

## Lesson 6. How is a population of radishes likely to change when hungry caterpillars arrive?

### Plan Lesson 6

By now, students are familiar with a general framework for the process of natural selection and a tool we call 6 Key Steps in Natural Selection. In Lesson 3 they created a graph to describe the distribution of variants of the plant trait “hairiness” in a population of radish plants. Today they will use graphs and 6 Key Steps to figure out how a population of radishes might change over several generations when their environment is altered by an invasion of hungry caterpillars.

In this lesson, students focus on a case of natural selection in plants. They explore a scientist’s findings summarized in a set of graphs that serve as evidence for the mechanism of change over time.

But first, students watch a video describing the plant life cycle and analogize to the life cycle of piloses they learned about in Lesson 4.

#### Learning Targets in this Lesson

- Graphs can tell the story of trait change over multiple generations.
- Individuals with beneficial trait variants have more offspring than those that don’t. This explains how a change in the frequency of a trait variant takes place over multiple generations.
- Natural selection occurs in plants just as it does in animals.

Sequence of Experiences		
<b>1. Introduction, Life Cycle Video, Graph Review</b>	 All Class	 10 Minutes
<b>2. Set the Stage for Group Work</b>	 All Class	 10 Minutes
<b>3. Find Evidence in Graphs</b>	 Small groups	 10 Minutes
<b>4. Make Meaning</b>	 All class	 10 Minutes
<b>5. Wrap Up</b>	 All class	 5 Minutes

#### Materials

##### For the class

Class graph from Lesson 3

A paper 6 Key Steps for the class to complete in the lesson. Keep and post after completion.

Plant Life cycle video

Slide deck for this lesson

For each student

Notebook pages 13-14

**Preparation**

- Post the class graph from Lesson 3 if it isn't already displayed
- Locate the 6 Key Steps chart template in the L6 section of your crate with the "Story" column—equivalent to the "Story Strips" column from L4—left to be filled in during the lesson
- Preview the plant life cycle video.

**The Lesson**

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**1. Introduction, Life Cycle Video, Graph Review**



All Class



10 Minutes

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Introduce today's investigation question:

*How is a population of radishes likely to change when hungry caterpillars arrive?*

Explain why the class starts with a **video about a plant life cycle**.

*Remember that in the case of piloses, we learned that when an adult pilosa stayed healthy it had enough energy to have more offspring than adults that didn't stay healthy. Today's case is about a population of plants: radishes. What about an adult radish plant that has enough energy to have offspring?*

*Wait. Does a radish plant have offspring? What do radish offspring look like? In the case of plants, seeds are the offspring. Let's look at a short video of the plant life cycle.*

Show the video.

Ask students to retell the part of the radish life cycle starting with the seeds produced in the radish flowers. What happens to the seeds?

Listen for:

*When radish plants are healthy, they drop lots of seeds which sprout up into little plants (like the ones you saw in Lesson 2).*

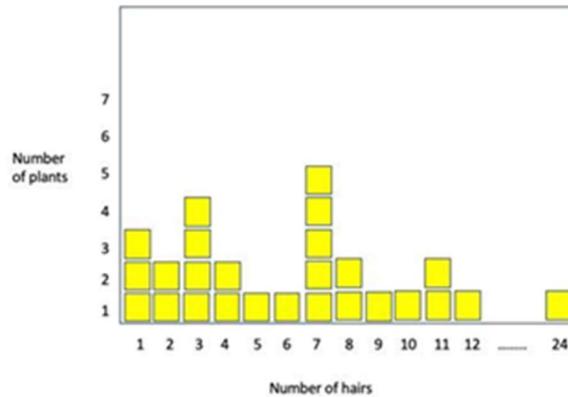
*These seedlings quickly grow into full grown adult plants like in our video.*

*The seeds from one generation of plants grow into the adults of the next generation.*

**Review how to find information in a graph.** Explain that today’s case also features the plant trait “hairiness” in a population of radishes. In this case, the radish population’s environment changes when a group of hungry, plant-eating caterpillars arrive in the radish garden.

Tell students they will use Nikola’s graphs to figure out the details of today’s story. So first, you will review how to “read” or get information from a graph.

Refer to the Lesson 3 graph that you have posted in the classroom, which should look something like the sample below.



Give the graph a **name** or title.

Point to a single sticky and ask what this square represents. [The number of hairs on the leaf stalk of one individual radish plant.]

Ask how many plants had fewer than 5 hairs.

Ask what the most common number of hairs is.

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**2. Set the Stage for Small Group Work**  All class  10 Minutes

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Before students move to small groups, reiterate today’s question:

*How is the hairiness trait in a population of radish plants likely to change when hungry caterpillars arrive?*

Point to the paper version of the 6 Key Steps chart. Explain that by the end of the lesson, students will be able to describe all the steps in this change over time story. Ask the class to help you fill in the first two steps in the column titled “The Story” (rows 1 and 2) with the information you have already provided. Ask:

- *What trait are we looking at in this new case?*
- *What are the variants of that trait?*
- *What's the environmental change in this case?*

Listen for and record these ideas for the “The Story” column on the paper chart:

Key Steps	The Story
Variation in traits	Trait = hairiness
<i>What is the trait and what are its variants?</i>	Variants = none, a few, some, lots of hairs
Environments change	Hungry caterpillars arrived – these are predators/ herbivores
<i>How did the environment change?</i>	

*We'll come back to the chart shortly. But let's talk about what we think will happen next. The caterpillars are hungry – they're going to try to eat the radish plants.*

Project pictures of the leaves of two radish plants: one has no hairs and the other is hairy.

**Picture 1**



**Picture 2**



Ask:

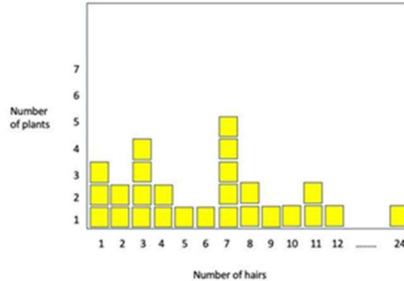
*Do you think the hungry caterpillars would prefer to eat the hairier radish plants, like the plant in Picture 1, or the less hairy radish plants, like the plant in Picture 2?*

Ask for raised hands to show which plant students think caterpillars will prefer. Have someone from each group very briefly explain their answer. Tell students that by the end of the lesson, they'll have an answer to this question.

Next, tell students:

*Nikola wanted to know if radishes would look different many generations after the hungry caterpillars arrived. We're going to use her data to predict how the radishes will change!*

Point again to the sticky-note graph that students made with Nikola’s data in Lesson 3 and ask students to predict which plants the caterpillars will eat. Explain that you are going to be the caterpillars by removing the stickies. Ask students which plants you think the caterpillars will eat. As the students offer suggestions, remove the corresponding sticky note from the graph. Continue this until you’ve removed approximately 8-15 sticky notes; this should be enough to help the students see the change in the distribution.



The class will likely agree that many or all the plants with no hairs will be eaten. There may be disagreement about which/how many of the few-haired plants will be eaten.

Tell the class that they will work in small groups to look at Nikola’s data to determine if the class prediction—shown in the sticky graph—was correct.

### 3. Find Evidence in Graphs



Small group

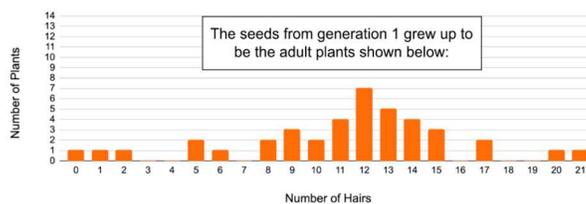
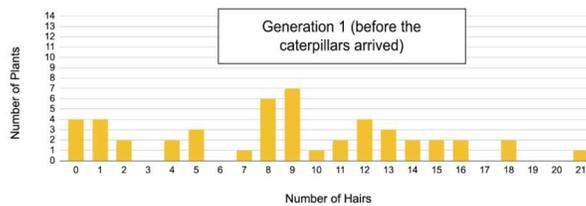


10 minutes

Have students move to their small groups. Encourage them to discuss their ideas and answers to the questions with their groups and then record answers in their own notebooks.

#### A. Find evidence in the line plots

Ask students to turn to page 13 in their notebooks where they will see Nikola’s graph of the plants before the caterpillars arrived (yellow) and the seeds from generation 1 that grew up to be adult plants (orange). Ask students to discuss the question: Was the class prediction accurate? What do the graphs tell us about which plants the caterpillars ate?



Circulate among small groups, checking for students' ability to find information from the graph.

After 2-3 minutes, call the class to attention and ask a few volunteers to share their answers. If there is general consensus, summarize and move on.

*I see there's agreement that plants with no hairs or not many hairs may not survive the caterpillars and the hairier plants will survive and produce seeds that can grow into the next generation of plants.*

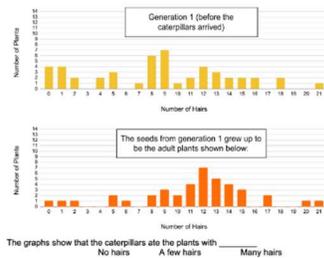
*What changes did you see in the next generation?*

If there is disagreement, ask a few volunteers to explain their group's thinking. If you think students are having trouble getting information from the graphs, do a quick review with a group or with individuals. If they disagree on which plants the caterpillars would destroy or damage, ask one or two students to provide their reasoning.

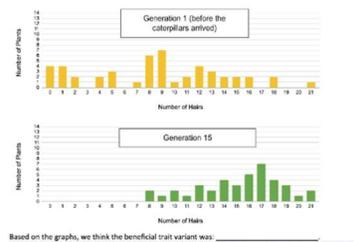
### B. What is the beneficial trait variant?

Have students turn to page 14 in their notebooks.

Lesson 6: How is a population of radishes likely to change when hungry caterpillars arrive?



Lesson 6: How is a population of radishes likely to change when hungry caterpillars arrive?



Explain the next challenge is to use the information in the two graphs on page 14 in their notebooks to figure out which is the beneficial hairiness trait variant in this case. After they discuss ideas with their group, they should write answers in their own notebooks.

Note: Students may wonder why the radishes took longer to evolve (15 generations) than the piloses (5 generations). If so, explain that less hairy radishes were probably more able to deal with their environmental change than the piloses with thicker trunks. This is because the caterpillars might have only eaten a part of the less hairy radishes so they might still have had a few offspring.

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#### 4. Make Meaning



All class



10 Minutes

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Gather the class (with their notebooks) in a discussion circle.

Project the graphs of generation 1 and generation 15. They show a shift to the right (more hairs) from one generation to the next.

Tell the class they can use their notebooks any time in this discussion

*You have just used graphs to figure out part of the hairiness change over time story. Let's look at the 6 Key Steps in natural selection chart. We filled in the first 2 rows at the start of class.*

*Now can we complete the rest of the chart?*

Point to the 3<sup>rd</sup> row of the 6 Steps chart you have posted and ask:

*What did the graphs tell us about a beneficial trait variant?*

Listen for:

- The line plots show us that there used to be lots of radishes with no/few hairs before the caterpillars came but the 2<sup>nd</sup> generation graph shows that there are very few.
- So we think the caterpillars ate those plants so they died or were harmed and didn't have seeds.
- So we think that the hairy variant must be beneficial.

Fill in row 3 on the chart (see reference example below) and then point to the 4<sup>th</sup> row.

*What can we say about being healthier and having more offspring?*

Listen for:

- The graphs show us that there are more hairy plants in the 2<sup>nd</sup> generation (evidence from graphs).
- We know that offspring tend to look like their parents so the hairier plants must have been healthier because the seeds grew up to be hairier plants in the next generation.

Fill in row 4.

Point to the fifth row.

*What can we say about the time it takes for the hairiness trait to change?*

Listen for:

- We saw there was change after only one generation. But an even bigger change by generation 15.
- After more time and more generations, maybe the population will be mostly very hairy plants.

Fill in row 5.

The last row is the investigation question.

*The last row is really our investigation question today: How is a population of radishes likely to change when hungry caterpillars arrive?*

*What should we write in this row?*

Based on student responses, fill in row 6.

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## 5. Wrap Up



All class



5 min

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Ask the students to briefly summarize what they will “take away” from today’s lesson.

Provide the sentence starter: “In today’s lesson we learned that \_\_\_\_.”

Listen for ideas such as the ones below, and add them to the Take aways chart:

- Graphs can give evidence to tell us which trait variant was beneficial
- When caterpillars invade, over time, hairier plants will become more and more common.

Our questions for the next lesson are:

*Do the 6 key steps apply to present day animals?*

6 Key Steps chart completed as reference for teacher.

The Case: radishes, caterpillars and hairiness trait variant		Where did the evidence come from? This column is not included on the chart. This information is for teacher reference.
Traits vary?	Trait= hairiness Variants = none, a few, some, lots of hairs	We were told
Environmental Change?	Hungry caterpillars arrive	We were told
Beneficial trait?	Hairier plants survive and are healthier, no/few hairs die or are harmed	We saw there were more hairy plants in the generation after the caterpillars arrived and very few no/non hairy ones
Healthier/more babies?	The hairier plants had more seeds/babies that would grow up to be adults in next generation	We saw in the 2 <sup>nd</sup> graph that there were more hairy plants which must have come from seeds from healthy parents
Many generations?	Will happen again and again	We saw graphs of several generations and there were more hairier plants each time
Nowadays look different?	Radish plants are hairier now than they were many years ago	Graphs show us that there are more hairier plants in each generation