



Clipbirds*

This hands-on activity allows students to experience variation within a population and the effect of selection pressure on the population. Which variations are advantageous for survival and reproduction in East Clipland? In West Clipland?

Evolution is the result of natural selection acting upon variation within a population. Organisms with favored traits within a given set of environmental circumstances have a selective advantage over individuals with different traits. It is this mechanism that leads to speciation. It is important to understand that favored traits are only advantageous within a particular situation and may not aid survival in another circumstance. A cat's long tail may aid in balancing on a tree branch but be disadvantageous in a house with frequently closing doors. In the case of the fictitious Clipbirds, different types of food favor different beak sizes. One beak size is superior to another only in context.

The classic bird beak activity usually involves having students attempt to pick up various objects with a wide variety of "beaks," including scissors, spoons, etc. This traditional approach demonstrates competition in an ecological sense, but does not clearly demonstrate *variation within a population, which is central to evolution*. In the Clipbirds activity the "beaks" are all the same, except for size. The proportion of big-, medium-, and small-beaked birds changes in response to the available types of food.

Vocabulary: evolution, variation, population, adaptation, advantage, characteristic, speciation, reproductive isolation

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See: <http://www.ucmp.berkeley.edu/education/lessons/clipbirds/>

Learning Goals

Big Idea 7: Intra-specific differences

- Individuals of the same species may differ.

Big Idea 8: Adaptation/Evolution

- Species are adapted to their environments and species adapt to changes in their environment. If the environment changes only certain species survive.
- Organisms with traits best suited to their environment have better chances of survival.
- Those organisms carrying traits that are better suited for a particular environment will have more offspring.
- Selection pressure could lead to a change in the characteristics of a population.
- Adaptation requires both variability and selection pressure.
- Given an understanding of the needs of a given organism, identify particular physical traits that would help it to survive in a given environment – e.g., "What would <organism> need to have to survive in <environment>?"

Big Idea 11: Descent with modification

- Species evolve from common ancestors.
- Different species could arise from one species if different groups had different selection pressures.

Lesson Plan

1. Estimated time

This activity should take approximately 45 minutes.

2. Introduce the activity (Engage)

Display the Clipland Scene transparency and tell the class a fanciful but engaging story about a population of imaginary birds (Clipbirds) that lives happily in a faraway fictional place, known as Clipland. Point out to the class that somehow the large population became divided into two smaller populations, east and west. Perhaps a mountain range rose up in a big hurry, or a flock of the Clipbirds got lost and ended up on the opposite side of a preexisting range of mountains. (This is fictional, so have some fun with it.)

3. Guided inquiry (Explore)

Note: Initially, two groups of six students will start the game. Most of the class will be involved as “offspring” are added.

Materials

- Six bags of “food” (assembled by ER team, for East and West Clipland, Seasons 2-4)
- 20 large binder clips
- 20 medium-sized binder clips
- 20 small-sized binder clips
- 30 plastic cups
- 1 Food Values transparency (pdf)
- 1 Clipbird Populations transparency (pdf)
- 1 Clipland Scene transparency (pdf)
- 1 overhead transparency projector

Procedure

1. Ask the students to notice how the birds in East and West Clipland are alike and how they are different from each other. Help them to notice that the beaks of the birds vary in size: big, medium, and small.



Be sure to discuss the different size beaks as *variations within a population*.

2. Explain that birds of various beak sizes usually do just fine, but it takes more food energy to maintain the larger beak size than the smaller sizes.
3. Display the Food Values in Megacalories transparency. Allow students time to understand that the various foods have different food values and that birds of different beaks sizes have different needs.
4. Select six students to be east birds and six to be west birds. Within each group, give two students large clips, two students medium clips and two students small clips. Each student/bird also gets a plastic cup to serve as its stomach. Tell them that in order to eat, they must use the clips in the correct clip mode (demonstrate) and they must put all food that is successfully eaten into their “stomachs” (plastic cups).
5. Spread out the food for the 2nd Season in two places that represent East and West Clipland.
Note: it is easiest on a carpeted floor, so the food items do not roll around too much.
6. Give them 20 seconds to eat all they can. Make sure they do not scrape or shovel the food into their stomachs, as this will badly skew the results.
7. After the feeding frenzy, put up the Food Values transparency. Ask students to calculate the value of the food they ate (help them with one or more examples written on the board). If a student doesn’t eat enough to survive then he turns in his beak and sits down. If a student ate enough to survive then she continues as part of the population. Each student who ate enough to reproduce gets another bill the same size as her own and selects a student from the audience to be her offspring.
8. Have a crew of students clean up all uneaten food from the floor and return to the Ziploc bag.
9. Put up the Clipbird Populations transparency. Record 2 birds in each of the boxes labeled 1st Season because that was the initial number. Ask the now-living east and west birds to raise their beaks if they are now in the game. Include all surviving birds and their offspring. Record the numbers in the 2nd season boxes. (Note: these are the birds resulting from the 2nd season of feeding.)
10. Repeat directions 5-9 with the food for the 3rd season. Before spreading the food, let students know that the content of food has changed (i.e., the quantity of each food type is different).
11. Repeat directions 5-9 with the food for the 4th season. Before spreading the food, which has again changed, ask students what types of environmental pressures might have caused this change (e.g., drought, insect invasion ruining the crop, etc.).
12. Have all students turn in their beaks and clean up the mess.
13. Put up the Clipbird Populations transparency.
14. Ask students to describe what happened to the Clipbird populations and what they think caused the changes.
15. Keep the discussion going so that students can create their understanding that selection can happen within a population that can favor one type over another.

4. Discuss the activity (Explain)

The activity covers a number of important concepts:

- Evolution results from selection acting upon genetic variation within a population.
- Adaptations often persist in a population because they are in some way advantageous.
- Inherited characteristics affect the likelihood of an organism's survival and reproduction.
- Evolution acts on what exists.
- The proportion of individuals with advantageous characteristics may increase due to their increased likelihood of surviving and reproducing.
- Speciation requires reproductive isolation.

Use the above concepts as a guide to asking questions or use the following questions at the end of the activity:

- Display the Clipbird Populations transparency and ask students what the numbers tell them. What do they notice about the birds on each side?
- What happened to the Clipbird populations in the two different areas?
- Which type of beak was helpful (advantageous) in East Clipland? In West Clipland? Why?
- We changed food by dumping out the contents of a Ziploc bag. How would food sources change for birds in real life? For example, sometimes changes in the weather affect the amount of available food. In Florida in the winter of 2009-10, there was a cold snap and orange trees were affected.

5. Make an evolutionary tree (Elaborate)

After the activity, display the food bags in order – West Clipland, Seasons 2, 3, and 4 on one side; East Clipland, Seasons 2, 3, and 4 on the other. Ask students about the content of these bags. What happened to the food supply? Can they come up with scenarios for why this might have happened? How does this tree of bags relate to the "tree of life" in the Lego activity?

