Stickleback fish

ENGAGE

- Slide show shown to group
- **Phenomena**: Is having armor always an advantage? Why or why not?
- What do fossils reveal about the past, present and the future?
    - Brainstorm what we can learn about the evolutionary past by looking at fossils that are on your tables. Add your ideas to the quickwrite.
    - Does it give you insight into the value of armour?
    - Fossil record photos
- Impressions of bones
- Skeletons
- What are the characteristics you are noticing about the fossils?
    - Survey 1 Survey about your observations
        - After you take the survey discuss results either as think pair share or class discussion
        - my fossil record slide
            - Does this change what you wrote above?
            - How do explain the differences?
            - Questions?
            - Why are they different?
            - How did that happen?

EXPLORE

- Now lets look at more about these fish
- HHMI site

- We will start with Experiment 2 the Fossil part of the virtual lab
    - In the "Notebook" tab, click on the "*Tutorial 2: Score a Fossil Fish*" button. Follow the instructions for learning how to score fossil specimens before attempting Experiment 2.

    - When you have finished, if you have mastered the fossil scoring, click on "*Go to Experiment 2*". Follow the instructions as they appear in the window. YOU MAY SKIP Part 1: Preparing Fossils. Click on the "*Skip Part 1: Fossil Prep*" button. In Part 2, you will score fossil fish from geological Layer 2 (an older layer) and then from geological Layer 5 (a more recent layer). Follow the instructions in the window on the left to score the fossil fish for Part 2. Once you have completed the scoring for both geological layers, enter the totals on **SURVEY II AND** into the boxes on the right and press the "*Submit Totals*" button

    - Now follow the instructions to graph your data using the automated version of the graph ("*Click here*" in number 2). Then compare your data to those of the research group by clicking on the blue button on the left "*Verify Your Data*".

FINISH SURVEY II

EXPLAIN

- Debrief fossil experiment above
    - Results of Survey II
- Look at graphs
- Quick write: What did you notice about what was happening between the layers?

- Video of what expect to see (on HHMI website 2 minutes long)
    - How does this happen?
    - Earth Science focus

        - In the video it says that this place (Truckee formation in Nevada) was once a lake filled with fish.
        - What do you observe about this place today?
        - What questions do you have about this place?

    - Read the text- https://www.zionnationalpark.com/explore/guidebook/geology/

    - How did our streamtables model the processes described in the reading.

    - Change the model to better model processes described in the article- do another run (or two if you have time)

Back to our fish

- Learn about the ice age affects
    - Show short video (on HHMI website 1 minute long)

- Learn about pelvic reduction
    - Short video (on HHMI website 1 minute long)

EXTEND-Part II of virtual lab

- Extension of our learning on living fish we will now do Experiment 1
    - OPEN SURVEY III AND FILL IN THROUGH PREDICTIONS

- NOW GO BACK TO THE VIRTUAL LAB at the HHMI site
    - Click on the "*Notebook*" tab. Then click on the link to begin the lab ("*Click here*").

    - Now click on "*Start Tutorial 1*". Read through the text and graphic information to the right, and then proceed to staining and scoring living fish for experiment 1. You start the

tutorial by clicking on the tray of fish to begin, and then following the directions as if you were the laboratory student.

- In the window you are viewing, you may toggle between the lateral (side) view of the fish, and the ventral (belly) view of the fish. Moving your cursor around the image should move the image to allow for best viewing. You should also magnify the image ( ) for a closer image of the fish. When you have decided on your score (complete pelvis, reduced pelvis, or absent pelvis), click on your answer to see how you have done. Score all 20 tutorial fish.

  - When you have finished, if you have mastered the scoring, click on "*Go to **Experiment 1***".** Follow the instructions as they appear in the window. You will start by staining some fish as would occur in the real lab in Part 1. Follow the instructions to stain a jar of fish from Bear Paw Lake. In Part 2, you will score fish from Bear Paw Lake and from Frog Lake. These two lakes have the same river drainage to the ocean, which means that they were probably populated by the same sea-run population of threespine stickleback at the end of the last ice age. However, these lakes provide distinct environments for their resident sticklebacks—in particular, one lake contains large fish, such as the trout, that prey on stickleback, and the other lake lacks large predatory fish.

  - Follow the instructions in the window on the left to score the fish for Part 2. Once you have completed the scoring for both lakes, enter the totals in **SURVEY III (where you left off above)** AND into the boxes on the right and press the "*Submit Totals*" button

  - Now follow the instructions to graph your data using the automated version of the graph ("*Click here*" in number 2). Then compare your data to those of the research group by clicking on the blue button on the left "*Verify Your Data*".

- **Review Survey III results**
  - Predictions?

  - What did the data tell us?
- Learn about the ice age affects
  - Show short video (on HHMI website 1 minute long)
- Learn about the ice age affects
  - Show short video (on HHMI website 1 minute long)

- Learn about pelvic reduction
  - Short video (on HHMI website 1 minute long)

EVALUATE

- How can we evaluate what we learned?
- We can apply what we learned to a new scenario
    - Ceanothus IMAGES
    - Survey IV

Teacher notes:

The film that summarizes what is happening to these fish is on the HHMI website. Search for the short film "***The Making of the Fittest: Evolving Switches, Evolving Bodies***". *(may be under "show more")* Watch this excellent video (about 15 minutes in length) as an introduction to exactly to what is happening http://www.hhmi.org/biointeractive/vlabs/stickleback/index.html.