

Lesson 2. Are All Radish Plants (and Snails) the Same?

The “Big Idea”	Although individuals in a population have similar traits, there is variation from one individual to another. A trait variant can be helpful or harmful, or neutral to an individual depending on the environment.
Investigation Question	Are all radish plants (and snails) the same?
Summary	Students complete the variation notebook activity. In small groups, students zoom in on a plant (radish) and an animal (snail) trait and collect observational data from a small set of individuals. They consider the possible benefits of a particular trait variant (e.g., longer rootlet, more vibrantly colored whorls) and brainstorm how it might benefit an individual’s chances for survival and reproduction. The class pools their ideas to answer the investigation question. They repeat the variation notebook activity and reflect on whether their responses have changed.
Materials	<p>For the class</p> <ul style="list-style-type: none"> ● Slide deck for this lesson <p>For each small group of 3-4 students</p> <ul style="list-style-type: none"> ● A set of germinating radish seeds planted 5 days before ● A set of snail shells <p>For each student</p> <ul style="list-style-type: none"> ● Notebook pages 4-8 ● Hand lens

Lesson Description and Rationale

In the last class, students were introduced to scenarios in which populations of animals look different nowadays than they did long ago. They were provided with images of long ago and nowadays scenarios and were asked for their initial ideas about what happened in between, what we call “the missing middle,” or the mechanism of change over time. This lesson takes an important first step in building an explanation of the process scientists call natural selection.

Variation is an essential ingredient for natural selection. Variation or variability occurs naturally in any plant or animal trait. Individuals in a population have the same set of traits – for example, an insect mouthpart used to suck up nectar, legs used for motion, or a rootlet that emerges from a germinating seed. However, if you look carefully at a particular trait and compare the trait as it appears in each individual, you’ll find small or sometimes large differences – some individual insects in a population have mouthparts of different lengths than others’; a toad may have longer legs than another toad; rootlets may be straighter or curlier from one radish seed to the next. These differences in traits are called trait variations (or trait variants). Particular trait

variants may be of little consequence to the survival and reproductive capacity of individual members of a population under certain circumstances, but under different environmental circumstances, they may be helpful or harmful to an individual.

Traits vary! This seems like a simple idea. What's tricky is that when we talk about variation, we need to think about a trait and variations of that trait and to think of the significance of each trait variant for individuals in the population. In Lesson 4, students will think of the impact of individual trait variants on a population as a whole.

Today, students look at a population of germinating radish seeds and a group of snail shells to see whether these traits vary between individuals – or not. If there is trait variation, students speculate whether a particular variant might be helpful or harmful to survival and the chance to have babies (reproduce) – or neither!

Note: The whole lesson is devoted to the idea of variation. Trait variations occur naturally and are the raw materials for natural selection. Students may initially resist the idea that there is variation within a population and think that all individuals in a population have identical traits. Helping students understand trait variation is crucial to their eventual understanding of natural selection.

Half the class will look at a group of germinating radish seeds that came from the same batch, are the same age, and were grown the same way. They will look for a trait that all seedlings have in common. They will decide if this trait is the same in every seedling or varies in some way. They record their radish data. The other half of the class observes snail shells, looking for a trait common to all of the shells and then identifying variation in that trait.

They use their observations to answer the question.

Are all radish plants (and snails) the same?

Finally, they speculate on the idea that a particular variation might be helpful or harmful or neither. This lesson lays the groundwork for Lesson 3, in which students use graphs to depict and model variation in a population.

Learning Targets in this Lesson

- Individual plants in a population may look similar but they also differ from each other. This is called “variation.” These little differences – for example, hairier versus balder – are known as “trait variants.”
- A trait variant can be helpful to an individual or it can be harmful or it can be neither.

Sequence of Experiences		
1. Introduction and What Do You Think Activity	All class	5 Minutes
2. Look for Evidence of Variation	Small groups	20 Minutes
3. Make Meaning and What Do You Think (Now) Activity	All class	10 Minutes
4. Wrap Up	All class	5 Minutes

Preparation

- Plant radish seeds at least 5 days before this lesson. Directions for germination are provided in a separate instruction sheet:
https://www.evolvingmindsproject.org/files/ugd/cc79a9_3a724e998aca4569b41cb869fb72bd7d.pdf?index=true
- Organize all materials that students will need to examine the variation in the germinating seeds and snail shells.

The Lesson

1. Introduction and What Do You Think Activity (5 Min)

Ask students to open their science notebooks to page 4. What Do You Think?

Imagine you come upon a group of 5 plants that are all the same kind and the same age. Would you expect the plants would all look the same or would they look like one of the other 3 possibilities? Circle your choice. We'll come back to this at the end of class!

Note: Keep this introduction very brief so there's time for the Lesson 2 activity.

2. Look for Evidence of Variation (20 Min)

In the last class you observed pictures of a population of animals as they looked many hundreds of years ago and nowadays. There were no pictures of what things looked like in the time in between – so you were asked what you thought was happening in “the missing middle.”

We said that a population is a group of similar individual plants or animals and that a structure like leg length or color or mouth parts is called a trait.

Maybe you noticed that individuals in the population you studied had the same traits but the traits weren’t always exactly the same. We call these differences variation and that’s our focus today.

Show the class the picture of the owls many years ago.

Are the owls all the same?

Model the use of the terms population, individual, trait and variation,

*This is a **population** of owls, there are six individuals. A **trait** we notice right away is feather color. There’s **variation** in the color among individual owls. In this population of owls, more individual owls have the light color variation of the feather color trait.*

Ask if students know the word “variation,” or if they have heard the word or if they know what it means. You can check for understanding by referring to another picture that small groups used in Lesson 1 and asking students to describe a trait and variation.

Note: Here are some traits and trait variants that students may notice
Guppies: trait-coloration; variation-lots of spots or fewer of spots
Owls: trait-color of feathers; variation-darker or lighter feathers
Cane toads: trait-leg length; variation-longer or shorter legs
Soapberry bugs: trait-mouthpart length; variation-longer or shorter mouthparts

Briefly review the activity.

- Students will work in small groups.
- Half the groups will work with 10 germinating radish seeds (a small population of radishes) and the other half with a set of 6 snail shells (a small population of snails). After 10 minutes, the groups switch: radish groups look at shells and vice versa.

Project or post the steps in the small group activity.

Look for evidence of variation. Are all radish seedlings or snail shells the same?

1. Observe radish seedlings **or** snail shells and see if you can find a trait that varies.
2. Discuss the variations in that trait that you can see with your group.
3. Discuss your ideas about whether a variation might be helpful or harmful to an individual radish seedling.
4. Record observation of variations in your notebook on pages 5 and 7.

After 10 minutes, the groups switch from radish seedlings to snail shells or snail shells to radishes!

3. Make Meaning and What Do You Think (Now) Activity (10 Min)

Gather the class in a discussion circle.

The **purpose** of this discussion is to consolidate students' understanding of the (1) distinctions between an individual and a population and a trait and trait variant and (2) the idea that trait variants can be helpful, harmful or neither to an individual. Helpful trait variants make it more likely an individual will survive and reproduce.

Discussion question: *Are all germinating radish seeds the same or is there variation?*

Ask someone to describe evidence from the radish seedling observations.
Ask the class if there is agreement and if there are questions.

Note: In this lesson we do not want to talk about the influence of external factors (some seeds got a little more water than others, etc.). We want to keep the focus on characteristics that plants inherit rather than environmental factors.

Ask the class the same questions about snail shells.

Follow up questions relevant to the role of variation in natural selection:

Do you think in a group of plants or animals you'll always find variation or is variation rare? What makes you think so?

Does variation matter? Do you think a trait variant [name a variant you heard students identify, for example, longer/shorter root lengths], could be helpful, harmful or neither? What makes you think so?

Link the ideas in this lesson to everyday life.

Try this! Look at one kind of plant or animal (dandelions, carrots, squirrels, the leaves on a tree) in your everyday life. Can you find a trait that varies? Can you think of an organism (plant or animal) you studied earlier in the year or in another grade and recall any variations in that population?

What Do You Think (Now) Activity

Finally, ask students to turn to page 8 in the notebook and complete the second What Do You Think sheet.

Ask for a show of hands

Was your prediction the same?

Different? (if so, what changed your mind?)

4. Wrap Up (5 Min)

Summarize the discussion:

In a small population of radish seeds that came from the same packet and were grown in the same conditions, we see similar traits but observe that there is variation. We think having certain trait variants could make a difference to an individual plant's survival and ability to develop seeds that can grow into new radishes. We had similar thoughts about snails' shells.