A Study of Traits

Lesson 1: Why Do Individuals Look Different?

Grade: 9-10 General Biology

Length of lesson: 75 minutes

Placement of lesson: Lesson 1 of 9

Unit Overarching Goal

In plants and animals, similarities and differences among individuals within a species result from proteins coded for by the DNA inherited from their parents. Variations among individuals are the result of mutation, meiosis, and recombination through sexual reproduction.

Unit Central Question

What is the best explanation for the similarities and differences we see in individuals within a species—not only for one species, but for every species of plant and animal?

Lesson 1 Main Learning Goal

Individual organisms have characteristics that differ from others of the same species.

Lesson 1 Focus Question

What might cause individuals to have versions of a trait that are different from others of the same species?

Ideal student response

There is variation between individuals of the same species. There are different explanations for the cause of this variation. Evidence helps scientists evaluate the strengths and limitations of each explanation.

The Phenomenon

Individuals of the same species show variation in traits. Most jaguars have orange fur with black spots, while some are completely black. Some mosquitos are resistant to insecticides such as DDT, however other mosquitos are not. Some geese can fly at extremely high altitudes, while others cannot.

Background on jaguar coat color

Jaguars can be characterized by their traits, such as fur color. However, jaguars have different versions of the fur color trait. Most jaguars are orange with dark spots, however there are also jaguars that are completely black. This difference is caused by the type of melanin in their fur. The cells of spotted jaguars produce pheomelanin which is a reddish-orange pigment resulting in orange fur color. Black jaguars produce eumelanin, a much darker pigment, resulting in black fur which does not allow the spots to be easily seen. Melanin is the pigment responsible for coloration in many other organisms, including humans.

Both types of melanin are produced as a result of hormone binding to MC1R proteins embedded in the cell membrane. It is differences in the structure of the MC1R protein that lead to differences in the function of the protein causing the production of different forms of melanin. Eumelanin is produced from MC1R proteins with a five amino acid deletion and an adjacent amino acid substitution of threonine for leucine in the extracellular binding domain of the protein. Pheomelanin is produced when this region is intact.

What causes this difference in the MC1R protein structure and subsequently its function? Proteins are composed of a chain of amino acids that are joined together by dehydration synthesis. There are 21 amino acids that all have a generalized structure consisting of a hydrogen atom, an amino group ($-NH_2$), and a carboxylic acid group (-COOH) bonded to a central (alpha) carbon. The name “amino acid” is derived from the amino group and the carboxylic acid

group. Also bonded to the central carbon is a sidechain, or residue (R group). Each amino acid has a different R-group which can vary from a few atoms to many. Based on the chemical properties of their R groups, amino acids within the protein chain may be attracted to or repelled by other amino acids in the chain. As a result, the protein folds into a unique and specific shape based on the amino acids that compose it, and the sequence of those amino acids. Thus, the order in which amino acids are joined results in a unique structure caused by differences in the R-groups. If one or more amino acids are added or deleted from the protein, or if one amino acid is substituted for another, the resulting protein will have a different shape and potentially will function differently.

Which amino acids are joined to form a protein, as well as the total number of amino acids and their order, is determined by the DNA found in the nucleus of each cell. DNA has a double helix structure formed of two chains with alternating phosphates and deoxyribose sugar, with nitrogenous bases extending out from this "backbone." The nitrogenous bases are adenine (A), thymine (T), cytosine (C), and guanine (G). The two chains in DNA are held together by hydrogen bonding between complementary bases on each strand. Adenine and thymine form a complementary pair as do cytosine and guanine.

The segment of DNA that codes for a specific protein is called a gene. Three sequential nucleotides on a strand, for example ATC or GTC, are called a codon and code for a particular type of amino acid. Because there are 64 possible codons (i.e., there are 64 possible three-base sequences for 4 different bases) and 21 amino acids, an amino acid may be coded for by more than one codon. However, each codon only codes for one amino acid.

Based on the order of nucleotide codons in DNA, amino acids are bonded in the correct order to form a protein with a specific shape and function. However, DNA is protected inside the nucleus and the assembly of amino acids into proteins happens in the cytoplasm of the cell. An intermediate molecule, mRNA, carries the information of the DNA code from the nucleus to the cytoplasm to direct the synthesis of proteins.

Different versions of a gene for a particular trait are called alleles. In the case of jaguars, there are two alleles for the MC1R protein. The differences in the nucleotide codon sequences of the two alleles results in differences in amino acid sequences for the two proteins with different structures. The difference in the structures of the two MC1R proteins leads to differences in function and the production of different types of melanin.

Science Content Storyline

Individual organisms have characteristics that differ from other individuals of the same species. For example, different jaguars have different colored fur, some mosquitoes are resistant to insecticides, and some geese can fly at extreme altitudes. There are different explanations for why these variations occur. Evidence helps scientists evaluate the strengths and limitations of explanations.

Materials

- Handout 1: Variation in Organisms
- Handout 2: Explanations for Variation
- Lesson 1 slide deck

Advance Preparation

- Make copies of handouts for each student. If you are unable to make color copies of Handout 1 for each student, a classroom set of color copies in page protectors can be used.

Lesson 1 General Outline

Time (min)	Phase of lesson	How the science content storyline develops
5	**Unit Central Question: What is the best explanation for the similarities and differences we see in individuals within a species—not only for one species, but for every species of plant and animal?** The teacher introduces the central question for the unit and elicits ideas about variation. The teacher makes student thinking visible by recording student answers to the unit central question.	
5	**Lesson Focus Question**: **What might cause individuals to have versions of a trait that are different from others of the same species?** The teacher introduces the lesson focus question.	
60	**Variation Case Studies** <u>Activity Setup</u> Individually, students read one of three case studies (jaguars, mosquitos, and geese) and take notes to form an initial response to the focus question. <u>Activity</u> Students jigsaw the three case studies to identify patterns of variation. Students discuss their assigned case study with their expert group and revise their response to the focus question. In home groups, students share their case study and discuss similarities and differences between expert groups' responses to the focus question. The teacher elicits ideas and probes for specificity. <u>Activity Follow-up</u> Students write an initial explanation for the patterns in variation among individuals of the same species and compare their thinking with others in their group. They examine three common explanations for the variations observed in the case studies and determine which explanation is most common to their ideas. The teacher elicits ideas and probes for specificity as well as elicits ideas about evidence needed to evaluate each explanation.	Individual organisms have characteristics that differ from other individuals of the same species. For example, different jaguars have different colored fur, some mosquitoes are resistant to insecticides, and some geese can fly at extreme altitudes. There are different explanations for why these variations occur. Evidence helps scientists evaluate the strengths and limitations of explanations.
5	**Summarize and Link to Next Lesson** The teacher and students summarize the lesson. The teacher links to the next lesson.	

Lesson 1: Why Do Individuals Look Different?

Phase of Lesson: *Unit Central Question: What is the best explanation for the similarities and differences we see in individuals within a species — not only for one species, but for every species of plant and animal?*

Main Learning Goal: Individual organisms have characteristics that differ from others of the same species.

Focus Question: What might cause individuals to have versions of a trait that are different from others of the same species?

Unit Overarching Goal:

In plants and animals, similarities and differences among individuals within a species result from proteins coded for by the DNA inherited from their parents. Variations among individuals are the result of mutation, meiosis, and recombination through sexual reproduction

Notes:

Time: 5 Minutes

STeLLA Strategies

- ❖ Strategy 1: Ask questions to elicit student ideas and predictions
- ❖ Strategy 2: Ask questions to probe student ideas and prediction

Science Ideas

- Characteristics of all organisms are determined by proteins in each cell.
- Proteins are made within the cell through instructions found in the DNA passed from parents to offspring.
- Individuals possess unique DNA. These differences in DNA arise through mutations and recombination of DNA during reproduction.

Common Student Ideas

- Genes are traits
- Each parent contributes genetic information for certain traits and not others (i.e. he has his mother's eyes and father's nose).
- Different cell types (skin, muscle, bone) found in an individual's body contain different DNA.
- Some characteristics of offspring are determined by the parents' environmentally acquired characteristics.
- DNA is made of proteins and/or amino acids.
- Organisms eat protein; they do not make proteins.

Lesson 1: Why Do Individuals Look Different?

Introduction

In this unit, you will have a chance to think why individuals have characteristics, or traits, that are the same or different than others of the same species. You will consider possible explanations for these similarities and differences. As you consider these explanations, you will also look at the relationship between structure (shape) and function.

To help you learn more about these questions, the unit will focus on the question below.

Unit Central Question

What is the best explanation for the similarities and differences we see in individuals within a species – not only for one species, but for every species of plant and animal?

Process and Procedure

1. Write your best ideas about the unit central question in the space below. Leave space to revise your ideas as you learn more in later lessons.
2. As you have new ideas, record them in a different color.

Focus on Student Thinking

- Use STeLLA Strategy 1: Ask questions to elicit students' initial ideas and predictions to get a variety of ideas out. Make it clear to students that you are not going to tell which ideas about what causes the similarities and differences among individuals within a species are right or wrong at this point; the activities of this series of lessons will help support or challenge the ideas they share now. The purpose is to reveal several student ideas so you and the students get a sense of the different ideas in the class. The goal is *not* to surface every idea each student has.
- Question: What is the best explanation for the similarities and differences we see in individuals within a species – not only for one species, but for every species of plant and animal? Sample student responses follow:
    - The individual had a mutation that caused the difference.
    - Individuals inherit their traits from their parents.
    - Individuals get their traits from one parent (i.e. they have their mother's eyes).
    - An individual's traits are determined by their genes.
    - An individual can change their traits (i.e. work out to get larger muscles).
- Use STeLLA Strategy 2: Ask questions to probe student ideas and predictions. Examples of questions include the following:
    - Tell us more about … .
    - What do you mean when you say … ?

  If many students use the phrases "mutation," "genes," or "inherit," ask probe questions to determine students' understanding of these ideas. Often, students have a general understanding of these ideas.

Implementation	Notes
Introduce Unit Central Question and Link to Previous Unit ● Let students know that in this unit, they will learn more about what causes the variation that we observe in individuals of the same species. Invite students to turn and talk about their understanding of a species: ○ A biological species is a group of individuals that can breed together (panmixia). However, they cannot breed with other groups. In other words, the group is reproductively isolated from other groups. ● It is important to note that the purpose of this lesson is *not* to have students arrive at a right answer, but to make their thinking about the causes of variation visible by getting as many of their ideas out as possible using probe questions and charting student ideas. *Unit Central Question* ● **STEP 1:** Introduce the unit central question, "What is the best explanation for the similarities and differences we see in individuals within a species—not only for one species, but for every species of plant and animal?" Note that this question is printed in the box to help them find it more easily later. Ask students to write their best ideas about the unit central question in the space under the box. ● Lead a class discussion to allow students to share their ideas with the entire class. ● **STEP 2:** As students share their ideas, have students record any new ideas in a different color. ○ It is important to note that the purpose of this lesson is NOT to have students arrive at a right answer, but to make their thinking about changes in populations visible by getting as many of their ideas out as possible and probing for specificity in what they say. ● Share with students that we will return to the unit central question and revise our ideas as we learn more over the course of the lessons in the unit. Use the information in "Focus on Student Thinking" in the SE key to see examples of ways to elicit and probe student ideas.	

Lesson 1: Why Do Individuals Look Different?

Phase of Lesson: *Focus Question: What might cause individuals to have versions of a trait that are different from others of the same species?*

Main Learning Goal: Individual organisms have characteristics that differ from others of the same species.

Focus Question: What might cause individuals to have versions of a trait that are different from others of the same species?

Unit Overarching Goal:

In plants and animals, similarities and differences among individuals within a species result from proteins coded for by the DNA inherited from their parents. Variations among individuals are the result of mutation, meiosis, and recombination through sexual reproduction

Notes:

Time: 5 Minutes

STeLLA Strategies

- ❖ Strategy 1: Ask questions to elicit student ideas and predictions
- ❖ Strategy 2: Ask questions to probe student ideas and prediction

Science Ideas

- Individual organisms have characteristics that differ from other individuals of the same species.
- There are different explanations for why these variations occur. Evidence helps scientists evaluate the strengths and limitations of explanations.

Common Student Ideas

- Genes are traits
- Each parent contributes genetic information for certain traits and not others (i.e. he has his mother's eyes and father's nose).
- Different cell types (skin, muscle, bone) found in an individual's body contain different DNA.
- Some characteristics of offspring are determined by the parents' environmentally acquired characteristics.
- DNA is made of proteins and/or amino acids.
- Organisms eat protein; they do not make proteins.

Lesson Focus Question

3. Write the focus question for the lesson in the box below. Then, write your best ideas about the question under the box. Be sure to leave space to revise your answer as you learn more.

What might cause individuals to have versions of a trait that are different from others of the same species?

Focus on Student Thinking

- Use STeLLA Strategy 1: Ask questions to elicit student initial ideas and predictions to get a variety of ideas out. Make it clear to students that at this point in the lesson, we are gathering a lot of ideas and that you are not going to tell which ideas about why individuals have different versions of a trait are right or wrong at this time.
- It is important to note that the purpose of this lesson is *not* to have students arrive at a right answer, but to make their thinking about causes of variation visible by getting as many of their ideas out as possible and probing for specificity in what they say.
- These are some sample student responses:
    - They have different genes.
    - They grew up in different environments.
    - They have parents who look different from each other.
    - Girls look like their moms and boys look like their dads.
    - Because there is variation.
- Use STeLLA Strategy 2: Ask probe questions to get more information about student thinking and understanding. Be prepared to ask probe questions such as the following:
    - What do you mean by “gene”?
    - Can you say more about how growing up in different environments might cause individuals to have different variations of a trait?

Implementation	Notes
Introduce the Lesson Focus Question ● Share with students that in today's lesson we will focus on why individuals can look different than others of the same species. ● **STEP 3:** Introduce the lesson focus question: *What might cause individuals to have versions of a trait that are different from others of the same species?* ○ Ask students to record the Lesson 1 Focus Question in the box in their workbook. ○ Remind them to leave space to revise their response as they learn more information during the lesson. ● Ask students to share their ideas with the entire group. Use STeLLA Strategy 1: Ask questions to elicit student ideas and predictions to get a variety of ideas out. ● Use STeLLA Strategy 2: Ask questions to probe student ideas and predictions to make student thinking visible. Use the information in "Focus on Student Thinking" in the SE key to see examples of ways to elicit and probe student ideas.	

Lesson 1: Why Do Individuals Look Different?

Phase of Lesson: *Variation Case Studies*

Main Learning Goal: Individual organisms have characteristics that differ from others of the same species.

Focus Question: What might cause individuals to have versions of a trait that are different from others of the same species?

Unit Overarching Goal:

In plants and animals, similarities and differences among individuals within a species result from proteins coded for by the DNA inherited from their parents. Variations among individuals are the result of mutation, meiosis, and recombination through sexual reproduction

Notes:

Time: 60 Minutes

STeLLA Strategies

- Strategy 1: Ask questions to elicit student ideas and predictions
- Strategy 2: Ask questions to probe student ideas and prediction
- Strategy 3: Ask questions to challenge student thinking

Science Ideas

- Different jaguars have different colored fur because they have different amounts of melanin in their fur. Orange jaguars have moderate amounts of melanin while black jaguars have much more melanin.
- Some mosquitos are resistant to insecticides and can survive when they are exposed to insecticides.
- Some geese can fly at extremely high altitudes because they have a different type of hemoglobin. Other geese do not have this hemoglobin and cannot fly at extreme altitudes.
- There are different explanations, including parents, genes, and mutations, for why these variations occur.

Common Student Ideas

- Genes are traits
- Each parent contributes genetic information for certain traits and not others (i.e. he has his mother's eyes and father's nose).
- Different cell types (skin, muscle, bone) found in an individual's body contain different DNA.
- Some characteristics of offspring are determined by the parents' environmentally acquired characteristics.
- DNA is made of proteins and/or amino acids.
- Organisms eat protein; they do not make proteins.

Variation Case Studies

4. In your expert group, read and annotate the case study you selected. For your species, record the variation described in the text and ideas about how that variation occurred in some individuals.

	Jaguars	Mosquitos	Geese
Description of Variation	The fur color is either orange with black spots or all black	Some mosquitos are resistant to the insecticide and others are not resistant	Some geese have a type of hemoglobin that allows them to fly at high altitudes. Other geese do not have the regular type of hemoglobin OR Some geese can fly at high altitude and other geese cannot
Ideas about how the variation occurred	1. They get fur color from their parents 2. Some needed dark fur to hide in shadows in their environment and others needed blotchy fur to blend in 3. There was a mutation in the ones that are all black	1. When the insecticide was used, the mosquitos needed to become resistant 2.Their genes cause the resistance 3.The insecticide caused a mutation to make them resistant	1. The high altitude where the geese live made them develop the new hemoglobin 2.They get the high altitude hemoglobin trait from their parents 3.The different hemoglobin was caused by the geese's genes

Implementation	Notes
Activity Setup: Introduce the Variation Case Studies • Share that, to begin to answer the unit central question and today's focus question, we will examine several organisms that show interesting variations among individuals • Assign students to home groups of three students per group. Tell students that each person in the group should read a different case study. Let students decide which case study each will read. • Have students move to sit with others reading the same case study. Note that this will be their expert group. *Activity: Jigsaw Case Studies* • **STEP 4:** Allow quiet time for each expert group to read their case study. Remind students to highlight or underline key ideas in the text that will help them answer the focus question. • Have students discuss their case study and record the group's ideas about why two organisms of the same species might have different traits. Remind students that they will share the information from their expert groups in their home group. • As students discuss their ideas in their expert groups, use STeLLA Strategy 2: Ask questions to probe student ideas and predictions to learn more about student prior knowledge and misconceptions. • Have students revise their response to the lesson focus question in a different color. Making revisions in a different color helps students keep track of their learning and emphasizes that they do not have to have correct answers at the beginning of a lesson.	

5. In your home group, use your expert group notes to share the story of your species. As others in your home group share, complete the other columns of the chart.

6. In your home group, discuss the similarities and differences between your ideas about the causes of variation in the three species.

Similarities between our ideas about the causes of variation in the three species	**Differences between our ideas about the causes of variation in the three species**
Variations in traits come from parents Variations happen when individuals live in different environments Variations are based on genes	Variations are due to mutations Variations are *caused* by the environment

Focus on Student Thinking

- Use STeLLA Strategies 1 and 2 to elicit and probe student observations about the variation they observed in the species in the case studies and their ideas about how the variation occurred. The purpose is to reveal student thinking about the nature of variation and how it occurs. Ask elicit questions to get a variety of ideas out and to learn about students' prior knowledge and misconceptions. Be clear that you are just helping them to hear each other's ideas at this time and that they will add to, revise, and eliminate ideas as they learn more in this unit.

- As students work to identify the similarities and differences in their ideas, circulate among the teams asking elicit and probe questions. Example teacher and student responses follow:
  T: Tell about the similarities you see in your ideas. (ELICIT)
  S1: We all think that you get different traits from your parents and that variations are based on the genes you have.
  T: Tell me more about genes. (PROBE)
  S1: Well, you get them from your parents . . .
  S2: Each parent gives you one gene for a trait.
  T: What different ideas did you have? (ELICIT)
  S3: Um, we all had something about the effect of the environment on traits.
  T: I see something about environment on both sides of your chart. Can you explain why it's in both places? (PROBE)
  S1: It's on both sides, because we all had something about the environment, but some of us thought it just happened randomly—like, they evolved that way, but others thought the environment made the variation happen.

Implementation	Notes
● **STEP 5:** Students should return to their home groups. Have students share their case study and the expert group's ideas about how the variation in organisms happens. Remind students to take notes about the other case studies and ideas about the cause of variation. ● **STEP 6:** After students have shared their case studies, ask them to complete the two-column table to show similarities and differences between their ideas about the causes of variation in the three species. ● As groups are discussing the similarities and differences, use STELLA Strategy 1: Ask questions to elicit student ideas and predictions to get a variety of ideas on the table. Use STeLLA Strategy 2: Ask questions to probe student ideas and predictions to learn more about students' prior knowledge and common student ideas. Refer to "Focus on Student Thinking" in the SE key for possible questions to elicit and probe student ideas.	

7. Individually, write a paragraph that includes your best ideas about why some individuals have traits that are different from other individuals of the same species.

   Student A
   (A1) Individuals from the same species have different traits because they got different genes from their parents. (A2) For example, some geese get the gene for high altitude hemoglobin from their parents. (A3) These geese can fly over Mt. Everest. (A4) Other geese get the gene for regular hemoglobin from their parents. (A5) They can't fly at high altitudes.

   Student B
   (B1) Some mosquitos had a mutation that made them resistant to insecticides. (B2) They passed that mutation on to their offspring. (B3) Other mosquitos didn't have a mutation, so their offspring were killed by the insecticides.

8. Consider the possible explanations for the cause of variation give to you by your teacher. As you read, decide which explanation is most similar to your ideas.

9. Number each sentence in the paragraph you wrote in step 7. Use the organizer below to determine how well your ideas align with the three possible explanations for variation. To do this, write the sentence number in the box(es) that best match the idea in that sentence. If a sentence fits in more than one box, write the sentence number in both boxes.

Parents	**Genes**
A1 A2 A4 --- B2 B3	A1 A2 A4 ---
--- B1 B2 B3 **Mutation**	--- A3 A5 **None or do not know**

Implementation	Notes

Activity Follow-up
• **STEP 7:** Have students individually write a paragraph with their best ideas about why some individuals have traits that are different from other individuals of the same species.
  • Note that in the next step they will compare the ideas of their paragraph with popular ideas that other students often have, so they should include all their current ideas in their paragraph.
  • Reassure students that they are just beginning this series of lessons, so they are not expected to have correct answers at this point. Mark that they will have several opportunities to revise and add to their ideas.
• **STEP 8:** Pass out the Explanations for Variation handout. Introduce these explanations as ideas that some students have had about why organisms have different traits than others of the same species. Ask students to read the three explanations and consider which ideas are similar to their current ideas.
• **STEP 9:** Have students number each sentence in the paragraph they wrote in step 7. Then have students put the number of each sentence into one of the four boxes in the organizer to show which idea(s) their sentence aligns with. It is possible to have the same number in more than one box.
  • Have students share their ideas and their placement in the four boxes with their home group. They should focus on any sentences that they were not sure how to categorize.	

10. Based on how you placed your numbered sentences in step 9, with which explanation(s) do your current ideas fit best and why? If you placed a lot of sentences in the “none or do not know” box, describe why your ideas are different from the possible explanations. Be prepared to share your thinking with the whole class.

Focus on Student Thinking

- Ask appropriate probe (STeLLA Strategy 2) and challenge questions (STeLLA Strategy 3) as students discuss their responses. Be prepared to ask questions such as these:
    - Can you talk more about why you think that your idea doesn’t fit well with any of the explanations? (PROBE)
    - Say more about how genes cause traits. (PROBE)
    - Where do parents get the different genes to pass on to their offspring? (CHALLENGE)
    - What do you mean by mutation? (CHALLENGE)
    - What ideas do you have about the relationship between genes and mutations? (CHALLENGE)

Implementation	Notes
• **STEP 10:** In a whole class discussion, have students describe which of the three possible explanations fits best with their ideas and why. If students placed many of their sentences in the "none or do not know" box, ask them to describe why their ideas are different from the possible explanations. Ask elicit and probe questions to uncover and reveal student thinking. Refer to "Focus on Student Thinking" in the SE key for possible questions to elicit and probe student ideas.	

Lesson 1: Why Do Individuals Look Different?

Phase of Lesson: *Summarize and Link*

Main Learning Goal: Individual organisms have characteristics that differ from others of the same species.

Focus Question: What might cause individuals to have versions of a trait that are different from others of the same species?

Unit Overarching Goal:

In plants and animals, similarities and differences among individuals within a species result from proteins coded for by the DNA inherited from their parents. Variations among individuals are the result of mutation, meiosis, and recombination through sexual reproduction.

Notes:

Time: 5 Minutes

STeLLA Strategies

- ❖ Strategy I: Summarize key science ideas

Science Ideas

- Individual organisms have characteristics that differ from other individuals of the same species.
- There are different explanations, including parents, genes, and mutations, for why these variations occur.
- Evidence helps scientists evaluate the strengths and limitations of explanations.

Common Student Ideas

- Genes are traits
- Each parent contributes genetic information for certain traits and not others (i.e. he has his mother's eyes and father's nose).
- Different cell types (skin, muscle, bone) found in an individual's body contain different DNA.
- Some characteristics of offspring are determined by the parents' environmentally acquired characteristics.
- DNA is made of proteins and/or amino acids.
- Organisms eat protein; they do not make proteins.

Summarize Ideas

11. Reread your initial response to the lesson focus question. Consider the ideas that you saw in the activities you completed. If you would like to add to or revise your ideas, do so in a different color.

Implementation	Notes
Summarize • **STEP 11:** Invite students to reread their initial response to the lesson focus question and consider the ideas from their work in this lesson. Have students revise or add to their ideas about the lesson focus question in a different color. • Remind students that today we examined possible explanations for the variations that exist among individuals of the same species. Three possible explanations include parents, genes, and mutation. Include any other ideas that emerged from the class discussion. *Link to Next Lesson* • Link to the next lesson by sharing that in the next lesson they will explore the source of the variation they observed in this lesson.	