**Representing Lesson Plan Modification**

I teach Biology and try to ground all of my lessons in Ecology because I believe it is useful to show the interrelatedness of different living systems. However, one of the difficulties I have encountered teaching Ecology is that students’ lived experiences are often contrary to the lessons I am trying to deliver. For example, when discussing trophic levels in the context of food chains, I like to show students what happens to organisms at one trophic level if another trophic level is disturbed (Fig. 1 & 2). The decrease or removal of one species from the food chain often has drastic consequences for species at other trophic levels. While excellent case studies exist that give real-world examples of this phenomenon—known as a “trophic cascades”—none of the examples directly impact the students’ lives.

One example of a trophic cascade that I like to use is the removal of salmon from a food chain. Importantly, this food chain includes humans. I like this example because it is a real-world scenario that should affect humans. Hypothetically, a reduction in the number of salmon should lead to a decrease in the number of humans (as in Fig. 2). Obviously, this does not occur because humans can switch to alternative food sources as salmon become scarce. This reduces the efficacy of my lesson because there are no examples of a limited food source decreasing human populations. Of course, this is a good jumping-off point for discussions about how food chains are often unrealistic scientific models and that food webs are more appropriate because they more accurately portray the relationships among species. This does not change the fact, however, that trophic cascades do exist in nature and that they are an important concept for students to understand.

There is yet another discrepancy between students’ realities and my salmon example. I can present data to demonstrate the dramatic decline in salmon populations over the past three decades but students can still go to a grocery store or a restaurant and buy salmon. This reality makes it difficult for students to appreciate the impact that our overfishing of salmon has had on ecosystems because the decline in salmon is not immediately apparent to them. All of the data in the world pales in respect to students’ actual experiences, which leads to conceptual conflicts that are difficult to overcome with my current lesson. My goal is to change how students view the world and operate within it, so I need a way to reconcile what I am trying to teach with what students actually experience. I still believe that the salmon model provides a robust example of trophic cascades but I also feel that I need to modify my lesson in order to fundamentally change how students view ecological relationships.

Attached is an annotated lesson plan, which I believe begins to address some of the issues I have raised above. I use a cross-curricular approach that explores different ways of knowing to enhance students’ understanding of species’ interconnectedness.

**Lesson Preparation**

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| Subject: Science  Grade: 10 | Lesson Title: Food chains and trophic cascades.  Time: 78 minutes | |
| **Big Idea or Question for the Lesson:** How do declining species’ populations influence the integrity of ecosystems? | | |
| **Prescribed Learning Outcomes:**   * B3: Explain various ways in which natural populations are altered or kept in equilibrium. | | |
| **Objectives (SWBAT):** | | |
| **Content and Language Objectives:**   * Give examples of how traditional ecological knowledge (TEK) enhance our understanding of ecosystems and biodiversity. * Explain how habitat destruction, pollution and exploitation of resources affect ecosystems. | | **Skills/Strategies required:**   * Verbal and non-verbal communication skills. * Collaborative skills. * Presentation skills. * Research skills. * Problem-solving strategies. |
| **Materials/equipment needed:** Personal electronic devices, visual vocabulary cards, textbooks. | | |
| **Assessment Plan:**   * Formative: In-class activity and group presentation. * Summative: To be completed at the end of the unit. | | |
| **Adaptations:** Visual vocabulary cards.  **Modifications:** Written summary of presentation.  **Extensions:** Textbook questions. | | |

**PROCEDURE**

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| --- | --- | --- | --- | --- |
|  | **Time** | **Students will…** | **I will…** | **Indicators…** |
| **Development** | | | | |
| *Hook1:* | 10 min | * Predict what will happen to other trophic levels when a species is disturbed. | * Have four student come to the front of the class and assign them a trophic level in a food chain. * Change the number of students at each trophic level. | * Students will non-verbally organize themselves based on modifications to a food chain. |
| *Teacher-led1:* | 5 min | * Discuss what will happen to a food chain when salmon are removed. | * Explore changes to salmon food chain. * As an exercise, remove salmon from the food chain. | * Make sure students can accurately predict the results of removing salmon from the food chain. |
| *Guest Speaker2:* | 25 min | * Write down two questions to ask the guest speakers after their presentation. | * Introduce guest speakers and facilitate the questions and answer session. | * Collect questions from students for review and completion mark. |
| *Group work:* | 20 min | * In groups of three, answer the attached questions using technology. * If finished early, answer textbook questions. | * Hand out questions and circulate through groups. | * Visually assess students’ group participation. |
| **Closing** | | | | |
| *Strategy:* | 15 min | * Answer questions when called upon. | * Call on different groups to answer designated questions. * See if other groups have information to add/modify. | * Assess quality of answers and modify if necessary. |
| *Recap:* | 3 min | * Complete exit slip. | * Hand out and collect exit slips. | * Exit slip for completion. |

**Questions for Group Activity**

1. How do we know that salmon populations have declined in British Columbia (include at least two different ways of knowing)?
2. Name three factors that have led to the decline in salmon populations.
3. How has the decrease in the number of salmon affected grizzly bear populations?
4. Has the decline in the number of salmon affected human populations? Explain your answer.
5. List two methods being used to restore salmon populations in the Greater Vancouver Area. Create one more strategy to help recover the salmon populations.

**Lesson Plan Annotations**

1. Previously, I used the white board to alter a simple flow chart (e.g. phytoplankton – small fish – salmon – bear) in order to have students explore the idea of food chains and trophic cascades. In my modified hook, I take advantage of embodied knowledge to enrich my students’ learning experience by allowing them to take on the roles of the animals I present in the food chain. This method allows students to think about processes at the level of individual organisms (e.g. bear-salmon), which can help them internalize complex biological models, such as trophic cascades (Wilensky & Reisman, 2006). In this activity, students act and reason as their assigned animal to solve the problem of fluctuating food supplies. For instance, if there is a decrease in the salmon population, how might the bear population react?

To run this activity, I would divide students equally into the following four trophic levels: phytoplankton, small fish, salmon, or bear. Then, I would group the students by trophic level and have them stand at the front of the class. I would start by instructing the small fish group to “catch” three phytoplankton without talking. If they do not catch the required amount of food they will die. I will do the same for the salmon and bear groups. Obviously, not every predator will have enough prey to survive. This tells us something about how food chains are structured, with lower trophic levels having significantly more individuals in order to support higher trophic levels. I would now ask students to restructure themselves into a food chain that allows all animals to survive. The students should organize themselves so that there is mostly phytoplankton, some small fish, fewer salmon and even fewer bears. Now I could ask students what would happen to the number of organisms at each trophic level if I removed most of the salmon. The students could point up or down to show whether their population will increase or decrease respectively.

To summarize this activity, I would ask students to describe their reasoning in determining whether their population would increase or decrease. I would also ask follow-up questions such as, “If the salmon decrease, what might the bears do to survive?” This gives students the opportunity to access higher cognitive processes (e.g. analysis and application; Anderson *et al.*, 2001). By including embodied learning into my lesson, I present students with another way of knowing that allows them to more robustly engage with the process of trophic cascades, rather than just memorize the information (Wilensky & Reisman, 2006).

1. After students had had the opportunity to grapple with the idea of food chains and trophic cascades, I would invite two guest speakers from the local community to share stories about salmon with my class. These speakers would describe the real effects that reduced salmon populations have had on the surrounding ecosystem and economy. Ideally, one speaker would be local First Nations and describe how their people traditionally harvested salmon, how they do it now and how the introduction of commercial fishing has impacted the salmon. The second speaker would be a youth from a local interest group, such as the Salmon Habitat Restoration Project (SHaRP), who describes how people are trying to mitigate the effects of human development on salmon populations and why saving the salmon is important.

Using the Indigenous pedagogy of storytelling, my students would be able to extract pieces of the stories that are relevant to their construction of salmon as a vital component of their local ecosystem (Li, 2015). Further, the inclusion of a youth who is close to their age may help my students appreciate that the decline in salmon is a real problem that people like them are involved in solving. I think that using a storytelling pedagogy would allow my students to relate what I am teaching them in class with what is going on in their community. This is a more holistic approach to education that links the classroom to real-world issues that affect my students.

**Conclusion**

Increasingly, educational researchers are recognizing the importance of different ways of knowing in students’ construction of discipline-specific knowledge. However, incorporating new knowledge systems requires a dissolution between the Eurocentric model of education and our ideas about what qualifies as legitimate knowledge. As educators, we must appreciate that each way of knowing brings unique benefits to our students’ understanding of course content and we must strive to incorporate different knowledge systems as stand-alone entities. For example, we do not need to justify the use of Indigenous ways of knowing through their similarities with a “Western” knowledge system. Instead, we should value that both ways of knowing lend to a dynamic and multidimensional understanding of the prescribed content (Parsons & Beauchamp, 2012).

Of course, regardless of the knowledge system we employ, it is our obligation as educators to continually assess whether or not the students’ realized learning outcome is the same as our intended learning outcome. In other words, no matter which educational path we take, we need to make sure that students end up at the desired destination. With all ways of knowing, there is the danger of introducing conceptual conflict, which can act as a barrier to learning. This problem is compounded when incorporating multiple ways of knowing into a single lesson. We must take special care that our use of disparate pedagogies does not obscure our intended message.

I believe that the thoughtful incorporation of embodied learning and Indigenous pedagogies into my existing lesson plan has the ability to make Ecology and the idea of trophic cascades more relevant to my students. Further, I feel that by including different ways of knowing into my lesson I give students more opportunities to successfully access the desired content knowledge.

**References**

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