly. Yeah.

Erin Larson:

Very cool. And so it sounds like overall students reacted positively to this activity, but were there certain things that they really liked or they really didn't like that you noticed?

Whitney Beck:

Yeah, so I think they, again, enjoyed having this hands on activity, working with the crayfish and the snails, and they didn't seem to mind too much coming in outside of class to monitor snail deaths because it's such a random thing to do, and they're fish and wildlife students and often haven't thought about organisms outside of the fish world. So this is a whole new area of streaming ecology for them. So just the novelty of it was interesting. I will say that they didn't, so when we used the crayfish and snails for the nitrogen excretion experiment, they did not enjoy filtering and I thought that was funny because that's something we do so much in grad school. We have to filter the excretion of water to actually run the water for ammonium. And I feel like I know a lot of stream ecologists and limnologists who spend hours of their grad school summers doing that. So I told them this is good groundwork to help prepare you for the hard labor later on.

Erin Larson:

And so it sounds like overall this is an activity that's worked pretty well with your stream ecology class the two times that you've done it so far. But have you made any changes between years or would you change this in the future based on things that have, how things have gone in the past?

Whitney Beck:

Yeah. One thing I would like to do is include the students a little bit more in the experimental design. So rather than just saying, "Here's what we're doing, here's what you have to work with," see if they have any ideas about how to better structure it or if they want to include different treatments or response variables. Like maybe, they wanted to put a disc with algae in the tanks to see if snail herbivory changes in the presence of crayfish. That could be a really cool experiment too. So giving them some options and really giving them leeway to make it their own would be something that I want to incorporate in the future. And this semester I have a pretty small class. It's only eight students. So I think that trying the bigger freedom and experimental design with a smaller class will be a good test, and hopefully we can incorporate that in future years if it works well.

Erin Larson:

Cool. Yeah. Because in the past have you been having the class analyze the whole class data or is everyone just working with their own subset of the data that they collected?

Whitney Beck:

They analyze the whole class data, but I do think with a smaller class you could maybe split into two groups and have two different treatments, and then have presentations about what you learned and share it with the rest of the class, or something like that. So there's a little more flexibility.

Erin Larson:

Yeah, that's awesome. Yeah, you end up sacrificing, we ran into something similar with the stream ecology class that I've helped teach at Cornell where we do a leaf pack decomposition project, and we were trying to figure out how we negotiate letting students work with whole class data versus designing their own mini experiments where they might have fewer replicates to then to work with. Which is definitely a trade off for thinking about experimental design sometimes, and data analysis, and prioritizing one over the other.

Whitney Beck:

Yeah. I had the same kind of experience with leaf pack decomposition data where last year I did split students into groups and let them come up with their own treatments, but a lot of their replicates washed away, and we didn't end up with a lot of data to work with in the individual groups. So we did end up combining everything into whole class data. So I understand that struggle as well. I'm sure we all go through that at some point. Trying to make those decisions.

Erin Larson:

Yeah, definite pros and cons. And so another question I had for you is thinking about, it sounds like you were teaching this for a pretty upper level majors class and do you think you could or would you be able to adapt this type of activity to for smaller or more introductory classes? It sounds like you're already adapting it for a smaller class, but maybe for a larger class size than you've had before. Anything like that for folks who might be thinking about these types of class activities?

Whitney Beck:

So I've thought a little bit about how this could be adapted for more of an introductory class because the hypothesis-driven approach, and analyzing the data in Excel, and reading lab reports, those skills could be transferable to a freshman class, or even a high school class, or something like that. And what I think would be fun for students at an introductory level is to actually come out and help collect the organisms. If that was a chance for them to get out into the field and see the natural habitat of these organisms, they might really enjoy that. And then once we're in the lab, I think simplifying the experiment would be possible. So not varying crayfish and snail size, but just picking one, having some monster crayfish and some tanks and then some tiny crayfish in other tanks and they would have some intuition about the number of snails that each of those sizes might be able to eat.

Whitney Beck:

Another thing that could be really interesting for introductory classes is leaving the crayfish for a few days and then adding the snails so the students could actually see crayfish consuming snails potentially

because we didn't actually observe that a lot in these longer term experiments where the crayfish were fresh out of the stream and had leaves and others substrate in the tanks. So if we had some hungry crayfish and could actually see them in action, I think that would be really fun for intro level students.

Erin Larson:

Yeah, that sounds really cool. So Whitney, it sounds like you've had a lot of cool teaching opportunities so far during your PhD now that you're wrapping up, and so I was wondering if you had any advice for, especially for grad students who might be teaching in the aquatic sciences for the first time based on your experiences?

Whitney Beck:

Yeah, so I will say that I was a little bit nervous at first because I am teaching mostly seniors who often have a vast wealth of knowledge, and I've tried to look at that more as an opportunity where I can be inquisitive with them and learn with them and from them as well. So providing structured time and activities, but also learning from them is something I've tried to do. So I'll give you an example. We were on a field trip last week at a stream and I just saw these logs that were covered in gelatinous masses, and I couldn't tell what they were. I'm sure I'm a phycology, so I'm trying to study algae. And so my mind immediately went to cyanobacteria, but I brought the logs to my students and they are fishery students. And so they said, "Oh, this is some type of egg, but I don't really know."

Whitney Beck:

And so we were kind of talking back and forth and wondering, and I brought the samples back to the lab. I took pictures of them, posted them on Twitter, and even respected professors were kind of arguing, "What is this? What is this mass on the wood?" Some people thought it was algae, some people thought it was snail eggs. And so I finally looked at it under the microscope and it does look like some kind of gastropod eggs. Just having that freedom though to not be sure, and to talk about it with students, and I think that makes a much more enjoyable experience for everyone.

Erin Larson:

Yeah, I completely agree. Thank you so much Whitney, for taking the time to talk to us today. I've really enjoyed it and hopefully it's helpful for our listeners as well.

Whitney Beck:

Yeah, thank you. It's been really fun, Erin.

Outro:

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