

Peppered Moth Simulation as Evidence for Natural Selection

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OLTD 502

Introduction

For my redesign and critique on an online activity for OLTD 502, I have chosen to an activity that I use in my face to face Biology 11 class. As part of the curriculum, students are expected to understand Darwin's Theory of Natural Selection as it is related to changes in DNA and speciation. There are many different ways a teacher can chose to meet this learning outcome. For this particular outcome, I use an online version of a pepper moth simulation. This particular simulation provides students with an opportunity to use technology to research the lifecycle of the peppered moth, the environmental factors that caused the moth to change its dominant color and then to simulate the predator and prey interaction.

As the students progress through the website, they use a handout to fill in the data from the different scenarios. After the data collection process is over, the students then move on to a set of analysis questions to demonstrate their knowledge of the Theory of Natural Selection. Although the students were engaged in the original activity and they could complete the data collecting process independently, they struggled to complete the other questions. They found the critical thinking questions difficult to complete without assistance. I quickly realized that the simulation itself was a useful tool to understand the Theory of Natural Selection and that the handout itself was lacking. At this point, I set about redesigning the handout so that it would meet the learning objective.

Reinventing the handout wouldn't just mean adding in some clipart and sticking on a couple more questions. The main issue with the previous assignment was that it lacked clear objectives and acceptable evidence that learning had occurred. The goal behind changing the original assignment was to increase student understanding of the Theory of Natural Selection by implementing the three stages of backwards design. Understanding by Design, introduced by Grant Wiggins, suggests that teachers should design their learning materials based on a three step process: identify desired results, determine acceptable evidence and plan learning experiences and instruction. Following this framework for improving student achievement, I redesigned the pepper moth simulation handout by using this approach.

For the redesign, I first filled in the Understand by Design template created by Wiggins. The template includes guided questions to help the teacher remain focused on the three main components of lesson design mentioned above. Creating the new activity from knowing the end results, helped keep the new assignment focused. Once the template was completed, I then went on to recreate the accompanying student handout. Using my filled in template, I added in certain sections and deleted others out of the handout. I detailed comparison listed by the three stages of backward design are included below. Combining these two components together, the new assignment now had clear objectives and supplied evidence of student understanding of Natural Selection.

The three stages of backward design

Stage 1: Identify desired results

In the original, predesign of this activity, there are no objectives listed at the top of the assignment to clearly indicate what the student is expected to learn from completing the simulation. In the redesign, I have stated three clear objectives:

- To explain the events that lead to the industrial melanism
- To collect, analyze and interpret data collect from the peppered moth simulation
- To discuss how the peppered moth reinforces Darwin's Theory of Natural Selection

Without having clear objectives at the beginning of the lesson, it's difficult for both the student and the teacher to reach the desired learning goals. I find that when my students are in a lab or performing a simulation as with this assignment, there is a tendency for them to want to 'play' and go off on different tangents. Although that experience can be valuable, it's helpful to have clear learning goals to redirect them to become more focused on the formative assessment at hand.

Stage 2: Determine acceptable evidence

In this stage of Understanding by Design, the goal is to determine the evidence that would demonstrate that the student has met the learning goals. In both instances, the original and the redesign use analysis questions to check for understanding. In the original assignment, it's difficult to see if the students have met the learning outcome, but in the redesign, the analysis questions match up with the objectives of the assignment. The new set of questions also take into account that students occasionally try to sabotage the desired results of the simulation by deliberately eating the moth that is the most camouflaged. To overcome this issue, I have included the following questions as part of the analysis:

1. Did the data you collected in the light forest support the theory of natural selection? Why or why not?
2. Did the data you collected in the sooty forest support the theory of natural selection? Why or why not?

In doing so, students can have the data in their table backwards because they deliberately did the opposite of what is expected of them, yet still explain that they understand the concept of Natural Selection. Redesigning the handout so that the end results are in mind while designing the assignment, insures that the intermediate steps in the assignment match the overall goals.

Stage 3: Plan learning experiences and instruction

After clearly indicated the learning objectives and determining how the students are going to demonstrate their understanding, it's time to develop the activity. I have chosen the peppered moth simulation to demonstrate the Theory of Natural Selection for several reasons: it is a classic case study of evolution that has been widely studied, it is one of the rare cases that the evidence of evolution occurring can be witnessed within one person's life time and finally, because Kettlewell's experiment is so eloquently simple. Although studying the Theory of Evolution can be daunting for some students, having them simulate that they are a bird eating moths can take a serious topic and make it more engaging and approachable.

The assignment begins by having the students visit several different sections of the website prior to starting the simulation. The original has the students jumping in immediately to perform the simulation. Having used the original assignment with my students, I found that my students had a lack of understanding of the life cycle of this particular moth, the environment that it lives in and the predator and prey interactions. Because they lacked this background information, the students often had difficulty answering the analysis with any depth to their responses. Once I included the background information into the handout, the students had more knowledge and more confidence that lead to more in depth and greater detailed written response.

An important skill in any area of Science is collecting and analyzing data. Both handouts have included this important concept and not much has changed in either assignment. Having done the original handout several times with my students, I noticed that there were always one or students trying to sabotage the assignment and eat the dark moths in the sooty forest. As mentioned above, I added in additional analysis questions that allows this small sample of students to still analysis their data correctly. The remaining of the questions designed to allow the students to interpret their data and then explain their knowledge of Natural Selection. Creating the desired learning outcomes first and then

developing the activity afterwards increases student understanding of the learning required of them.

Conclusion

I was introduced the backward design approach while in my teaching practicum. At the time, this seemed like a utopian idea because I was so unfamiliar with the curriculum, I had no idea where I was going, let alone to develop lessons backwards. However, I did see the value in the concept and quickly adopted the idea of Understanding by Design and incorporated it into my teaching practices. I now, when given a new course, do work backwards as I develop my units and lessons.

I found this activity particularly useful. I had used the original version of the simulation in class, and although I liked the idea of the activity, I found that my students lacked a deep understanding of the concept of Natural Selection. The activity quickly became something that was fun to do. As I changed the assignment to include more background information on the moth, its environment and previous experiments, it was evident by the responses from my students on this assignment and then again on summative assessment, that they had a greater understanding of Darwin's Theory of Natural Selection.

As I continue in this program, I see the value of including more simulations and online activities for my students. From my own observations, when technology is used, students are more engaged, they work closely in with peers in small groups collaborating, there are less discipline issues and their retention of the material is high. Seeing these positive results and then combining it with the theory of Understanding by Design, I can see myself transitioning into a blended classroom and away from the traditional face to face environment.

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