Genetics
Lesson 2b: Dominant and Recessive Traits

Grade 6	**Length of lesson:** 50 minutes	**Placement of lesson in unit:** 2b of 6 two-part lessons on genetics
Unit central question: Why are individuals of a species different from one another?		**Lesson focus questions:** Can certain traits disappear in a family? Can offspring have traits their parents do not have?
Main learning goal: Some traits mask or cover up other traits. The traits that mask other traits are called *dominant traits*. The traits that are covered up are called *recessive traits*.		
Science content storyline: Sometimes when parents have different traits, all of their offspring will exhibit one parent's trait, and the other parent's trait will seem to disappear because none of the offspring exhibit it. A trait that is present in one generation might not appear in the next generation, and conversely, a trait that doesn't show up in one generation might appear in the next generation. For each trait, individuals inherit a set of instructions from their mother and another set of instructions from their father. The instructions for a particular trait are called *genes*, and different instructions for the same trait are called *alleles*. If an individual gets the same set of instructions from both parents, that trait will be expressed. If an individual gets a different set of instructions from each parent, only one of the traits will be expressed. When this happens, the trait that's expressed is called a *dominant trait,* and the trait that's hidden or unexpressed is called a *recessive trait*. Tracking the pattern of trait inheritance across several generations of a family can help you figure out whether a particular trait is dominant or recessive.		
Ideal student response to the focus questions: A trait from one parent can seem to disappear in a family if it doesn't show up in any of the offspring. But the trait could reappear in a later generation. That's because some traits are dominant and some are recessive. Even though you get instructions for a trait from both your mom and your dad, if those instructions are different, the dominant trait will show up, and the recessive trait will be hidden. In the case of the dachshund puppies, the short-hair trait was dominant, so all of the offspring had short hair. Even though none of the puppies had long hair, the set of instructions for the long-hair trait were still passed on to them, and the trait came back in the next generation.		

Preparation

Materials Needed	**Ahead of Time**
• Science notebooks • Class charts: Our Current Ideas about Inheritance; Our Questions about Inheritance (from previous lessons) • 1/4" colored blue and green sticky dots (enough for 3 of each color per student), or green and blue pencils (1 of each color per student) **Student Handouts** • 2.1 Mendel's Ideas (1 per student)	• Review the Genetics Content Background Document, especially sections 1 and 6.

Lesson 2b General Outline

Time	Phase of Lesson	How the Science Content Storyline Develops
6 min	**Link to previous lesson**: Students share their reasons from the previous lesson for supporting or not supporting three claims about how traits are passed from parents to offspring.	• A trait that is present in one generation might not appear at all in the next generation. • A trait that does not show up in one generation might appear in the next generation.
3 min	**Lesson focus questions:** The teacher introduces the focus questions; *Can certain traits disappear in a family? Can offspring have traits their parents do not have?*	
5 min	**Setup for activity:** The teacher introduces students to Gregor Mendel and his pea-plant experiments.	
15 min	**Activity:** Students compare the three generations of dachshunds with three generations of pea plants that Mendel grew, noting the similar results. After generating their best explanations for these results, they compare Mendel's ideas with the ideas on their class chart.	• A pedigree is a chart that tracks certain traits across several generations of a family. • Individuals receive trait instructions from their parents. Mendel called these instructions *factors*. Today we call them *genes*. • Genes can have different forms called *alleles*. These different forms of a gene provide instructions for variations of a trait. For example, the set of instructions that result in purple flowers is different from the set of instructions that result in white flowers. • Individuals get one variation of a gene (allele) from each parent, which means that each individual has two alleles for each trait. • Individuals inherit a random combination of the parents' alleles. • If an individual inherits the same allele from each parent, that trait will show up. • If an individual inherits a different allele from each parent, only one of the traits will show up. • When an individual inherits two different alleles, the trait that shows up is called a *dominant trait*. The trait that does not show up is called a *recessive trait*.
10 min	**Follow-up to activity:** Students compare the science ideas on Mendel's list with the ideas on the class chart and decide whether the chart should be modified.	• Some traits are dominant, and some traits are recessive. When an individual receives two different sets of instructions for a trait from the parents, only the instructions for the dominant trait will be followed. The dominant trait will be expressed, and the recessive trait will be covered up.
10 min	**Synthesize/summarize today's lesson:** Students discuss today's focus questions and summarize science ideas that might help them answer the unit central question.	• Trait variations exist in a species because individuals inherit a random combination of genes from their parents.
1 min	**Link to next lesson:** The teacher foreshadows the next lesson in which students discover what modern scientists know about trait inheritance that Mendel did not know.	

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6 min	**Link to Previous Lesson** **Synopsis:** Students share their reasons from the previous lesson for supporting or not supporting three claims about how traits are passed from parents to offspring. **Main science idea(s):** • A trait that is present in one generation might not appear at all in the next generation. • A trait that does not show up in one generation might appear in the next generation.	Highlight key science ideas and focus question throughout.	**Show slides 1 and 2.** At the end of the last lesson, we reviewed the claims of three students, Juan, Celia, and Michael, and you decided which claim you agreed with based on the dachshund pedigree evidence. Then you completed three sentences in your science notebooks that indicated which claims you supported and did not support. Turn to those sentences in your notebooks now, and let's review your answers and evidence. **NOTE TO TEACHER:** *Make sure students connect their ideas to the dachshund pedigree evidence from lesson 2a. The first generation of offspring from one short-haired parent and one long-haired parent all exhibited the same trait—short hair. However, in the second generation, some offspring had short hair, and others had long hair. Using this evidence, only Celia's claim makes sense. The long-hair trait didn't disappear, so the instructions for short hair must have covered up the instructions for long hair in the first generation of puppies.* In today's lesson, you're going to apply what you've learned so far about trait inheritance to some experiments with		

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			pea plants.		
3 min	**Lesson Focus Questions** **Synopsis:** The teacher introduces the focus questions; *Can certain traits disappear in a family? Can offspring have traits their parents don't have?*	Set the purpose with a focus question or goal statement.	**Show slide 3.** Today's focus questions are *Can certain traits disappear in a family? Can offspring have traits their parents don't have?* Does one of these questions look familiar? We investigated the first question yesterday, and in this lesson, we'll add to our ideas and answer both questions. **NOTE TO TEACHER:** *Direct students to write the second focus question in their science notebooks and draw a box around it.*		
5 min	**Setup for Activity** **Synopsis:** The teacher introduces students to Gregor Mendel and his pea-plant experiments.	Make explicit links between science ideas and activities **before** the activity.	Yesterday we saw the pedigree results in the dachshund family over two generations. These same patterns show up in all kinds of sexually reproducing organisms. For example, did you know that plants reproduce by making seeds, and just like animals, they have male parts and female parts that come together to make a seed? The pollen produced by the male part of the flower is carried to another flower, where it fertilizes an egg. From the combination of the pollen and the egg, the plant produces seeds that become the		

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			plants' offspring. **NOTE TO TEACHER:** *Although some plants self-pollinate, for simplicity, focus on the process that takes place between two plants. One male plant, represented as a square in the pedigree diagram, provides the pollen, and a female plant, represented as a circle, provides the egg.* A long time ago, in the 1850s and 1860s, a monk named Gregor Mendel was experimenting with pea plants in his garden when he noticed a pattern of trait inheritance that was very similar to the pattern we observed in the dachshund family. **Show slide 4.** What Mendel did with pea plants can also be represented on a pedigree chart. Let's investigate Mendel's experiments with the pea plants and the ideas about inheritance he came up with based on the results.		
15 min	**Activity** **Synopsis:** Students compare the three generations of dachshunds with three generations of pea plants that Mendel grew, noting the similar	Ask questions to elicit student ideas	First, let's look at the parent pea plants. One plant has white flowers, and one has purple flowers. Based on what we saw with the dachshund puppies, what do you predict the first generation of pea-plant offspring will look like when a purple-flowered		

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	results. After generating their best explanations for these results, they compare Mendel's ideas with the ideas on their class chart. **Main science idea(s):** • A pedigree is a chart that tracks certain traits across several generations of a family. • Individuals receive trait instructions from their parents. Mendel called these instructions *factors*. Today we call them *genes*. • Genes can have different forms called *alleles*. These different forms of a gene provide instructions for variations of a trait. For example, the set of instructions that result in purple flowers is different from the set of instructions that result in white flowers. • Individuals get one variation of a gene (allele) from each parent, which means that each individual has two alleles for each trait.	and predictions. Engage students in analyzing and interpreting data and observations.	plant is crossed with a white-flowered plant? **Show slide 5.** What do you notice about the first generation of pea plants? When these purple-flowered offspring pollinate each other, what flower color do you think the second generation of	I think the results will be just like the dachshund puppies, and all of the flowers will be either purple or white. I think the flowers will be like a light purple. I don't think they can be only white or only purple. I think the flowers will be purple, because that seems like the stronger color. All the flowers are purple.	Are you saying you think that traits for flower color and traits for hair length are passed on to future generations in the same way? Does anyone agree or disagree with this prediction? What do you mean by stronger?

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	• Individuals inherit a random combination of the parents' alleles. • If an individual inherits the same allele from each parent, that trait will show up. • If an individual inherits a different allele from each parent, only one of the traits will show up. • When an individual inherits two different alleles, the trait that shows up is called a *dominant trait*. The trait that doesn't show up is called a *recessive trait*.		offspring will exhibit? **ELL support:** ELL students may benefit from predictive drawing and/or writing in their notebooks. To draw on students' sense making resources, you may also want to have an open-ended class discussion (science talk) that will encourage students to collaboratively explore ideas and develop understanding. **Show slide 6.** What do you notice about the second generation of pea plants?	Well, it will probably be a mix of colors, like in the second generation of puppies where some puppies had short hair and some had long hair, but none had medium-length hair. So I think there will be some white flowers and some purple flowers. There are both purple and white flowers, just like the mix of short hair and long hair in the second generation of dachshund puppies. There are *more* purple flowers than white flowers, just like there were *more* short-haired dachshunds than long-	Does anyone want to add on?

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				haired dachshunds.	
		Link science ideas to other science ideas.	Mendel found these results incredible and tried to figure out why a trait would disappear in one generation of pea plants and reappear in another generation. He tested six other pea-plant traits, like seed color and plant height. In each case, he found similar results: A trait would disappear in one generation and show up again in a later generation. From these experiments, Mendel came up with some ideas that he thought might explain the pattern he saw in his pea plants. **NOTE TO TEACHER:** *Distribute handout 2.1, Mendel's Ideas. First, go over the instructions to make sure students understand the activity. Then have a volunteer read the first idea and another student restate the idea in his or her own words or relate the idea to either the dachshund or pea-plant pedigree. Read through all seven ideas using this strategy; then compare each of Mendel's ideas with students' ideas about trait inheritance on the class chart.* **Show slide 7.**		
		Make explicit links between science ideas and activities **during**	Mendel's seven ideas about how traits are passed from parents to offspring are listed on this handout. After I read the instructions, I'd like a volunteer to read		

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		the activity.	the first idea on the page. Then I'd like someone else to restate this science idea in your own words or connect it to something you saw in the dachshund or pea-plant pedigree. Let's use that strategy for all seven statements. **NOTE TO TEACHER:** *Read through all seven ideas **before** dividing the class into small groups and having students compare Mendel's ideas with the class chart. Make sure students have the necessary supplies for the activity (either the blue and green dots or colored pencils).* **Show slide 8.** **Small-group discussion:** Now let's compare Mendel's ideas with the ideas about trait inheritance that we've come up with so far. For this activity, you'll discuss each of Mendel's ideas in your small groups and then look at our class chart of ideas about inheritance to see if you find a similar idea. If you find an idea on our class chart that also appears on Mendel's list, place a green sticky dot on the handout chart. If you don't find any ideas on the class		

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			chart that appear on Mendel's list, place a blue sticky dot on the handout chart to show that it's a new idea. **ELL support:** Clarify that the wording on the class chart doesn't need to match the wording on Mendel's list exactly. As long as the ideas are similar, the words and names for things can be different.		
10 min	**Follow-Up to Activity** **Synopsis:** Students compare the science ideas on Mendel's list with the ideas on the class chart and decide whether the chart should be modified. **Main science idea(s):** • Some traits are dominant, and some traits are recessive. When an individual receives two different sets of instructions for a trait from the parents, only the instructions for the dominant trait will be followed. The dominant trait will be expressed, and the recessive trait will be covered up.	Highlight key science ideas and focus question throughout.	**Show slide 9.** Now I'd like a representative from each small group to come up and share your discoveries with the class. Identify which idea on the class chart you think is similar to an idea on Mendel's list. Make sure to explain how you think they're similar. If the class agrees with your comparison, you'll place a green sticky dot next to the idea on the chart. **NOTE TO TEACHER:** *Invite representatives of each small group to come up, point out an idea on the class chart that matches an idea on Mendel's list, and compare the two ideas.* *If classmates agree with the comparison, have the group representative place a green dot next to the idea on the class chart that is similar to Mendel's idea.* **Show slide 10.** Next, let's talk about ideas that appeared on Mendel's list but not on our class		

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		Make explicit links between science ideas and activities.	chart. Do you think we should add any of these ideas to our class chart? Why or why not? Finally, let's look at the ideas that appear on our class chart but not on Mendel's list. Do you think we should keep any of these ideas, revise them, or cross them off the chart? Make sure to give the reasons for your answers. **NOTE TO TEACHER:** *At this point in the lesson, it might be interesting to talk about the evolution of scientific ideas. For instance, in Mendel's day, the terms* genes *and* DNA *hadn't been developed yet. The trait instructions that Mendel called* factors *were later called* genes*. While Mendel's term wasn't wrong, scientific ideas evolve and develop as understanding increases. This will be addressed in the next lesson, but it's useful to mention here, since students are comparing their own developing ideas with Mendel's. You may want to include other examples from your own class chart, such as* chromosomes *or* cells.		
10 min	**Synthesize/Summarize Today's Lesson** **Synopsis:** Students discuss today's focus questions and summarize science ideas that might help them answer the unit	Highlight key science ideas and focus question throughout. Engage students in	**Show slide 11.** Today's focus questions are *Can certain traits disappear in a family? Can offspring have traits their parents don't have?* **Small-group discussion:** In your small		

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	central question. **Main science idea(s):** • Trait variations exist in a species because individuals inherit a random combination of genes from their parents.	constructing explanations and arguments. Engage students in communicating in scientific ways.	groups, discuss these questions and determine the best answer. What evidence can you provide from the dachshund and pea-plant pedigrees to support your ideas? **ELL support:** Since students have interacted only with ready-made representations, it may benefit them to write or draw representations of the inheritance process in their notebooks. **NOTE TO TEACHER:** *Ask a few students to share highlights of their small-group discussion with the class.* **Whole-class share-out:** Let's hear from a few of you. What do you think are the best answers to today's focus questions? Make sure to include your reasons and evidence.	Since you get two genes, one from your mom and one from your dad, if your mom and dad have different traits, you might still have both sets of instructions, but the dominant trait is what shows up. The other trait is hidden, but it doesn't disappear. In the dachshunds, the long-hair trait didn't disappear; it was just hidden.	What do you think would happen if

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					your mom and dad had the same trait?
				You'd have the same trait they have, and that's the trait that would show up.	Is that what happened with the second generation of dachshund puppies? Both parents had short hair, but some of the offspring had long hair. How do you think that could have happened?
				The long-hair trait is only hidden; it doesn't disappear. So the second generation of puppies can have either long or short hair.	
			So far in these lessons, we've been talking about traits that are passed from parents to their offspring. But learning about trait inheritance can also help us understand and explain why individuals of a species are different from one another. **Show slide 12.** How do you think the traits we inherit from our parents make us look like other people in some ways and different in		

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			other ways? **Turn and Talk (2 min):** Discuss this question with a partner, and try to include in your answers some of the new science ideas we learned about in this lesson. See if you can use the terms *genes*, *alleles*, *dominant traits*, and *recessive traits* as well. Now draw a line in your science notebooks below today's focus questions and summarize any ideas you currently have that might help us answer the unit central question, *Why are individuals of a species different from one another?*		
1 min	**Link to Next Lesson** **Synopsis:** The teacher foreshadows the next lesson in which students discover what modern scientists know about inheritance that Mendel didn't know.	Link science ideas to other science ideas.	**Show slide 13.** Today we learned about Mendel's pea-plant experiment and his ideas about trait inheritance. We also discovered that some of the words we use today, like *genes*, *chromosomes*, and *DNA*, hadn't been developed in Mendel's day. Next time we'll explore how scientific discoveries after Mendel's time led to new understandings of how traits are passed on from parents to offspring. Stronger microscopes enabled scientists to see things that Mendel could only imagine!		