

Lesson Plan: Enchanted Traits

By: Darby Feldwinn

Reading By: Mandi de Witte

Target Grade: 3rd

Teacher Prep Time: 10 minutes

Lesson Time: 4 hours (We recommend doing this lesson over 5 days, one part per day.)

- Part 1: Tree Study -Forbidden Forest
 - 10 min - Introduction
 - 20 min – Azkaban Oaks
 - 20 min – Hogwarts Pines
 - 10 min - Forbidden Forest Summary
- Part 2: Tree Study -Enchanted Forest
 - 5 min - Introduction
 - 20 min – Azkaban Oaks
 - 20 min – Hogwarts Pines
 - 15 min - Enchanted Forest Summary
- Part 3: Where do Traits Come From?
 - 5 min - Introduction
 - 10 min – Ron and Hermione’s Ideas
 - 30 min – Claims and Evidence
- Part 4: Science Study of Tree Heights in Different Forests
 - 10 min - Introduction
 - 35 min – Tree Heights in the Forbidden and Enchanted Forests
- Part 5: Where are Traits Come From
 - 10 min - Introduction
 - 20 min – What Makes You How You Are? (Inherited and Acquired Traits)

Where This Lesson Fits in:

Before students do this lesson, they should have already done an activity that has allowed them to learn that an organism’s traits are inherited from its parents, and that variations of these traits exist within a population (3-LS3-1).

Lesson Overview:

This lesson integrates science (part 1) with language arts (parts 2 and 3). During the lesson, students explore two species of trees that are growing in two different areas. This allows them to confirm that within a population, there are variations in trait values. In addition, they observe that the environment that an organism lives in can affect the value of a trait. This discovery is reinforced by readings that introduce the terms “inherited traits” and “acquired traits.” This allows students to make a connection between the trees that they studied and the traits that they (humans) have.

Learning Objectives:

- Students will analyze data and conclude that the environment can affect a species’ traits.
- Students will know that traits can be inherited, acquired, or a combination of the two.
- Students will be able to recognize claims within written text, as well as the data used to back up the claims.

NGSS:

- **Performance Expectation**
 - 3-LS3-2: Use evidence to support the explanation that traits can be influenced by the environment.
- **Science and Engineering Practice**
 - #4 Analyze and Interpret Data
 - Analyzing data in 3–5 builds on K–2 experiences and progresses to introducing quantitative approaches to collecting data and conducting multiple trials of qualitative observations. When possible and feasible, digital tools should be used.
 - Represent data in tables and/or variable graphical displays (bar graphs, pictographs and/or pie charts) to reveal patterns that indicate relationships.
 - Compare and contrast data collected by different groups in order to discuss similarities and differences in their findings.
- **Disciplinary Core Idea**
 - LS3.A Inheritance of Traits and LS3.B Variation of Traits
 - Different organisms vary in how they look and function because they have different inherited information; the environment also affects the traits that an organism develops.
- **Crosscutting Concept**
 - #3 Scale, proportion, and quantity
 - In grades 3-5, students recognize natural objects and observe that phenomena exist from the very small to the immensely large. They use standard units to measure and describe physical quantities such as weight, time, and temperature, and volume.
- **Common Core State Standard**
 - RI.3.1 Reading Informational Text
 - Ask and answer questions to demonstrate understanding of a text, referring explicitly to the text as the basis for the answers.
 - RI.3.9 Reading Informational Text
 - Compare and contrast the most important points and key details presented in two texts on the same topic.

Materials Needed:

- Student worksheet (1 per student + 1 class worksheet)
- Ruler that measures in cm (1 per student)
- Meter stick - putting a piece of tape at one cm, or coloring in a cm on the meter stick helps students understand the scale easier
- Piece of poster paper any size will work but I used 27" × 30"
- Forest Comparison Graphs
- Document camera

Teacher Prep:

Part 1:

- Printout the worksheet.
- On the class worksheet, fill in the Forbidden Forest, Hogwarts Pines graph.

Part 2:

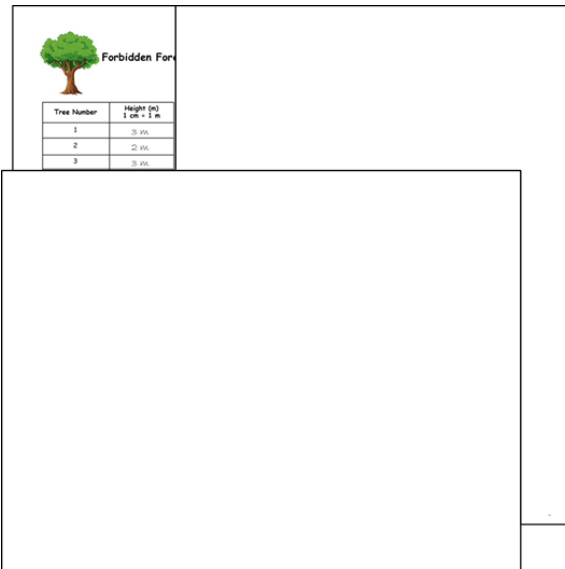
- On the class worksheet, fill in the Enchanted Forest, Azkaban Oak graph and the Enchanted Forest, Hogwarts Pine graph.

Lesson Sequence:

* For this activity we recommend that students work in groups of 4.

Part 1: Tree Study - Forbidden Forest	
10 minutes	<p>Introduction</p> <ul style="list-style-type: none">• Pass out worksheets and a ruler to students.• Tell students, "Today you will be an arborist. An arborist is a scientist that studies trees. You have been asked to study two types of trees in the Forbidden Forest." Show them what the Azkaban Oaks and Hogwarts Pines look like.• Ask students, "Do you think we could draw a tree at full height on a piece of paper?"<ul style="list-style-type: none">○ ESR: No, they are too big.• Tell students, "Since the trees could not fit on a piece of paper, another arborist has drawn pictures of the trees using a scale. For this study, the scale is 1 cm equals 1 m."• Show students a meter stick so that they know the length of a meter. Point out the centimeter scale that has been taped off or colored in so that they can compare the length of a centimeter to a meter. Re-explain that if they measure a tree on the paper as being 1 centimeter, it means that tree is 1 meter in the forest.• Put the class worksheet under the document camera. You will fill this out along with the students. As a class, show students how to position their ruler so that they can measure the size of the broomstick. Use this measurement to fill in question 1, making sure that students understand that while they measured 2 cm on the paper, the broomstick would be 2 m in the forest.
20 minutes	<p>Azkaban Oaks</p> <ul style="list-style-type: none">• Tell students, "We will now measure the Azkaban Oaks on page 1, and record these measurements on page 2. We will also make a graph so that we can see how many trees are at each height."• On the class worksheet, show students how to measure Azkaban Oak with the number 1 on it, and record 3 m on page 2. Then fill in one box on the graph in the column for a tree height of 3 m to represent this tree.• Repeat this process at least one more time. After, tell students, "If you are comfortable doing the measurements, feel free to measure the rest of the Azkaban Oaks on your own. If you would like a little more help, we will do a few more as a class."• Repeat the process until the majority of students know how to make the measurements and graph their results. Then, let students do the rest on their own.• Give students 5 minutes to finish measuring and graphing their results.• While students are completing their measurements and graph, remove the class worksheet from the document camera and fill in the rest of the measurements for the Azkaban Oaks and complete the graph. Then turn the Forest Comparison Graphs over so that all you can see is the white side of the paper, and position them on page 2 of the class worksheet so students can only see the numbers that you complete as

a class (shown below). Then put the class worksheet back under the document camera.



- Once students are finished, have them tell you the measurements for the Azkaban Oaks and reveal the measurements one by one. Then show the graph so they can compare their work.
- As a class, complete questions 2-8, filling them out in the class worksheet as students complete them in their worksheet.
 - For question 6, make sure that students notice that the Azkaban Oaks all have similar heights and the most likely height is in the middle.
 - For question 8, make sure that students understand that even though all of the Azkaban Oaks are in the same area and the same age, trees of the same species still grow to different heights, just like humans of the same age can be different heights. If students are struggling with this concept, have two students stand up whose birthdays are closest to each other and have the other students in the class compare their heights. They should see that while they are close in age, their heights are not exactly the same.

20
minutes

Hogwarts Pines

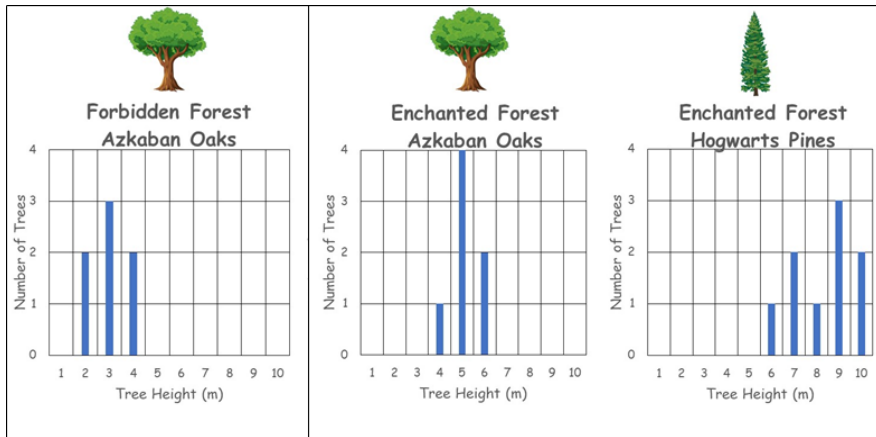
- Have students repeat the process for Hogwarts Pines in the Forbidden Forest (page 3) and fill in questions 9 - 14 on their own. Once they have their answers, have them check them with their group of 4.
- The measurements and graph in the class worksheet should already be filled out. Place the class worksheet under the document camera using the reverse side of the Forest Comparison Graphs to hide the measurements and graph (as was shown above for the Azkaban Oaks).
- Have students tell you their measurements as you reveal them on the class worksheet.
- Have students tell you the answers to questions 9-14, while you record them on the class worksheet.
 - For question 14, make sure students have noticed that the Hogwarts Pines have a wider range of heights than the Azkaban Oaks.
- Discuss question 15 as a class and make sure students understand that Hogwarts Pines are a different height than the Azkaban Oaks because they are a different species of tree. Then, fill in the answer in the class worksheet as students fill it in on their worksheet.

<p>10 minutes</p>	<p>Forbidden Forest Summary</p> <ul style="list-style-type: none"> • Tell students, “We will now use our data to see if we can predict what type of tree we are observing based only on its height.” • Put the Forest Comparison Graph from the Forbidden Forest under the document camera. <div data-bbox="500 331 1079 768" data-label="Figure"> <table border="1"> <caption>Forbidden Forest Data</caption> <thead> <tr> <th>Tree Type</th> <th>Tree Height (m)</th> <th>Number of Trees</th> </tr> </thead> <tbody> <tr> <td rowspan="3">Azkaban Oaks</td> <td>2</td> <td>2</td> </tr> <tr> <td>3</td> <td>3</td> </tr> <tr> <td>4</td> <td>2</td> </tr> <tr> <td rowspan="5">Hogwarts Pines</td> <td>5</td> <td>1</td> </tr> <tr> <td>6</td> <td>4</td> </tr> <tr> <td>7</td> <td>2</td> </tr> <tr> <td>8</td> <td>1</td> </tr> <tr> <td>9</td> <td>1</td> </tr> </tbody> </table> </div> <ul style="list-style-type: none"> • Have students tell you the type of tree they predict an 8 m tree will be, and why. Then fill in the answer on the first part of question 16 on the class worksheet as students fill it in on their worksheet. • Repeat the process for a 4 m tree, and fill in the second part of question 16. • Tell students, “We will now summarize what we learned about the Forbidden Forest.” As students tell you the answers, fill in question 17 in the class worksheet while students fill it in on their worksheet. 	Tree Type	Tree Height (m)	Number of Trees	Azkaban Oaks	2	2	3	3	4	2	Hogwarts Pines	5	1	6	4	7	2	8	1	9	1
Tree Type	Tree Height (m)	Number of Trees																				
Azkaban Oaks	2	2																				
	3	3																				
	4	2																				
Hogwarts Pines	5	1																				
	6	4																				
	7	2																				
	8	1																				
	9	1																				

Part 2: Tree Study - Enchanted Forest

<p>5 minutes</p>	<p>Introduction</p> <ul style="list-style-type: none"> • Have students turn to page 4 of their worksheet and summarize what they learned about the trees in the Forbidden Forest. • Tell students, “The Enchanted Forest saw your report from the Forbidden Forest and they would like you to complete a similar study for them.” • Remind students that when they measure the trees in the Enchanted Forest, if they measure a tree as 3 cm, that tree would be 3 m in the forest.
------------------	---

<p>20 minutes</p>	<p>Azkaban Oaks</p> <ul style="list-style-type: none"> • Have students repeat the process for Azkaban Oaks in the Enchanted Forest (page 6) and fill in questions 18 - 22 on their own. Once they have their answers, have them check them with their group of 4. • The measurements and graph in the class worksheet should already be filled out. Place the class worksheet under the document camera using the reverse side of the Forest Comparison Graphs to hide the measurements and graph. • Have students tell you their measurements as you reveal them on the class worksheet. • Have students tell you the answers to questions 18 - 22, while you record them on the class worksheet. • Put the Forest Comparison Graphs under the document camera so that students can see the graphs from the Forbidden Forest and the Enchanted Forest for the Azkaban Oaks at the same time, as seen in the picture below.
-------------------	---

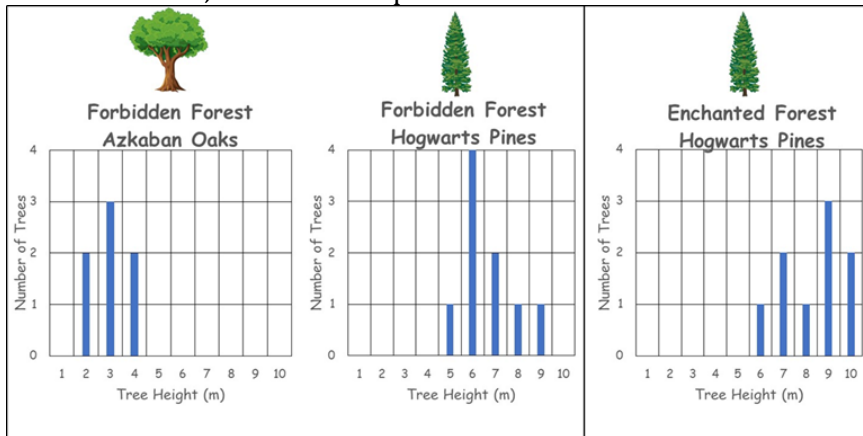


- Have students tell you what is similar about the graphs. Make sure students notice that the range is the same in both graphs and the most likely tree height is still in the middle. Record one of their ideas in the class worksheet for the first part of question 23. Students can record any of the shared ideas in their worksheet.
- Have students tell you what is different about the graphs. Make sure students notice that the trees are taller in the Enchanted Forest than in the Forbidden Forest. Record one of their ideas in the class worksheet for the second part of question 23. Students can record any of the shared ideas in their worksheet.

20 minutes

Hogwarts Pines

- Have students repeat the process for Hogwarts Pines in the Enchanted Forest (page 7) and fill in questions 24 - 28 on their own. Once they have their answers, have them check them with their group of 4.
- The measurements and graph in the class worksheet should already be filled out. Place the class worksheet under the document camera using the reverse side of the Forest Comparison Graphs to hide the measurements and graph.
- Have students tell you their measurements as you reveal them on the class worksheet.
- Have students tell you the answers to questions 24 - 28, while you record them on the class worksheet.
- Put the Forest Comparison Graphs under the document camera so that students can see the graphs from the Forbidden Forest and the Enchanted Forest for the Hogwarts Pines at the same time, as seen in the picture below.



- Have students tell you what is similar about the graphs. Make sure students notice that the range is the same and the most likely tree height is still in the middle, and that this was the same thing that they saw for Azkaban Oaks. Record one of their ideas in the class worksheet for the first part of question 29. Students can record any of the

	<p>shared ideas in their worksheet.</p> <ul style="list-style-type: none"> • Have students tell you what is different about the graphs. Make sure students notice that the trees are taller in the Enchanted Forest than in the Forbidden Forest, and this is the same thing that they saw for Azkaban Oaks. Record one of their ideas in the class worksheet for the second part of question 29. Students can record any of the shared ideas in their worksheet.
<p>15 minutes</p>	<p>Enchanted Forest Summary</p> <ul style="list-style-type: none"> • Tell students, “We will now use our data to see if we can predict what type of tree we are observing and where it is located based only on its height.” • Start by putting the Forest Comparison Graph from the Forbidden Forest under the document camera. Ask students, “Can a tree that is 2 m tall grow in the Forbidden Forest and, if so, what type of tree would it be?” <ul style="list-style-type: none"> ○ ESR: Yes, a 2 m tree could grow in the Forbidden Forest, and it would be an Azkaban Oak. • Put the Forest Comparison Graph from the Enchanted Forest under the document camera. Ask students, “Can a tree that is 2 m tall grow in the Enchanted Forest and, if so, what type of tree would it be?” <ul style="list-style-type: none"> ○ ESR: No, trees in the Enchanted Forest are taller than 2 m. • Fill in the first part of question 30 in the class worksheet as students fill it in on their worksheet. • Put the Forest Comparison Graph from the Forbidden Forest under the document camera. Ask students, “Can a tree that is 9 m tall grow in the Forbidden Forest and, if so, what type of tree would it be?” <ul style="list-style-type: none"> ○ ESR: Yes, a 9 m tree could grow in the Forbidden Forest, and it would be a Hogwarts Pine. • Put the Forest Comparison Graph from the Enchanted Forest under the document camera. Ask students, “Can a tree that is 9 m tall grow in the Enchanted Forest and, if so, what type of tree would it be?” <ul style="list-style-type: none"> ○ ESR: Yes, a 9 m tree could grow in the Enchanted Forest, and it would be a Hogwarts Pine. • Put the graphs for both the Hogwarts Pines from the Forbidden and Enchanted Forests under the document camera and ask students, “What is the more likely location for the 9 m tree?” <ul style="list-style-type: none"> ○ ESR: It is more likely this tree is in the Enchanted Forest, because more trees are at that height in the Enchanted Forest than in the Forbidden Forest. • Fill in the second part of question 30 in the class worksheet as students fill it in on their worksheet. • Tell students, “We will now summarize what we learned about the Enchanted Forest.” As students tell you the answers, fill in question 31 in the class worksheet while students fill it in on their worksheet. • Ask students, “Why do you think the trees in the Enchanted Forest are growing taller?” Write these on poster paper so that they can be brought out for parts 3 and 4. <ul style="list-style-type: none"> ○ ESR: Different amounts of rain, different temperatures, soil type, etc.
<p>Part 3: Where Do Traits Come From?</p>	
<p>5 minutes</p>	<p>Introduction</p> <ul style="list-style-type: none"> • Review with students what they learned about the Forbidden and Enchanted Forests, and why they think the tree heights are different in each place.

10 minutes	<p>Ron and Hermione’s Ideas</p> <ul style="list-style-type: none"> • Read the story on pages 9 and 10 aloud to students OR call on students to take turns reading.
30 minutes	<p>Claim and Evidence</p> <ul style="list-style-type: none"> • Explain to students that a claim is a statement about the way something in the world works, and it has to be something that can be tested. For example, the larger the fish, the farther it swims. • Ask students, “How could this be tested?” <ul style="list-style-type: none"> ○ ESR: Get two fish, one that is smaller and one that is bigger. Put a GPS chip on them and see how far each fish swims. • In their groups of 4, have students generate statements that are claims, and identify how they would test them. Afterwards, have a few students share their examples. • Tell students, “In the story, Ron and Hermione make claims about where their traits come from. I am going to read the story to you one more time. While I do this, see if you can identify the claims that Ron and Hermione are making.” • Reread the story to the students. Then, in groups, let them discuss what claims were being made. • Have students share what Ron and Hermione’s claims were. Once a class consensus has been reached, record the claims in question 32 of the class worksheet while students copy it into their worksheet. • Explain to students that claims in science have to be supported by evidence. Evidence comes in the form of observations, measurements, or research on other scientists’ observations and measurements. • Have students discuss in their groups the evidence that Ron and Hermione used to support their claims. • Have students share the evidence that Ron and Hermione used to support their claims. Once a class consensus has been reached, record the evidence in question 33 of the class worksheet while students copy it into their worksheet. • Bring out the poster paper from part 2 where students brainstormed why the trees were different sizes in the forests. • Ask students, “Are these examples of claims?” If anything on the poster is not something that can be tested (ex: the magic is different in the forests), then cross it out. • Have students generate ways that they could gather data to support their claims, and write these next to the claim.
<p>Part 4: Science Study of Tree Heights in Different Forests</p>	
10 minutes	<p>Introduction</p> <ul style="list-style-type: none"> • Ask students, “What is a claim?” <ul style="list-style-type: none"> ○ ESR: A claim is a statement that can be tested. • Ask students, “What were the claims that Ron and Hermione made about their traits?” <ul style="list-style-type: none"> ○ ESR: Ron claimed that traits are inherited, and Hermione claimed that traits are learned. • Remind students that claims have to be supported by evidence. Then, ask students, “What can we use as evidence to support a claim?” <ul style="list-style-type: none"> ○ ESR: We can use observations, measurements, and research. • Ask students, “What evidence did Ron and Hermione use to support their claims?” <ul style="list-style-type: none"> ○ EST: Ron used the observation that people are born with given eye and hair

colors and that they cannot be changed with practice. Hermine used the observation that people are not born knowing how to read and write, but they are able to learn these traits with practice.

35 minutes

Tree Heights in the Forbidden and Enchanted Forests

- Read the blurb at the top of page 12 to students.
- Tell students, “I am going to read the article to you. As I read the article, we are going to identify claims that the authors make as well as the evidence they use to support their claim. When we see a claim, we will underline it and when we see evidence, we will box it.” Write “claim” on the class worksheet and underline it, and write “evidence” and box it.
- Read each paragraph and have students try to underline the claim(s) and box the evidence. After each paragraph, have students discuss in their group what the claim(s) and evidence were. Then have them share their thoughts while you annotate the class worksheet. Have students check and correct their worksheets if necessary. After you have completed annotating the article, it should look like the pages below.
 - Point out that for paragraph 1, the scientist put their data in a table instead of integrating it into their writing which is a common practice in science.
 - It is helpful to use two colors of pen for the first paragraph because the data in the table is used for evidence in more than one claim.

Part 4: Science Study of Tree Heights in Different Forests

After recess, Ron and Hermione went back to their class for science time. Their teacher, Professor Sprout, explained they will read an article published by an arborist that has been doing a study on both the Forbidden Forest and the Enchanted Forest.

Claim Evidence

Tree Heights in the Forbidden and Enchanted Forests

Azklaban Oaks and Hogwarts Pines grow in both the Forbidden and Enchanted Forests. The heights of the trees are given in Table 1.

Table 1: Tree Heights

Tree Type	Forbidden Forest		Enchanted Forest	
	Average Height	Height Range	Average Height	Height Range
Azklaban Oak	3 m	2 m	5 m	2 m
Hogwarts Pine	6 m	4 m	9 m	4 m

In both forests, Hogwarts Pines are taller than Azklaban Oaks. Another key difference between the species is that Hogwarts Pines have a greater range of heights than the Azklaban Oaks. This suggests that while the trees inherit an approximate height from their parents, there is a range of heights that the trees can reach. In general, trees also grow taller in the Enchanted Forest than in the Forbidden Forest.

We believe the difference in tree heights measured in the Forbidden and Enchanted Forests is caused by two factors. Factor 1 is the amount of rainfall: the greater the rainfall, the taller the trees. If there is more rainfall, the trees are able to absorb more water, making them taller. The average rainfall in the Forbidden Forest is 19 inches, while in the Enchanted Forest it is 43 inches which causes the trees to be taller in the Enchanted Forest.

Factor 2 is temperature: the hotter the temperature, the shorter the trees. As temperature increases, more water evaporates from the ground, which reduces the amount of water for the trees, thereby making the trees shorter. The average temperature in the Forbidden Forest is 76°F, and in the Enchanted Forest is 68°F, which causes the trees in the Forbidden Forest to be shorter.

These findings show that environmental factors can play a role in the height a tree reaches. To verify our conclusions, we took an Azklaban Oak and a Hogwarts Pine seed from the Enchanted Forest and planted them in the Forbidden Forest. We then measured the heights of the trees when they were the same age as the trees in the original study. We found the heights to be 4 m for the Azklaban Oak and 5 m for the Hogwarts Pine, which were closer to the Forbidden Forest heights than the Enchanted Forest heights. This shows that the environment played a role in the height differences.

34. Trees are taller in the: Forbidden Forest Enchanted Forest

What claims did the arborist make about why the trees were different heights in the two forests and what data backs up those claims?

Claim 1: When the rainfall is greater, the trees are taller.

Data Forbidden Forest: 19 in Data Enchanted Forest: 43 in

Claim 2: When the temperature is hotter, the trees are shorter.

Data Forbidden Forest: 76°F Data Enchanted Forest: 68°F

After reading and discussing the article it was time for lunch. At lunch Ron and Hermione discussed how the tree study applied to their argument about quidditch and if it was a learned or inherited trait.

35. Ron argued that traits are inherited learned.

36. What evidence do you think Ron could use from the tree study to support his argument that traits are inherited? There was only a certain range of heights that one species of tree could reach in one area.

37. Hermione argued that traits are inherited learned.

38. What evidence do you think that Hermione could use from the tree study to support her argument that traits are learned? Taking a seed from one forest and putting it in another forest changes the tree height.

- As a class, fill out question 34, which summarizes the two environmental factors that the arborist suggested are affecting the tree heights.
- Bring out the poster where students brainstormed why the trees were different sizes, and compare their ideas with the ideas in the article.
- Read the blurb in the middle of page 13.
- Tell students, “We are now going to tie this study back to the ideas that Ron and Hermine had.” Ask students, “Where did Ron think traits came from?” Once a class consensus is reached, circle “inherited” in question 35.
 - ESR: Ron thought that you are born with (inherit) your traits.
- Ask students, “Is there any evidence from the article that trees have traits that are

	<p>independent of the environment that they are in?”</p> <ul style="list-style-type: none"> ○ ESR: There is only a small range of heights that trees can have and Hogwarts Pines have a larger range than Azkaban Oaks. The sizes of these ranges do not change for the two forests. ● Fill in a student response for question 36 on the class worksheet while students fill it in on their worksheet. ● Ask students, “Where did Hermione think traits came from?” Once a class consensus is reached, circle “learned” in question 37. <ul style="list-style-type: none"> ○ ESR: Hermione thought that you learn your traits. ● Ask students, “Is there any evidence from the article that the tree changed if they were in another environment?” <ul style="list-style-type: none"> ○ ESR: When seeds were taken from one forest and grown in the other forest, the trees grew to the same height as the trees of that same species in the forest they were planted in. ● Fill in a student response for question 38 in the class worksheet while students fill it in on their worksheet.
--	--

Part 5: Where Our Traits Come From

5 minutes	<p>Introduction</p> <ul style="list-style-type: none"> ● Have students summarize what they have learned so far in the activity. ● Ask students, “What is a claim?” <ul style="list-style-type: none"> ○ ESR: A claim is a statement that can be tested. ● Ask students, “What were the claims that the arborist made about why the trees were different heights in the two forests?” <ul style="list-style-type: none"> ○ ESR: They claimed that the more rain, the taller the tree and the hotter the temperature, the shorter the tree. ● Remind students that claims have to be supported by evidence. Then ask students, “What type of evidence can be used to support a claim?” <ul style="list-style-type: none"> ○ ESR: We can use observations, measurements, and research. ● Ask students, “What evidence did the arborist use to support their claims?” <ul style="list-style-type: none"> ○ ESR: They used temperatures, rainfall amounts, and tree heights.
-----------	---

30 minutes	<p>What Makes You How You Are? (Inherited and Acquired Traits)</p> <ul style="list-style-type: none"> ● Read the blurb and the story on pages 14 and 15 aloud to students OR call on students to take turns reading. ● Have a discussion about where traits come from. Make sure by the end of the conversation, students know that traits can be inherited or acquired, and that acquired traits are traits that are learned or come from the environment. Fill in the class consensus answer for question 39 in the class worksheet, and have students fill it in on their worksheet. ● Have students fill out question 40 individually. Afterwards, have them share their claims and evidence with their table group and then have the groups share these with the class. Most likely there will be disagreements about if tree height is an inherited or acquired trait. Read the following sentence from paragraph 1 of the blurb: “It is not always easy to tell which traits are inherited and which are acquired.” Tell them that the arguments that they are having are similar to the ones that scientists have when they are trying to decide what type of trait something is. By the end of the discussion, make sure that students understand that tree height is both an inherited and acquired trait. ● Ask students, “Since we think that tree height might be both an inherited and
------------	---

acquired trait, is one of these more important in deciding the height of a tree?"
 Allow students to discuss then bring up the following points.

- What affects your height? (ESR: The height of your parents and what you eat.) Is the environment or inheritance more important in human height? (ESR: The height of your parents is more important than what you eat.) If I eat healthy, do you think I would grow taller? (ESR: No, you are full grown. Therefore, the environment has a greater effect on us because we are not full grown.)
- Show students the Forest Comparison Graph and have a class discussion so that they realize that the range of heights seen within one forest is due to inheritance, but the difference in heights seen between the two forests is due to acquired traits.
- Tell students, "You have helped me learn that traits can be both inherited and acquired, and I look forward to learning more science with you."

Example Student Work:

Name: Darby

Enchanted Traits

Part 1: Tree Study—Forbidden Forest

You are an arborist (a scientist that studies trees) and have been asked to document the height of two types of trees that grow in the Forbidden Forest.

Azkaban Oaks
 Hogwarts Pines

You will study a section of the forest where all of the trees are the same age. On the paper we cannot fit a tree that is 10 m tall, so we have a system that maps the height of the actual tree to the height of the tree on our paper, this is called a scale.

Our scale: 1 cm = 1 m

Therefore, if a tree is 5 cm tall in the picture it is 5 m tall in the forest. Let's practice by measuring the height of this wand to the nearest cm.

1. The measured height of the broomstick is 2 cm. In the forest, the broomstick would be 2 m. In our data table we will record the broomstick height as 2.

Research Section of Forbidden Forest

1

Forbidden Forest: Azkaban Oak Study

Graph the data you collected below.

Forbidden Forest: Azkaban Oaks

Tree Number	Height (m) 1 cm = 1 m
1	3 m
2	2 m
3	3 m
4	4 m
5	2 m
6	3 m
7	4 m

2. Are all of the Azkaban Oaks the same height in the Forbidden Forest? No

3. What is the height of the tallest Azkaban Oak in the Forbidden Forest? 4 m

4. What is the height of the shortest Azkaban Oak in the Forbidden Forest? 2 m

5. What is the range in heights (height of tallest tree — height of shortest tree) of Azkaban Oaks in the Forbidden Forest? 4 m - 2 m = 2 m

6. What do you notice about the bar graph? The most likely height is in the middle.

7. What is the most likely height for an Azkaban Oak in the Forbidden Forest? 3 m

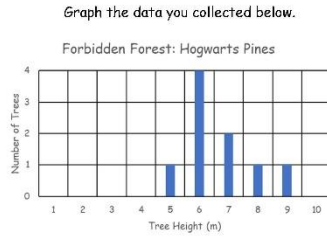
8. Are you surprised that the Azkaban Oaks are different heights even though they are in the same environment and the same age? Why or why not? I am not surprised because they are individual trees. Even trees of the same type reach different heights just like humans of the same age are different heights.

2



Forbidden Forest: Hogwarts Pine Study

Tree Number	Height (m) 1 cm = 1 m
1	7 m
2	6 m
3	9 m
4	6 m
5	6 m
6	8 m
7	5 m
8	6 m
9	7 m



- Are all of the Hogwarts Pines the same height in the Forbidden Forest? No
- What is the height of the tallest Hogwarts Pine in the Forbidden Forest? 9 m
- What is the height of the shortest Hogwarts Pine in the Forbidden Forest? 5 m
- What is the range in heights (height of tallest tree – height of shortest tree) of Hogwarts Pines in the Forbidden Forest? 9 m - 5 m = 4 m
- What do you notice about the bar graph? The most likely height is in the middle, the graph is more spread out.
- What is the most likely height for a Hogwarts Pine in the Forbidden Forest? 6 m
- Why aren't the Hogwarts Pines the same size as the Azkaban Oaks? Different types/species of trees grow to different heights.

3



- Predict if the following trees are Azkaban Oaks (AO) or Hogwarts Pines (HP).

A tree that is 8 m tall. Tree Type: HP

Why do you think it is that type of tree? The tallest Azkaban Oak was 4 cm and the Hogwarts Pines were taller.

A tree that is 4 m tall. Tree Type: AO

Why do you think it is that type of tree? The shortest Hogwarts Pine was 5 cm and the Azkaban Oaks were shorter.

- The key findings of your study in the Forbidden Forest are:

- In the Forbidden Forest, the Hogwarts Pines grow taller than the Azkaban Oaks.
- There are more Hogwarts Pines than Azkaban Oaks.
- Azkaban Oaks have a smaller range of heights than Hogwarts Pines.

4

Part 2: Tree Study—Enchanted Forest

Word got out about the excellent work that you did in the Forbidden Forest! The Enchanted Forest, which has the same type of trees, has asked you to repeat the study for them. Similar to the study in the Forbidden Forest, the Enchanted Forest picked a section of the forest (seen below) where all of the trees are the same age.



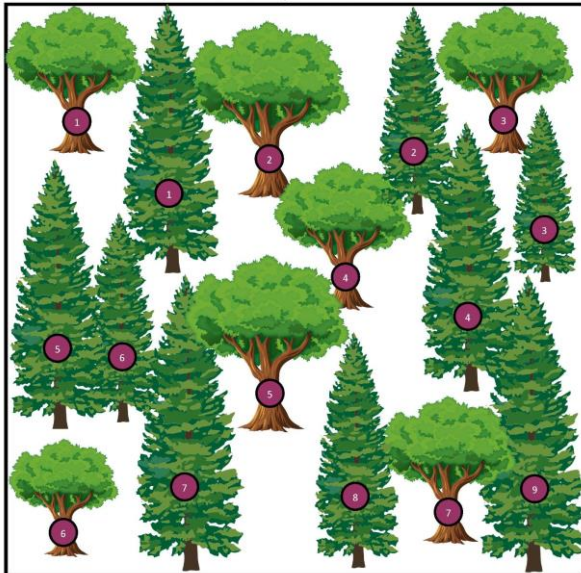
Azkaban Oaks



Hogwarts Pines

In the picture 1 cm = 1 m, measure the trees to the nearest cm.

Research Section of Enchanted Forest

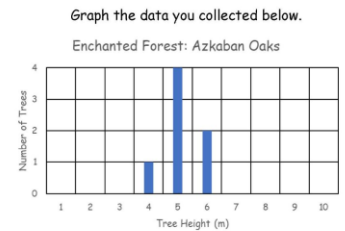


5



Enchanted Forest: Azkaban Oak Study

Tree Number	Height (m) 1 cm = 1 m
1	3 m
2	3 m
3	4 m
4	2 m
5	2 m
6	3 m
7	4 m



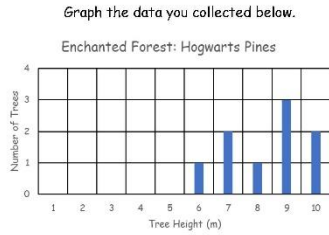
- Are all of the Azkaban Oaks the same height in the Enchanted Forest? No
- What is the height of the tallest Azkaban Oak in the Enchanted Forest? 6 m
- What is the height of the shortest Azkaban Oak in the Enchanted Forest? 4 m
- What is the range in heights (height of tallest tree—height of shortest tree) of Azkaban Oaks in the Enchanted Forest? 6 m - 4 m = 2 m
- What is the most likely height for an Azkaban Oak in the Enchanted Forest? 5 m
- Compare the graphs of the Azkaban Oaks from the Forbidden Forest and the Enchanted Forest. What do you notice that is similar? In both graphs, the tree heights of all the trees in one area are all within 2 m of each other.
- What do you notice that is different? The Azkaban Oaks in the Enchanted Forest are taller than the ones in the Forbidden Forest.

6



Enchanted Forest: Hogwarts Pine Study

Tree Number	Height (m) 1 cm = 1 m
1	9 m
2	7 m
3	6 m
4	9 m
5	9 m
6	7 m
7	10 m
8	8 m
9	10 m



24. Are all of the Hogwarts Pines the same height in the Enchanted Forest? No
25. What is the height of the tallest Hogwarts Pine in the Enchanted Forest? 10 m
26. What is the height of the shortest Hogwarts Pine in the Enchanted Forest? 6 m
27. What is the range in heights (height of tallest tree—height of shortest tree) of Hogwarts Pines in the Enchanted Forest? 10 m - 6 m = 4 m
28. What is the most likely height for a Hogwarts Pine in the Enchanted Forest? 9 m
29. Compare the graphs of the Hogwarts Pine from the Forbidden Forest and the Enchanted Forest. What do you notice that is similar? In both graphs, the tree heights of all the trees in one area are all within 4 m of each other.
- What do you notice that is different? The Hogwarts Pines in the Enchanted Forest are taller than the ones in the Forbidden Forest.



30. Predict if the following trees are Azkaban Oaks (AO) or Hogwarts Pines (HP) and if they grow in the Forbidden Forest (FF) or the Enchanted Forest (EF).

A tree that is 2 m tall. Tree Type: AO Forest: FF

Why do you think it is that type of tree growing in that forest? Azkaban Oaks in the forbidden forest are the only trees that grow this small.

A tree that is 9 m tall. Tree Type: HP Forest: EF

Why do you think it is that type of tree growing in that forest? While the Hogwarts Pines in both the Enchanted Forest and Forbidden Forest reach this height, 9 m was seen more often in the Enchanted Forest.

31. What are the key findings of your study in the Enchanted Forest?

- In the Enchanted Forest, the Hogwarts Pines grow taller than the Azkaban Oaks.
- There are more Hogwarts Pines than Azkaban Oaks.
- Azkaban Oaks have a smaller range of heights than Hogwarts Pines.
- Trees grow taller in the Enchanted Forest compared to the Forbidden Forest.

Part 3: Where Do Traits Come From?

Hermione and Ron are both third graders at Pigwarts Elementary School, a preparatory school for Hogwarts. One day at recess, Hermione invited Ron to play quidditch with her. Ron said, "No, I'm not good at quidditch, and I never will be."



"Why do you think you'll never be good at quidditch?" asked Hermione.

Ron sighed and admitted, "Well, I wasn't born to play sports. No one in my family is good at them. The people in my family are better at casting spells."

"That's silly!" exclaimed Hermione. "If you want to play quidditch, you just practice and that's how you learn!"

Ron shook his head, and explained, "No, that's not true. We are born to be a certain way, so I will never be able to play quidditch. For example, I have blue eyes that I was born with. Do you think I could just practice having brown eyes and then they would magically turn brown?"



Hermione scratched her head. "Hmmm, I guess that is true."

"Yeah!" Ron exclaimed. "I also have red hair and you have brown hair. That's another example, I just can't wake up tomorrow and have brown hair, can I?"

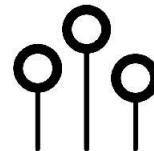


Hermione stood silent for a moment, but then suddenly had a thought. "Well remember when we started school here in Kindergarten? We couldn't read or write very well because we were little, but the teachers taught us how! Now we read and write all the time! See, you aren't just born knowing how to do things, you have to learn them."

Now Ron was the one left confused. "Well, that's true, but still there are some things that you can't really learn to do, like change your eye color. I think that for the most part, we are born with the different traits we have."

"Fine," said Hermione, "if you are too chicken to play quidditch, so be it. I think that we can learn traits from practicing and from other people and it doesn't really matter what you're born with."

Ron just shrugged and went over to go play on the swings, and Hermione continued to play quidditch.



32. A **claim** is a statement a person makes about the way something in the world works. For example, the larger the fish, the farther it swims. In this story, Ron and Hermione have both made **claims** about the different traits that they have. Fill in the claims that they made about traits.



Ron's Claim

You are born with the traits that you have.



Hermione's Claim

You can learn traits.

33. In order for a **claim** to be valid, it must be based on evidence that they have researched, observed, or measured. Each character also provides a few examples of why they think they are correct. These examples are the **evidence** they are using to support their **claim**. Fill in the evidence they stated to back up their claim.



Ron's Evidence

You cannot change your hair or eye color by practicing.



Hermione's Evidence

You did not know how to read or write when you were born and now you can.

11

Part 4: Science Study of Tree Heights in Different Forests

After recess, Ron and Hermione went back to their class for science time. Their teacher, Professor Sprout, explained they will read an article published by an arborist that has been doing a study on both the Forbidden Forest and the Enchanted Forest.

Claim

Evidence

Tree Heights in the Forbidden and Enchanted Forests

Azkaban Oaks and Hogwarts Pines grow in both the Forbidden and Enchanted Forests. The heights of the trees are given in Table 1.

Table 1: Tree Heights

Tree Type	Forbidden Forest		Enchanted Forest	
	Average Height	Height Range	Average Height	Height Range
Azkaban Oak	3 m	2 m	5 m	2 m
Hogwarts Pine	6 m	4 m	9 m	4 m

In both forests, Hogwarts Pines are taller than Azkaban Oaks. Another key difference between the species is that Hogwarts Pines have a greater range of heights than the Azkaban Oaks. This suggests that while the trees inherit an approximate height from their parents, there is a range of heights that the trees can reach. In general, trees also grow taller in the Enchanted Forest than in the Forbidden Forest.

We believe the difference in tree heights measured in the Forbidden and Enchanted Forests is caused by two factors. Factor 1 is the amount of rainfall: the greater the rainfall, the taller the trees. If there is more rainfall, the trees are able to absorb more water, making them taller. The average rainfall in the Forbidden Forest is 48 cm, while in the Enchanted Forest it is 109 cm, which causes the trees to be taller in the Enchanted Forest.

Factor 2 is temperature: the hotter the temperature, the shorter the trees. As temperature increases, more water evaporates from the ground, which reduces the amount of water for the trees, thereby making the trees shorter. The average temperature in the Forbidden Forest is 24°F (76°F), and in the Enchanted Forest is 20°C (68°F), which causes the trees in the Forbidden Forest to be shorter.

12

These findings show that environmental factors can play a role in the height a tree reaches. To verify our conclusions, we took an Azkaban Oak and a Hogwarts Pine seed from the Enchanted Forest and planted them in the Forbidden Forest. We then measured the heights of the trees when they were the same age as the trees in the original study. We found the heights to be 4 m for the Azkaban Oak and 5 m for the Hogwarts Pine, which were closer to the Forbidden Forest heights than the Enchanted Forest heights. This shows that the environment played a role in the height differences.

34. Trees are taller in the: Forbidden Forest Enchanted Forest

What claims did the arborist make about why the trees were different heights in the two forests and what data backs up those claims?

Claim 1: When the rainfall is greater, the trees are taller.

Data Forbidden Forest: 79 in Data Enchanted Forest: 43 in

Claim 2: When the temperature is hotter, the trees are shorter.

Data Forbidden Forest: 76°F Data Enchanted Forest: 68°F

After reading and discussing the article it was time for lunch. At lunch Ron and Hermione discussed how the tree study applied to their argument about quidditch and if it was a learned or inherited trait.

35. Ron argued that traits are inherited learned.

36. What evidence do you think Ron could use from the tree study to support his argument that traits are inherited? There was only a certain range of heights that one species of tree could reach in one area.

37. Hermione argued that traits are inherited learned.

38. What evidence do you think that Hermione could use from the tree study to support her argument that traits are learned? Taking a seed from one forest and putting it in another forest changes the tree height.

13

Part 5: Where Our Traits Come From

After lunch, Ron and Hermione went back to their third grade class for more science time. Professor Sprout explained that they would be reading an article about what makes you who you are.

Ron and Hermione gasped and looked at each other. Finally, they would know who was right! Professor Sprout passed out the article, and the whole class read it together.

What Makes You Who You Are?

Every person is different. We all have a combination of two types of traits.

Inherited traits are characteristics that we are born with. We inherit traits from our parents. Some examples of inherited traits are the color of our hair and eyes.

Acquired traits are things that are learned, or are influenced by the environment that we live in. It is not always easy to tell which traits are inherited, and which are acquired.

In fact, scientists have evidence that some traits may be a combination of both. Sometimes we start out with an inherited trait that we develop because of what we learn. For example, you may have inherited artistic ability from your mom, but it is up to you to use your ability to create great art. Some people are born with a calm, quiet personality, and some people are more outgoing and energetic. A calm, quiet person can be pleasant and a good listener. An outgoing, energetic person can be entertaining to others. But both of these people can also have problems if they don't work with their traits in a positive way. A quiet person can become withdrawn and awkward and an outgoing, energetic person can demand too much attention and forget about others.



14

Some acquired traits come from observing family members or others around us. For example, if your parents play musical instruments, you may become interested in learning about music as well. This is not always the case, though. Perhaps your dad likes to cook but you will never be interested in cooking, or perhaps your mom plays golf but you would rather be a skateboarder. You may also acquire interests because of the environment in which you grow up. Someone who grows up near the beach is more likely to be interested in swimming than someone who grows up in a cold mountain environment where many people enjoy skiing.

Part of the challenge in growing up and becoming you is learning to like who you are. This is easy if you are like most of the people around you. But what if you are different in some way? Sometimes it's hard to be different if you feel like there is something wrong with that. But there is nothing wrong with being different and every person has traits that are different from others. If we were all the same, the world would be a boring place! If you learn to like yourself, you will be happier being yourself. If there are things you do not like about yourself, you can work to change those things, if possible. Some traits cannot be changed. You can also learn to accept all or most of your traits.

After reading the article, Ron turned to Hermione and said, "Hmm, well maybe I will try to play quidditch with you tomorrow!" They both smiled and laughed, knowing that they learned something new about themselves.

39. Where do all living things get their traits? Living things get some of their traits from their parents (inherited traits). But they can also learn traits and the environment can affect traits (acquired traits).

40. Is tree height an inherited or acquired trait?

Claim: Tree height is both an inherited and acquired trait

Evidence: trees inherit a range of heights that they can grow as seen by our measurement in the forests. In addition, the environment affects tree height as seen when the seeds from the forbidden forest were planted in the enchanted forest and grew the height of trees in the forbidden forest.

15