

Loberg Lake Data Collection

Abstract

Does the lateral plate trait in a population of stickleback fish change over time? Is the trait variable among individuals in the population? In this simulation, students collect a random sample of stickleback fish from a virtual Loberg Lake and arrange them by lateral plate number on a labeled bar graph. They repeat the process for three sampling periods.

In tandem, teachers use a separate website that distributes data, controls student progression through the simulation, and aggregates the data from all students to generate a class bar graph for each sampling period.

Learning Objectives

- Individuals in a population typically vary in their traits.
In this example, the number of lateral plates in stickleback populations varies.
- The frequencies of trait variations in a population can change over time.
In this example, The frequencies of lateral plate phenotypes in the population of sticklebacks in Loberg Lake changed over time: low-plated fish became more frequent, and completely plated fish became less frequent.

Estimated time

- 30 minutes

Materials

- Computer lab with internet and projection. Teacher will need to project a separate internet site during the activity.

Instructions

1. *Set up:* Prior to beginning this activity with your class, using the Chrome browser, go to the teacher website on Teach.Genetics.utah.edu and set up a name and a PIN for each class. **USE ONLY NUMBERS IN THE PIN, AND MAKE SURE IT IS UNIQUE TO YOU.** Passwords are optional.

Important Advisories:

- Your PIN must be unique to you. If someone by chance chooses the same PIN, your simulation will not work. For a unique PIN, we suggest using a combination of your date of birth and class period number:

Example – DOB: 11/18/1972

Class period: 2

PIN: 1118722

Advisories (cont.)

- Because data sets are generated randomly and distributed to students as each class proceeds through activity, the class **MUST** progress through each data collection period in sync.
- Once the activity begins, students may not join in late. If you know that a student will be coming in late, you can log them on at the beginning of the activity on the computer that they will use.
- It is important that students **NOT** hit the back button during the activity, or they will be kicked out and unable to rejoin. If they do hit the back button, they will have the opportunity to cancel, thereby returning to the activity.

2. *Begin the activity:* Log on to the teacher website and enter the PIN you made for the class.
3. Tell students:
 - a. Go to the Stickleback Data Collection web page on Learn.Genetics.utah.edu
 - b. Log in with your name and the class PIN
 - c. Set your minnow trap and wait. **DO NOT AT ANY TIME HIT THE BACK BUTTON ON YOUR BROWSER.**
4. As students log on, you will see their names appear on the teacher site, along with a yellow status bar. As they set their minnow trap, the status bar will turn from yellow to green, indicating that they are ready for 1990. When all students have set their traps, the "Start Sorting Phase" button will turn green.

Note: Whether it is green or yellow, the "Start Sorting Phase" button still works. Make sure all students are logged on and ready before you proceed. Once the activity progresses, they cannot join in late.

Click "Start Sorting Phase."

5. Tell students:
 - a. Check your trap.
 - b. Sort the fish from your sample by number of plates. (To sort, click and drag the fish to the appropriate column in the graph.)
 - c. Submit your data.
 - d. Compare your graph with your neighbor's.
6. While students are still working, their status bars will be yellow. When the status bars for all students turn green and read 1990 done, click "Show 1990 Data." This will bring up an aggregate graph showing all of the class data.

- 7.** Project the aggregate graph and discuss:
 - Raise your hand if your graph looks different from your neighbor's.
 - Why might the graphs could look different?
 - Raise your hand if your graph looks different from the aggregate.
- 8.** Discuss sample size:
 - The fish in one trap may not be representative of the whole population. A larger sample size is more representative of the population.
 - (Optional) To demonstrate, ask two students about their preference in pizza, then make a statement about the whole group's preference based on those answers. Discuss the accuracy of your statement).
- 9.** Review graph interpretation:
 - What is the range in plate number?
 - What is the most frequent number of plates on fish in this sample?
- 10.** Click "Return to Class Manager" to exit the graph view.
- 11.** Tell students to set their minnow traps and wait.
- 12.** Click "Proceed to 1996." (When all students are ready, it will turn from yellow to green.)
- 13.** Tell students to set their minnow traps.
- 14.** When all of the students' traps are set, the "Start Sorting Phase" button will turn from yellow to green. Click "Start Sorting Phase."
- 15.** Tell students to check their traps, sort their fish, and submit their data.
- 16.** When the status bar for all students turns yellow and reads 1996 done, click "Show 1996 Data" to bring up an aggregate graph showing all of the class data.
- 17.** Project the aggregate graph and discuss:
 - What is the range in plate number?
 - What is the most frequent number of plates on fish in this sample?
- 18.** Click "Return to Class Manager" and click "Compare Data." Project the comparison of the 1990 and 1996 data.
- 19.** Remind students that 6 years have passed, and sticklebacks live for roughly 2 years. Discuss:
 - How are the 1990 and 1996 graphs different?
 - Describe lateral plate trait in the population for 1996.

- Are these the same fish from the previous sample, or different fish? (Answer: They are different fish.)
 - Where did the fish with fewer lateral plates come from? (Answer: They are the great-grandchildren of the 1990 population.)
20. Click “Return to Class Manager” to exit the graph view.
 21. Click “Proceed to 2002” (this button should be green).
 22. Tell students to set their minnow traps.
 23. When students’ status bars show that they are ready for 2002 and the button is green, click “Start Sorting Phase.”
 24. Tell students to check their traps, sort their fish, and submit their data.
 25. When the status bar for all students turns green and reads 2002 done, click “Show 2002 Data.”
 26. Project the aggregate graph and discuss:
 - What is the range in plate number?
 - What is the most frequent number of plates on fish in this sample?
 27. Click “Return to Class Manager” and click “Compare Data.” Project the comparison of the 1990, 1996, and 2002 data. Discuss the differences between the samples. Emphasize that each sample represents the descendants of the previous sample—not the same fish.

At any time, you may use your PIN and password (if you entered one) to return to the Class Manager and view the data for this class. You may wish to print the aggregate graphs for the three sampling years and give copies to your students. If for some reason you cannot access the data, example aggregate graphs are available in the Teacher Guide for the paper version of this activity.

After students complete the online activity, help them fill out their **Natural Selection Checklists**:

28. Fill in “Stickleback” for the ORGANISM and “Lateral Plate Number” for TRAIT.
29. Change over time
 - a. View the aggregate graphs. Ask students to decide if the data show a change in the trait (lateral plate number) in the population over time.
 - b. Check the appropriate box on the checklist: Has the frequency of the trait changed over time? (Yes)
 - c. As a group, generate an evidence statement.
30. Variability
 - a. Check the appropriate box on the checklist: Does the trait vary? (Yes)

- b.** Individually or as a class, write an evidence statement that sums up the data that indicate the trait is variable.

References

Bell, M. A., Aguirre W. E. & Buck, N. J. (2004). Twelve years of contemporary armor evolution in a threespine stickleback population. *Evolution* 58(4), 814-824.

Bell, M. A. (n.d.). Contemporary evolution of threespine stickleback in Loberg Lake, Alaska. Retrieved February 17, 2010 from the Bell Lab website.



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