

Variation in Traits

Lesson 5b: Changing Environments

Grade 3	Length of lesson: 45 minutes	Placement of lesson in unit: 5b of 7 two-part lessons on variation in traits
Unit central question: Do all of the mice living in the same environment, such as a field or forest, have an equal chance of surviving?		Lesson focus question: How do trait variations help living things survive if their environment changes?
Main learning goal: Variation in traits and the environment affect which plants or animals of the same kind survive long enough to produce young (babies).		
Science content storyline: Often, trait variation means that some individuals of the same kind of living thing are more likely to survive than others in their environment. If the environment changes, individuals with certain trait variations are more likely to survive for a longer time. This means that both trait variation and the environment affect which individuals are more likely to survive.		
Ideal student response to the focus question: If the environment changes, living things with certain variations of a trait will be more likely to survive than those with other variations. For example, if there's a drought and the land turns even browner, beetles with the brown color trait will have a better chance of surviving and having babies than yellow or red beetles because they blend into the environment better.		

Preparation

Materials Needed

- Science notebooks
- Chart paper and markers

Student Handouts and Teacher Masters

- 5.1 Changing Environments (Reading and Data Table) (1 per student)
- 5.2 Changing Environments Data Table—Answer Key (Teacher Master)

Ahead of Time

- Review the content background document, especially sections 3 and 4 on variation.
- On chart paper, reproduce the Changing Environments Data Table from handout 5.1 (Changing Environments). Alternatively, display the data table using a document reader.
- **Note:** Students may find it difficult to understand that individuals of the same kind that survive are more likely to have babies, or why this is important from a life-science point of view. Be prepared to address any confusion as it arises.
- **ELL support:** This lesson is heavily language based, so ELL students will need strong support to succeed in understanding the content and participating in the activities. Introduce students to the lesson materials, structure, and content in advance so they know what's expected of them. In particular, walk students through handout 5.1 (Changing Environments) and make sure they understand the reading and the data table. Review the words *drought*, *more/less likely*, *long enough*, and *particular*. Introduce the following vocabulary terms: *scenarios*, *surroundings*, *compatible*, *moths*, *produce young/babies/the next generation*, *advantageous*, and *crack seeds open*. Note that *young* in this lesson is a synonym for *babies*. The phrase *browner* (e.g., browner beetles; the desert turned browner) may confuse ELL students, so review the difference meanings.

Lesson 5b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
5 min	Link to previous lesson: The teacher reviews the focus question from the previous lesson and highlights key science ideas.	<ul style="list-style-type: none"> If the environment changes, some individuals of the same kind will be more likely to survive than others because of their trait variations.
1 min	Lesson focus question: The teacher introduces the focus question, <i>How do trait variations help living things survive if their environment changes?</i>	
3 min	Setup for activity: The teacher introduces an essay about changing environments and reviews how changes in the desert environment affected which beetles survived compared to the previous environment.	<ul style="list-style-type: none"> If the environment changes, some individuals of the same kind will be more likely to survive than others because of their trait variations.
10 min	Activity: Students read an essay about changing environments and discuss how changes in three different scenarios affected living things with certain trait variations.	<ul style="list-style-type: none"> When individuals of the same kind have trait variations that are compatible with changes in their environment, they are more likely to survive long enough to produce young (babies).
15 min	Follow-up to activity: Students analyze the scenarios in the essay and identify trait variations that determine which living things in each scenario survived long enough in their changed environment to reproduce. Then students record their analysis results on a data table.	<ul style="list-style-type: none"> The changes that occur in an environment affect the organisms that live there. Living things of the same kind with trait variations that are compatible with the changed environment are more likely to survive long enough to produce young.
10 min	Synthesize/summarize today's lesson: Students answer the focus question using key science ideas from the lesson to support their ideas and explanations.	<ul style="list-style-type: none"> Living things of the same kind show variation in traits. Trait variations enable some individuals to survive longer than others in their environment. The environment also plays a role in determining which individuals are more likely to survive. If the environment changes, individuals with certain trait variations may have a better chance of surviving long enough to produce young.
1 min	Link to next lesson: The teacher announces that in the next lesson, students will think about whether the next generation of living things of the same kind will have the same traits and variations as their parents.	

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5 min	<p>Link to Previous Lesson</p> <p>Synopsis: The teacher reviews the focus question from the previous lesson and highlights key science ideas.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • If the environment changes, some individuals of the same kind will be more likely to survive than others because of their trait variations. 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in making connections by synthesizing and summarizing key science ideas.</p>	<p>Show slides 1 and 2.</p> <p>Our focus question from last time was <i>What happens if the beetles' environment changes?</i></p> <p>Before we begin our lesson, let's review what we discovered from our desert model and how it relates to the key science ideas we've been learning about.</p> <p>ELL support: If you listed examples of these key science ideas in previous lessons, it may be helpful to display them for easy reference. Review these ideas before the lesson to make sure ELL students understand them.</p> <p>Show slide 3.</p> <p>Key science idea 1: Living things of the same kind show variation in their traits.</p> <p>What living things did we investigate in our desert model?</p> <p>What trait was the focus of our simulation?</p> <p>Who can list the variations in that trait?</p> <p>Key science idea 2: Trait variations help some individuals of the same kind survive longer than</p>	<p>Beetles.</p> <p>The color of the beetles.</p> <p>Red, yellow, brown, green, black.</p>	

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			<p>others in their environment.</p> <p>Which variations helped beetles survive in the first desert environment from lesson 3?</p> <p>And why did the beetles of this color survive longer?</p> <p>Key science idea 3: Trait variations that help some individuals survive longer in their environment might not help them survive longer if their environment changes.</p> <p>Is that what we found when the beetles' environment went through a drought? What is our evidence from the last lesson?</p>	<p>Some beetles that were <i>[X color]</i> survived, but mostly the <i>[Y color]</i> beetles survived.</p> <p>They blended in better with the environment, and the lizards couldn't see them as well.</p> <p>This time, more <i>[X color]</i> beetles survived.</p>	<p>How do you know? What is your evidence?</p> <p>How do you know? What is your evidence?</p>

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		Highlight key science ideas and focus question throughout.	<p>Why do you think beetles with different colors survived this time?</p> <p>Key science idea 4: Both trait variations <i>and</i> the environment affect which living things of the same kind survive longer than others.</p> <p>This is a very important science idea to remember. Both trait variation <i>and</i> the environment matter in the survival of living things.</p> <p>Write this key science idea in your notebooks and underline it.</p> <p>NOTE TO TEACHER: <i>If you had students write these key science ideas in their notebooks in the previous lesson, ask them to underline or draw a box around the final idea for emphasis.</i></p> <p>ELL support: Review these key science ideas with ELL students ahead of time. Focus in particular on the final summary idea and discuss its meaning to ensure they understand it.</p>	They blended into their surroundings better.	
1 min	<p>Lesson Focus Question</p> <p>Synopsis: The teacher introduces the focus question, <i>How do trait variations help living things survive if their environment changes?</i></p>	Summarize key science ideas.	<p>Show slide 4.</p> <p>So we learned from our desert simulation that <i>both</i> variations in the color trait of beetles and their environment affected which beetles survived longer in different conditions.</p> <p>In the first environment, some beetles had a better</p>		

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		Set the purpose with a <u>focus question</u> or goal statement.	<p>chance of surviving than others because of their color. But when the environment changed and went through a drought, other beetles were more likely to survive because their color blended into the environment better.</p> <p>Today we'll continue investigating how trait variations and the environment affect the survival of living things.</p> <p>Show slide 5.</p> <p>The focus question we'll think about is <i>How do trait variations help living things survive if their environment changes?</i></p> <p>Write this question in your science notebooks and draw a box around it.</p> <p>NOTE TO TEACHER: <i>Write the focus question on the board for students to refer to throughout the lesson.</i></p> <p>ELL support: Review the focus question ahead of time with ELL students to make sure they understand what it means.</p> <p>To help us answer this question, we'll investigate other kinds of living things besides beetles to see what happens if their environment changes.</p> <p>Do you think the results will be similar to what</p>		

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			happened to the beetles? Let's find out!		
3 min	<p>Setup for Activity</p> <p>Synopsis: The teacher introduces an essay about changing environments and reviews how changes in the desert environment affected which beetles survived compared to the previous environment.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> • If the environment changes, some individuals of the same kind will be more likely to survive than others because of their trait variations. 	<p>Make explicit links between science ideas and activities before the activity.</p> <p>Summarize key science ideas.</p>	<p>Show slide 6.</p> <p>In our last lesson, we recorded data on what happened to the desert beetles when drought changed their environment.</p> <p>How did the change in environment affect which beetles survived compared to the beetles that survived in our first simulation? What did the data show us?</p> <p>So even though the beetles in our second simulation had the same color variations as in the first simulation, a change in the environment played a role in which beetles survived and which were eaten.</p> <p>The beetles that blended into the first environment better because of their color didn't blend as well into this changed environment and were less likely to survive. But other beetles had a better chance of surviving in this new environment because of their color variations.</p>	<p>Different-colored beetles survived compared to the first environment because they blended into the changed environment better.</p>	

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			<p>Show slide 7.</p> <p>Drought caused a lack of water that changed the beetles' environment.</p> <p>Do you think an environment can change in other ways that affect the survival of living things?</p>		
10 min	<p>Activity</p> <p>Synopsis: Students read an essay about changing environments and discuss how changes in three different scenarios affected living things with certain trait variations.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> When individuals of the same kind have trait variations that are compatible with changes in their environment, they are more likely to survive long enough to produce young (babies). 	<p>Engage students in using and applying new science ideas in a variety of ways and contexts.</p> <p>Make explicit links between science ideas and activities during the activity.</p>	<p>Show slide 8.</p> <p>In today's investigation, you'll read about three changing environments and look for evidence of how those changes affected animals or plants of the same kind with different trait variations.</p> <p>NOTE TO TEACHER: <i>Distribute page 1 of handout 5.1 (Changing Environments) and review the instructions. Don't distribute page 2 of the handout (the data table) yet.</i></p> <p>ELL support: Read the essay, review any new vocabulary words, and orient ELL students to the data table before the lesson. Make sure students understand each scenario and what they're supposed to do with both the essay and the data table during the activity.</p> <p>Show slide 9.</p> <p>As you read the essay [<i>on your own/with a partner</i>], <i>underline</i> any changes that happen in each environment. Then read through the essay again and <i>circle</i> examples of traits that show</p>		

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			<p>variation in living things in each scenario.</p> <p>NOTE TO TEACHER: <i>Rather than having students read the essay individually or in pairs, engage the entire group in the activity to allow for collective sensemaking, language support for ELL students, and comprehension.</i></p> <p>Show slide 10.</p> <p>Whole-class discussion: Who can name a change to the environment that you underlined in the reading? How did this change affect a living thing in the scenario?</p>	<p>More of the white moths were eaten because they didn't blend into the black trees as well.</p> <p>Pollution changed the moths' environment.</p> <p>It turned the trees black.</p> <p>Droughts affect living things.</p>	<p>How did pollution change the environment?</p> <p>We saw that with our lizard and beetles. What is another living</p>

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			<p>Who can give one example of a trait variation you circled in the reading?</p> <p>How did variation in that trait help some living things survive?</p> <p>Show slide 11.</p> <p>The essay mentioned a new idea: If living things survive long enough, they can produce young, or babies. Why is that important for the survival of living things?</p> <p>ELL support: ELL students may think the moths turned black (like the trees) because of air pollution. They may also assume that the moths' babies will be black. Ask questions to make student thinking visible and identify any misconceptions that need to be addressed.</p> <p>NOTE TO TEACHER: <i>Keep this discussion brief. Elicit just a few examples to prepare students for the activity follow-up. Make sure students are linking the survival of an individual organism and</i></p>	<p>Some moths were white, and some were black.</p> <p>The colors of the moths.</p> <p>Black was a better color for moths.</p> <p>Even if a black moth survives, it will eventually die. But if it can have babies, there will be more black moths, and those moths might survive longer.</p>	<p>thing that is affected by droughts?</p> <p>What is the trait?</p> <p>What do you mean by “a better color”?</p>

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			<p><i>a population of organisms with a particular trait variation. Students may find it difficult to understand that individuals of the same kind that survive are more likely to have babies, or why this is important from a life-science point of view. By prepared to address any confusion as it arises.</i></p>		
15 min	<p>Follow-Up to Activity</p> <p>Synopsis: Students analyze the scenarios in the essay and identify trait variations that determine which living things in each scenario survived long enough in their changed environment to reproduce. Then students record their analysis results on a data table</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> The changes that occur in an environment affect the organisms that live there. Living things of the same kind with trait variations that are compatible with the changed environment are more likely to survive long enough to produce 	<p>Make explicit links between science ideas and activities after the activity.</p> <p>Engage students in analyzing and interpreting data and observations.</p> <p>Highlight key science ideas and focus question throughout.</p>	<p>NOTE TO TEACHER: <i>Distribute page 2 of handout 5.1 (Changing Environments). Orient students to the data table and review the instructions.</i></p> <p>Show slide 12.</p> <p>This data table will help you analyze each scenario in the reading. To complete the table, you'll provide data that relates to four key science ideas:</p> <ol style="list-style-type: none"> Trait: A <i>trait</i> is a feature or characteristic of living things of the same kind. Variation refers to the differences in a trait among living things of the same kind. Change in the environment means that the surroundings of living things are no longer the same. Survival and next generation refers to living things of the same kind that survive long enough in their changed environment to produce young, or babies. <p>ELL support: To understand new ideas related to these four key science ideas, ELL students may need to read the essay more than once.</p>		

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	young.		<p> <i>Embedded Assessment Task</i></p> <p>NOTE TO TEACHER: <i>This activity may be used as an embedded assessment of how well students understand the key science ideas in this unit.</i></p> <p>ELL support: Because the lessons in this unit are so heavily language based, you may want to use this activity as an embedded assessment of ELL students' English-language skills rather than an assessment of how well they understand the science ideas.</p> <p>Show slide 13.</p> <p>Let's walk through the example in the first row of the table so you'll understand how to complete the remaining rows. This example is from our second desert simulation, when we explored what happens to beetles when their environment changes.</p> <p>NOTE TO TEACHER: <i>Guide students through the example on the table and answer any questions. Then complete the first scenario together. As you fill in the row on the class data table you created, have students fill in the same row on their data tables. Then have them work on their own or with a partner to complete the remaining scenarios.</i></p> <p><i>The purpose of this data table is to help students</i></p>		

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			<p><i>connect the data in each scenario with the four key science ideas and build their understandings of this key idea: Both trait variation and the environment affect which living things of the same kind are likely to survive long enough to produce young.</i></p> <p>ELL support: The contingencies built into this key science idea (e.g., “likely to survive” and “long enough”) may be difficult for ELL students to understand. Make sure to explain what these phrases mean in context. The phrase <i>browner</i> may also confuse ELL students. Review the different meanings during the lesson preview and include examples so that students will understand the distinctions in this activity. (See note on overview page.)</p> <p>Now let’s complete the row for Scenario 1 together. First, look at the examples of traits you circled in the reading that show variation in living things. Then look at any changes in the environment you underlined.</p> <p>Complete each cell or box on your own data table as I fill in our class data table.</p> <p>Then work on your own or with a partner to complete the remaining two rows for Scenarios 2 and 3.</p> <p>ELL support: Practice completing the data table with ELL students prior to the lesson so they’ll understand what to do and how to analyze each</p>		

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			scenario.		
10 min	<p>Synthesize/Summarize Today's Lesson</p> <p>Synopsis: Students answer the focus question using key science ideas from the lesson to support their ideas and explanations.</p> <p>Main science idea(s):</p> <ul style="list-style-type: none"> Living things of the same kind show variation in traits. Trait variations enable some individuals to survive longer than others in their environment. The environment also plays a role in determining which individuals are more likely to survive. If the environment changes, individuals with certain trait variations may have a better chance of surviving long enough to produce young. 	<p>Highlight key science ideas and focus question throughout.</p> <p>Engage students in making connections by synthesizing and summarizing key science ideas.</p>	<p>Show slide 14.</p> <p>Our focus question today is <i>How do trait variations help living things survive if their environment changes?</i></p> <p>Show slide 15.</p> <p>We'll use our completed data tables to help us answer this question and summarize our understandings of the four key science ideas:</p> <ol style="list-style-type: none"> Traits Variation Changes in the environment Survival and the next generation of living things of the same kind <p>Who can summarize in one or two sentences how variations in a trait helped living things in each scenario survive when the environment changed?</p> <p>Try to use the four key science ideas in your answer.</p> <p>ELL support: You may want to provide ELL students with sentence starters to facilitate their participation in this discussion.</p> <p>NOTE TO TEACHER: <i>Help students build on</i></p>		

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			<p><i>one another's ideas to create a complete statement that answers the focus question rather than expecting one student to provide a complete summary of the science ideas. Help students build toward the ideal student response:</i></p> <p><i>If the environment changes, living things with some variations of a trait will be more likely to survive than those with different variations. For example, if there's a drought and the land turns browner, beetles with the brown color trait will have a better chance of surviving and having babies than yellow or red beetles because they blend into the environment better.</i></p> <p><i>Students can then use similar descriptions for each scenario in the essay.</i></p> <p>CONTENT NOTE: <i>Students should understand that some living things have trait variations that enable them to live longer. For example, the trait variations of some living things camouflage them so that predators can't see them as easily. These variations give them an advantage so they survive longer in their environment. When the environment changes, living things with different trait variations might have an advantage that enables them to survive longer. In other cases, the advantage might be structural in nature, such as the beaks of the birds, or related to an invasive species, such as the peccary. There are many ways an environment might change that give some trait variations an advantage over others.</i></p>		

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			<p>ELL support: This summary requires a fairly high level of English language fluency that some ELL students may not have. If possible, provide some alternative language that is more accessible for ELL students.</p>		
1 min	<p>Link to Next Lesson</p> <p>Synopsis: The teacher announces that in the next lesson, students will think about whether the next generation of living things of the same kind will have the same traits and variations as their parents.</p>	Link science ideas to other science ideas.	<p>Show slide 16.</p> <p>Today, we investigated how trait variations help some living things survive better than others when the environment changes.</p> <p>In our first scenario, the black moths survived longer than the white moths because they blended in with the black tree trunks. In our second scenario, birds with stronger beaks survived longer because they were able to break open seeds that were their only food source during a drought. And in our third scenario, cacti with more spines survived longer because peccaries that moved into the area preferred the cacti with fewer spines. In all of these scenarios, the living things that survived were more likely to have babies.</p> <p>Do you think the babies of living things that survive have the same traits and variations as their parents?</p> <p>That’s what we’ll investigate next time.</p>		