

Evolutionary Adaptations of Predators in their Environment

Lesson plan for grades 5-8

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Source: "Toothpick Birds," lesson 11 in *Laying the Foundation in Middle Grades Life and Earth Science*

Find more information on the Galapagos Finches at <http://www.bioquest.org/birdd/index.php>.

LENGTH OF LESSON: 50 Minutes

TEKS ADDRESSED:

7.2 Scientific processes: The student uses scientific inquiry methods during field and laboratory investigations.

The student is expected to:

- (B) Collect data by observing and measuring;
- (C) Organize, analyze, make inferences, and predict trends from direct and indirect evidence;
- (D) Communicate valid conclusions; and
- (E) Construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.

7.3 (C) Scientific processes: The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to represent the natural world using models and identify their limitations.

7.10 (B) Science concepts: The student knows that species can change through generations and that the instructions for traits are contained in the genetic material of the organisms. The student is expected to compare traits of organisms of different species that enhance their survival and reproduction.

7.12 (C) Science concepts: The student knows that there is a relationship between organisms and the environment. The student is expected to describe how different environments support different varieties of organisms.

CONCEPTS:

We say animals and plants are adapted for their environment. An adaptive response is an often reversible plastic response to an environment that has evolved to increase fitness, such as shivering in the cold, crawling into a cool hole when it's hot, and adjusting internal hormone levels biochemically. These heritable adaptations make species better able to compete for limited resources and thus survive in their environment over time.

Acclimation is a change of function and tolerance that results in a change of response to new physiochemical conditions and can be observed as a period of initial response, period of adjustment, and finally, a steady state.

DEVELOPMENTAL APPROPRIATENESS FOR MIDDLE SCHOOL STUDENTS:

The exploration activity offers everyone a chance to participate and safely explore adaptive differences in phenotypes of birds. While manipulating their tools in the exploration, adolescents use their sense of touch and spatial reasoning, and practice organizing their thoughts during the explanation and elaboration.

PERFORMANCE OBJECTIVES:

The students will be able to:

- Compare acclimation and adaptation,
- Calculate percentages of total results from experimental data,
- Interpret from their calculations which type of food their "beak" is best adapted for.

RESOURCES:

The following "foods" are for a class of 20 students

200 beans (lima beans, black beans, etc.)

200 toothpicks

200 fake leaves or flowers

200 pennies

The following tools to use as "beaks" for a class of 20 students

5 pairs of chopsticks

5 spoons

5 pairs of tongs

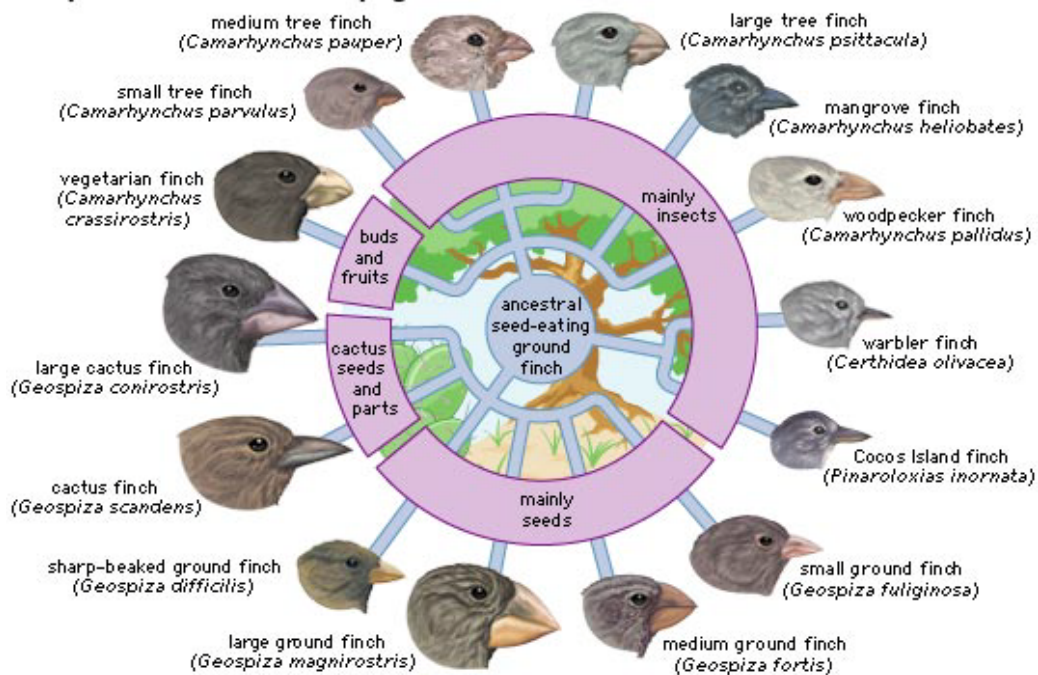
5 knives

20 3-oz. paper cups to use as "crops"

SUPPLEMENTARY MATERIALS, HANDOUTS:

- Student Lab and Procedure sheet (1 per student, 2-sided)
- Student Pre-assessment/Post-assessment sheet (1 per student, 2-sided)
- Acclimation and Adaptation PowerPoint Slide Show
- Picture of Galapagos finches (elaboration) like the one pictured below found at <http://faculty.scf.edu/odaffej/WasDarwinWrong.3/WasDarwinWrongEDIT11.html>.

Adaptive radiation in Galapagos finches



ENGAGEMENT

Time: 5-10 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<p>Say: "Adaptation and the environment is what we are going to discuss in today's lesson, but first, I want to see what you know before we get started. Here is a pre-assessment. You have one minute to answer the questions.</p> <p>[Pass out pre-assessment, pg. 7]</p>		
<p>Use Acclimation and Adaptation PowerPoint Slideshow to illustrate the differences between acclimating to a change in an environment and adapting to your environment through generations through genes.</p> <p><i>Note to Teacher: Additional facts and probing questions are written in the notes section of the Power Point Slideshow.</i></p>		

EXPLORATIONTime: 20 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<p>Today, we are going to explore how beak variation among closely related finches have adapted these predators for specific diets. You will model predatory behavior by feeding on prey items using specific tools. I will go over the instructions for the lab with you before our materials handlers pick up the supplies.</p>		

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<p><i>Make sure students are in 5 groups of 4 at their tables. Show the instructions page on the doc cam so the students can follow along and have a sampling of the supplies in front of you to demonstrate their use.</i></p>		
<p><i>Read through the Lab sheet and demonstrate using the lab tools before handing out the lab sheets. The students will complete their data tables completely with calculations during the explanation.</i></p> <p><i>Here are the rules:</i> <i>~You must use your "beak" only.</i> <i>~You may "eat" only one piece of food at a time.</i> <i>~You must place the food in your "crop" before you can reach for another insect.</i> <i>~You must stop feeding when time is called. If you are reaching for food and the teacher has called time, do NOT finish reaching for it. Instead, put your "beaks" down.</i></p>	<p><i>So what are you going to do first?</i></p> <p><i>Which of your food items will represent insects? Seeds?</i></p> <p><i>How long will each round be?</i></p>	<p><i>[Write hypothesis about which beak will pick up which food best.]</i></p> <p><i>[pennies]</i> <i>[beans]</i></p> <p><i>[10 seconds]</i></p>

EXPLANATION
Time: 5 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<p>We are going to find the average number of items picked up between the two rounds for each type of food. <i>(show formula on the doc cam)</i></p> <p>We will use this formula to determine the % selected for each type of food:</p>	<p><i>How could we find out which type of food is the best diet for your particular beak?</i></p>	<p><i>[Calculate how many of each type we picked up and then see which one we got the most of.]</i></p>

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<p>% selected = (#of particular type of food collected/# of that type of food given to the group)x100 Go ahead and fill in the last two columns of your chart on your lab sheet.</p>		
	<p><i>Tell me about your percentages. Which food did you find easiest to pick up with your tool? Why? Which food did you find the most difficult? Why?</i></p>	<p><i>[answers will vary]</i></p>
<p><i>Say: “Now that we know that certain tools are better suited to pick up different items. This holds true in the real world. Animals that have changed over time to better suit their environments have adapted to their environment. The key to this term is the fact that the change is over the course of many generations.”</i></p>		
<p><i>Say: “On the other hand, I noticed that all the people who had the same tool still had different numbers. That’s because I noticed that many of you adjusted to using an unfavorable tool. Animals in the real world also do this. When the arctic fox adjusts to the changing environment by changing its fur color, this is an adjustment by the individual animal. We call this acclimation.</i></p>		

ELABORATIONTime: 7 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
Ask:	<p><i>Why do you think the finches on the Galapagos Islands developed so many types of beaks?</i></p> <p><i>What are some ways that humans have adapted to their environment?</i></p> <p><i>What are some ways that humans acclimate to their environment?</i></p>	<p><i>[Accept all possible answers as long as they include justifiable environmental change.]</i></p> <p><i>Examples could include people who move to Austin, TX from northern states think our winters are mild, while native Austinites think winter can be very cold.</i></p>

EVALUATIONTime: 5 minutes

What the Teacher Will Do	Probing Questions	Student Responses Potential Misconceptions
<i>See post-assessment below, pg 8.</i>		

Name:

Date:

Adaptations Pre-Assessment

Indicate whether the following is *adaptation* or *acclimation* by writing the word in the blank.

_____ An organism becomes accustomed to a new climate or environment, particularly through a physiological adjustment.

_____ A heritable adjustment or alteration by a species over time that improves its chance of survival and reproduction.

A man decides to become a fireman. While working at this job, he grows strong and his muscles get big due to the physical work. When this man has children, can we predict that they will also have big muscles since their dad does? Why or why not?

Describe/discuss an example of an acclimation and an adaptation.

Name:

Date:

Adaptations Post-Assessment

Indicate whether the following is *adaptation* or *acclimation* by writing the word in the blank.

_____ An organism becomes accustomed to a new climate or environment, particularly through a physiological adjustment.

_____ A heritable adjustment or alteration by a species over time that improves its chance of survival and reproduction.

As a human population in Central Texas, our consumption of pizza has increased over time. What acclimations or adaptations might our bodies acquire due to the type of food we like to eat?

A man decides to become a fireman. While working at this job, he grows strong and his muscles get big due to the physical work. When this man has children, can we predict that they will also have big muscles since their dad does? Why or why not?

Describe/discuss an example of an acclimation and an adaptation.

Name:

Date:

Adaptations Post-Assessment [ANSWER KEY]

Note that the Post-Assessment is very similar to the Pre-Assessment.

This is to allow statistical comparison of changes in answers by students and classes.

Indicate whether the following is *adaptation* or *acclimation* by writing the word in the blank.

[Acclimation] An organism becomes accustomed to a new climate or environment, particularly through a physiological adjustment.

[Adaptation] A heritable adjustment or alteration by a species over time that improves its chance of survival and reproduction.

As a human population in Central Texas, our consumption of pizza has increased over time. What acclimations or adaptations might our bodies acquire due to the type of food we like to eat?

[Answers here could vary greatly. Some might accurately say that there won't necessarily be the same type of selection happening as discussed during class because the pizza is not limiting certain individuals, and therefore we may not see adaptations in our phenotypes. They might mention that our weight is increasing as we consume more pizza. Or, they could get creative and design new facial structures such as wider, rounder mouths that can take in more pizza at once, etc.]

A man decides to become a fireman. While working at this job, he grows strong and his muscles get big due to the physical work. When this man has children, can we predict that they will also have big muscles since their dad does? Why or why not?

[We can't predict that because this phenotypic "acclimation" to his work environment is not heritable. Only the genetic part of evolution through adaptation can have evolutionary consequences.]

Describe/discuss an example of an acclimation and an adaptation.

[Answers may vary. Possible correct answers include any of the animals in the PowerPoint Slideshow.]

Name:

Date:

Evolutionary Adaptations Lab Procedure

Purpose: In this activity you will observe how beak variation among closely related finches have *adapted* these predators for specific diets. You will model predatory behavior by feeding on prey items using specific tools.

Materials (per group of 4 students):

Foods: 20 beans (seeds), 20 toothpicks (worms), 20 cotton balls (flowers/buds), 20 pennies (insects)
Beaks: 1 pairs of chopsticks, 1 spoon, 1 pairs of tongs, 1 knife
4 small paper cups to use as "crops"

Procedure:

1. Read through the entire procedure before beginning.
2. In the space marked HYPOTHESIS on the student answer page, formulate a hypothesis as to which type of beak might work best with which type of food.
3. In the space marked PURPOSE on the student answer page, write the purpose of the lab.
4. Take note of the DATA TABLE on the student answer page.
5. You are going to be a predatory "bird" feeding on various "foods" trying to survive. When instructed to begin, you will have 15 seconds to "feed" on one type of food using only your assigned beak. A food counts as being "eaten" when it is put into your "crop" in your cup.

Here are the rules:

~You must use your "beak" with one hand only. You must stick with your beak and not trade with someone else during the four rounds of the experiment.

~You may eat only one food at a time.

~You must place the "food" in your "crop" before you can reach for another food.

~You must stop feeding when time is called. If you are reaching for an insect and your teacher has called time, do NOT finish reaching.

6. After time is called after each round, put all captured food into the plastic cup labeled "ROUND 1."
7. Complete your data table accurately. Determine how many of each type of food was consumed for each type of beak:
8. Find the average number of items picked up between the two rounds for each type of food. Use the following formula to determine the % selected for each type of food:
$$\% \text{ selected} = \left(\frac{\text{total number of a particular type of food collected}}{\text{total number of that type of food given to your group}} \right) \times 100$$
9. In the space marked EXPLANATION on your data table:
 - ~Provide specific reasons why you think certain foods were easier to pick up with your "beak."
 - ~Tell which type of food your beak is best suited for. Which one is your beak least suited for?
 - ~List ways that we might change this lab to make it better, such as variables that could be better controlled.

Name:

Date:

Evolutionary Adaptations Lab

PURPOSE

HYPOTHESIS

DATA TABLE

My Beak: _____

FOOD	ROUND 1	ROUND 2	AVERAGE	% Selected
Beans (Seeds)				
Toothpicks (Worms)				
Cotton Balls (Flowers/Buds)				
Pennies (Insects)				

SAMPLE CALCULATIONS

% selected = (total number of a particular type of food collected / total number of that type of food given to your group) x 100

EXPLANATION