

Inherited Traits

Lesson Overview

In this lesson, students will collaborate on an investigation of observable human traits to explore how traits are passed from parents to offspring. They will collect data from a personal survey of traits within small groups, share the data with the class, and then create graphs of assigned traits. Each group of students will post a graph of four specific traits and students will be able to see the frequency of a particular trait within a class and the entire 7th grade student body. Students will also discuss traits that are not inherited.

Alignment

Standard 7.L.4 The student will demonstrate an understanding of how genetic information is transferred from parent to offspring and how environmental factors and the use of technologies influence the transfer of genetic information.

7.L.4A.2 **Construct explanations** for how genetic information is transferred from parent to offspring in organisms that reproduce sexually.

Science and Engineering Practices (as appropriate)

7. S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.

Students should also ask questions and define problems; develop and use models; analyze and interpret data; use mathematical and computational thinking; plan and carry out investigations; engage in scientific argument from evidence; and obtain, evaluate and communicate information.

Crosscutting Concepts: Patterns, Structure and Function

Standard/Indicator Addressed

SCCCR Math 7.RP.2 Identify and model proportional relationships given multiple representations, including tables, graphs, equations, diagrams, verbal descriptions, and real-world situations.

- a. Determine when two quantities are in a proportional relationship.
- d. Use equations to model proportional relationships.

SCCCR Math 7.RP.3 Solve real-world and mathematical problems involving ratios and percentages using proportional reasoning (e.g., multi-step dimensional analysis, percent increase/decrease/ tax).

SCCCR Math 7.DSP.1 Investigate concepts of random sampling.

- a. Understand that a sample is a subset of a population and both possess the same characteristics.
- b. Differentiate between random and non-random sampling.
- c. Understand that generalizations from a sample are valid only if the sample is representative of the population.
- d. Understand that random sampling is used to gather a representative sample and supports valid inferences about the population.

SCCCR Math 7.DSP.2 Draw inferences about a population by collecting multiple random samples of the same size to investigate the variability in estimates of the characteristic of interest.

Standards for Mathematical Practice (as appropriate)

Standard 1: Make sense of problems and persevere in solving them.

- a. Relate a problem to prior knowledge.
- b. Recognize there may be multiple entry points to a problem and more than one path to a solution.

Standard 2: Reason both contextually and abstractly.

- a. Make sense of quantities and their relationships in mathematical and real-world situations.

Standard 3: Use critical thinking skills to justify mathematical reasoning and critique the reasoning of others.

- a. Construct and justify a solution to a problem.
- b. Compare and discuss the validity of various reasoning strategies.
- c. Make conjectures and explore their validity.
- d. Reflect on and provide thoughtful responses to the reasoning of others.

Standard 6: Communicate mathematically and approach mathematical situations with precision.

- a. Express numerical answers with the degree of precision appropriate for the context of a situation.
- b. Represent numbers in an appropriate form according to the context of the situation.
- c. Use appropriate and precise mathematical language

Connections

Active Learning Strategies

- [Line of Learning](#)
- [Give Me Five](#)
- [Frayer Model](#)
- [Bounce Cards](#)

Computational Thinking:

- Formulating problems in a way that enables us to use a computer and other tools to help solve them.
- Logically organizing and analyzing data
- Representing data through abstractions such as models and simulations
- The ability to communicate and work with others to achieve a common goal or solution

Content Connections

- Science
- English Language Arts
- Computational Thinking
- Mathematics

This lesson correlates well with mathematics standards on random sampling. See corresponding mathematics lesson: Just Like Me!

Content area literacy: Students should *analyze data from a variety of sources, including informational text, argue based on evidence, obtain data from various sources, and evaluate and communicate evidence.*

Lesson Plan

Time Required – Two 60 minute class periods

Disciplinary Vocabulary – dominant trait, recessive trait, homozygous, heterozygous, allele, inherited trait, phenotype, genotype, environmental factors

Materials Needed:

- Copy of picture of a litter of puppies (attached handout) to show on the board or make paper copies for the class
- Copies of Inherited Human Traits- Personal Survey Handout
- One copy of the Inherited Human Traits Graph per group
- One copy per class of Inherited Human Traits Teacher Handout

- Videos: “What are Traits?” (1:26) and “What is Inheritance?”(2:07)
<http://learn.genetics.utah.edu/content/basics/traits/>
<http://learn.genetics.utah.edu/content/basics/inheritance/>
- Large index cards for Frayer Model
- Copies of pictures of inherited traits or use online pictures from
<http://learn.genetics.utah.edu/content/basics/observable/>
- Sentence strips or chart paper
- Copies of Bounce Cards for student dialogue
(http://www.s2temsc.org/uploads/1/8/8/7/18873120/bounce_cards_strategy.pdf)
- One data table for each class created on a piece of chart paper

Formative Assessment Strategies: Line of Learning, Give Me Five, Bounce Cards, Frayer Model

Computational Thinking: This lesson addresses computational thinking by allowing students to interact with authentic data to organize and analyze data about genetic information, represent the data in a graph, use evidence, apply logic, and construct arguments for their proposed explanations, and evaluate and communicate the information scientifically.

Misconceptions:

According to *Benchmarks*, when asked to explain how physical traits are passed from parents to offspring, elementary-, middle-, and some high-school students express various misconceptions. For example, some students believe that traits are inherited from only one of the parents (e.g., the traits are inherited from the mother, because she gives birth or has most contact as children grow up; or the same-sex parent will be the determiner). Other students believe that certain characteristics are always inherited from the mother and others come from the father. Additionally, some students believe in a "blending of characteristics."

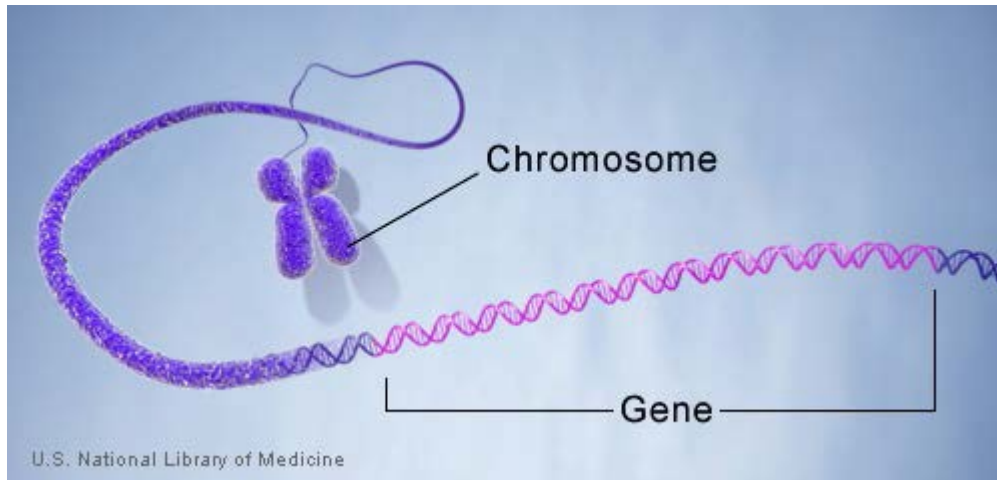
Early middle-school students explain inheritance only in observable features, but upper middle-school and high-school students have some understanding that characteristics are determined by a particular genetic entity that carries information to be translated by the cell. (*Benchmarks for Science Literacy*, [p. 341](#).)

Some students may also think that because they look similar to an aunt or uncle that they received those traits from them.



Engage

- Show the picture of the litter of puppies on your whiteboard (copy from attached handout and paste into a slide) or give out individual copies to students. Give students 5 minutes to answer the following questions.
- Questions that students should answer:
How are the puppies in this picture similar to one another? How do the puppies differ from one another? What do you think their parents looked like (size, color, ears, nose, etc.)? Write your own explanation for how a trait such as fur color is passed down from parents to offspring?
- As a formative assessment, these questions can be used to gauge students' prior knowledge and how much they understand about inherited traits.
- Distribute the **Bounce Cards** to students. Explain to the students the importance of engaging in productive dialogue and how it allows ideas to bounce from one person to another in order to increase their own and their peers' understanding.
- Have students work in small groups of three or four and use the **Bounce Card** prompts to discuss their responses to the opening activity on puppies.
- Teachers will use these responses to formatively assess students' understanding.
- Show the videos: *What are Traits?*(1:26) and *What is Inheritance?*(2:07)
<http://learn.genetics.utah.edu/content/basics/traits/>
<http://learn.genetics.utah.edu/content/basics/inheritance/>
- After viewing the short video clips, students should draw a **Line of Learning** under their original explanation and add to their thinking. Teachers can use this to assess how students can take information from a variety of sources to build their conceptual understanding.
- Use the **Give Me Five** Strategy to have students share out responses.
- This lesson will focus on how traits are passed from parents to their offspring.
- Remind students that genes are responsible for the inherited characteristics that distinguish one individual from another and that genes for a specific trait generally come in pairs. (*Show a model or image of a gene.*)



Genes are made up of DNA. Each chromosome contains many genes.

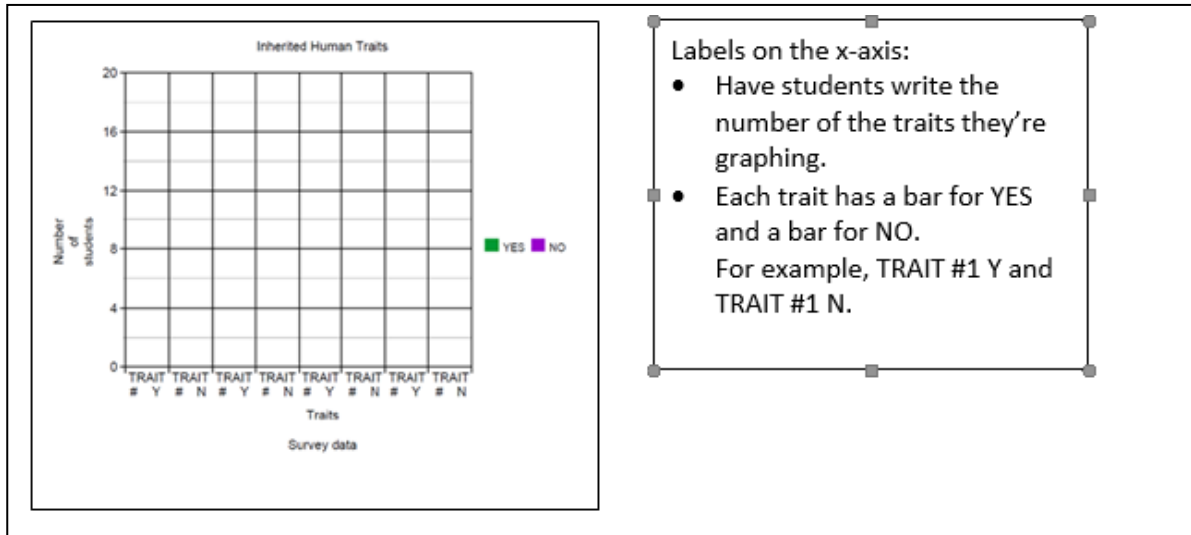
<http://ghr.nlm.nih.gov/handbook/basics/gene>

- Today, they will be exploring how **genes**, the directions for building a person, are passed from grandparents to parents and from parents to children and why each of us is unique.

Explore

- If students have access to a mobile device, have students pair up and take pictures of each other's face. If devices are not available, students can still observe each other's facial features without taking pictures. Students with bangs will need to pull back hair from forehead to observe each other's hairlines (widow's peak).
- Students should record similarities and differences that they observe with the features of the face.
- Ask the question: What could cause such differences in physical appearance?
- **Review each trait before students start the survey.** Show slides or photos of possible genetic traits such as detached earlobes, rolling of tongue, freckles and dimples, etc. You can go to <http://learn.genetics.utah.edu/content/basics/observable/> for pictures and information.
- Students should complete the survey independently before comparing their results and analyzing the data with their group of four. Each student should tally their group's results on their survey.
- When groups have finished tallying their results, display a blank copy of the Inherited Human Traits Survey. For each trait, survey the entire class. For example, say "Raise your hand if you are male." Enter the number in the yes column on the table. Then, "Raise your hand if you are female." Enter the number in the no column on the table. Quickly do this for each trait on the survey.
- Have students copy the data into their tables as you go.

- Assign each group of students **4 different traits** from the survey and have them create one bar graph of the **class** data for those traits. For example, one group could be assigned the first 4 traits on the survey, the next group the next four traits, etc.
- Each group graphs the 4 traits they were assigned on the Inherited Human Traits graph handout.



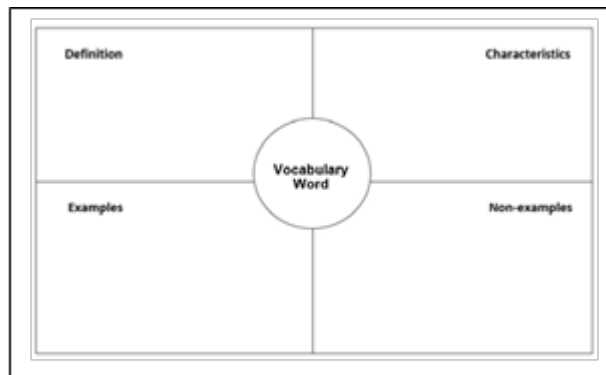
- Have students post their graphs in a specified place in the room. As other classes finish, they can add their graphs to the collection. Post all graphs for the same set of traits stacked together.
- Once students are finished, they should analyze the data in the table and graph to answer the following questions:
 - Which traits (alleles) are most common in your group? In the class?
 - Which traits (alleles) are least common in your group? In the class?
 - What evidence (data) suggests that humans are similar?
 - What evidence (data) suggests that humans are different?

Explain

- Call on a volunteer who would like to share his or her uniqueness with the class.
- Have the entire class stand up and then have the volunteer go down the list and call out one of their traits at a time.
- If a student does not have that trait, then that student sits down.
- The volunteer reading out his or her traits should stop when there are no other students standing.
- Have students make a note of how many students in the class shared the same traits as the volunteer.
- Ask the question, "How many times do you think we would have to repeat this process so that you are the only one standing?"
- If time permits, call on several other volunteers and repeat the process.

NOTE: The big idea of the Inherited Human Traits Survey is to allow students to see that although they share characteristics for traits with other students in the class, the combination of the traits that they inherit from their parents is unique or specific only to them. Also, it's important for students to realize that not all traits they have are inherited, such as: pierced ears, dyed hair, or intelligence. Help students differentiate between inherited and non-inherited traits listed in the survey. Ask them to name some other traits they think are not inherited.

- Copy the following vocabulary terms and definitions on sentence strips or chart paper. Review the terms and meanings with the class. These definitions will create a visual focus for students and provide a place to organize group Frayer Model notecards. This can then be used as an anchor chart for this unit. The sentence strips will serve as headers with the student-created Frayer Models as examples of each definition.
 - *Dominant trait*—A trait that will always be expressed in the phenotype, regardless of the other allele(s) that is (are) present. Alleles for dominant traits are represented by capital letters.
 - *Recessive trait*—A trait that will only be expressed in the phenotype if two recessive alleles are present. In the presence of a dominant trait, the recessive trait will not be expressed. Alleles for recessive traits are represented by lowercase letters.
 - *Homozygous* means that the offspring either has two copies of the dominant allele (homozygous dominant) or two copies of the recessives allele (homozygous recessive).
 - *Heterozygous* means that the offspring has one copy of the dominant allele (trait) and one copy of the recessive allele (trait).
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- A Frayer Model is a graphic organizer used for word analysis and vocabulary building.
- Give each group of four students a **large** index card. Have students divide the index card into 4 squares and place the vocabulary word (**dominant, recessive, heterozygous, or homozygous**) in a circle in the center of the card. Students will work collaboratively to decide on a definition (in their own words) to put in the top left square, characteristics for the word to put in the top right hand square, examples to put in the bottom left square hand square, and non-examples to put in the bottom right hand square. Display the example of a Frayer Model given above for students if

necessary.

- Students wanting or needing to work independently may do so.
- Students should use resources such as the video, the puppies, the information from the inherited traits survey, or other classroom resources to design their Frayer Models. See example below.
- When groups have finished creating their Frayer Models, the teacher can use these to formatively assess student understanding of the genetics vocabulary. The teacher can then post the notecards in the classroom below the sentence strips or chart paper indicating each word.

Extend

- Have students survey (by phone or in person) family members for the traits discussed in class and include as many generations as possible to look at the frequency with which the traits are present. Students can also survey their extended family to see how traits are distributed through your family tree (for example, traits that skip generations, traits found only in the females or males in their families, etc.).
- Allow time for students to share something new they have learned.
- Ask students to answer the *Focus Question: How are traits passed from parent organisms to their offspring?* in their notebooks as an Admit Ticket or Exit Ticket.

Lesson adapted from:

This lesson was adapted from the following:

- K-8 Science Lessons. (2010, August). Retrieved April 25, 2017, from <http://www.s2temsc.org/k-8-science-lessons.html> (Science S3 Seventh Grade 7-2.5 Lessons A & B)

The activity in this lesson was adapted from the following:

- Exploring Genetics. Across the Middle School. Science and Math Curricula. Dr. Jeffrey Batten. Carol Cutler White, Editor. 2nd Edition. July 2014. (n.d.). Retrieved April 25, 2017, from <http://www.greenomes.org/> (“A Personal Survey of Inherited Human Traits”)
- “Take a Class Survey,” Science Explorer Grade 7, Prentice Hall
- “Alike, But Not the Same,” Relating Genetics to Everyday Life, The Science House, North Carolina State University
- “An Inventory of My Traits,” University of Utah Genetic Science Learning Center (<http://teach.genetics.utah.edu/content/begin/traits/inventory.html>).



How are the puppies in this picture similar to one another?

How do the puppies differ from one another?

What do you think their parents looked like (size, color, ears, nose, etc.)?

Write your own explanation for how a trait such as fur color is passed down from parents to offspring?

Inherited Traits Photos



Science Lesson 2A Inherited Traits Photos

Lesson 2A Inherited Human Traits- Personal Survey

Complete this survey by answering “yes” or “no” for yourself at the end of each question. Then compare your traits to the group’s traits by putting the number of people with that trait in the “yes” box. The number of people who don’t have that trait goes in the “no” box. We will do the same thing for the class after data has been collected for all groups.

TRAIT	Group Totals		Class Totals	
	YES	NO	YES	NO
Answer YES or NO for yourself at the end of each question.				
1) Are you male?				
2) Are you right-handed?				
3) Do you have mid-digital hair on your knuckles?				
4) Do you have detached ear lobes?				
5) Do you have naturally curly hair?				
6) Do you have a widow’s peak?				
7) Do you have freckles?				
8) Do you have dimples?				
9) Do you have a cleft chin?				
10) Can you roll your tongue?				
11) Do you have allergies?				
12) Is your index finger (pointer) shorter than your ring finger?				
13) Do you have a straight thumb (not a hitchhiker’s thumb)?				
14) When you clasp your hands, do you cross your left thumb over your right?				
15) Can you see the colors red & green?				
16) Do you have almond shaped eyes?				
17) Do you have brown eyes?				
18) Do you have pierced ears?				
19) Do you have dyed hair?				
20) Are you intelligent?				

Lesson 2A Inherited Human Traits- Personal Survey **TEACHER COPY**

TRAIT	Group Totals		Class Totals	
	YES	NO	YES	NO
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2) Are you right-handed?				
3) Do you have mid-digital hair on your knuckles?				
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