

# Genetics and Heredity



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## Genetics and Heredity



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## Unit Overview

**Title of Unit:** Heredity

**Recommended Grade:** 4<sup>th</sup> grade

**Time Frame:** 10 days- 42 minute classes

**Unifying Theme:** Patterns- Identify observable patterns in the physical characteristics of plants or groups of animals.

**Integration Model:**

Math- creating data charts and graphs, predicting

History- chromosomes, Gregor Mendel

Reading- supplemental articles, researching

Art- creating puzzle pieces, magazine pictures

**Essential Questions:** How do the structures and functions of living things allow them to meet their needs?

**Unit Questions:**

- How do the parts of living things work together to carry out life functions?
- How does each plant or animal have different structures that serve different functions in growth, survival, and reproduction?
- Why do most living things need food, water, light, air, and a way to dispose of wastes?
- Why is energy needed for all organisms to stay alive and grow?
- How can living things be grouped based on their similarities and differences?
- How do tools make it possible to observe living things or the parts of living things that are too small to be seen with the naked eye?

**PA Academic Standards addressed in this Unit:**

3.1 Biological Science

3.1.B Genetics

3.1.4.B1 Describe features that are observable in both parents and their offspring.

3.3 Earth and Space Sciences

3.3.B Origin and Evolution of the Universe

### 3.3.4.B3 Ask questions about objects,, organisms, and events

Understand that all scientific investigations involve asking and answering questions and comparing that answer with what is already known.

Plan and conduct a simple investigation and understand that different questions require different kinds of investigations

#### **Brief description of Unit/ Ten Day Overview:**

In this ten day unit, the class will discover the features that are observable in both parents and their offspring. The students will explore how traits are inherited and also that not all traits are inherited. Students will learn how traits are controlled such as, incomplete, dominant, and recessive genes. Furthermore, students will explore how genes can combine to form specific traits.

#### **Day 1: Trait of an Organism**

Engage: Introduction to Unit and “What are inherited traits?” Discuss: Why does everyone in the classroom look different (except identical twins) from each other? Why do you look similar to your parents?

Exploration: What can you do? Students focus on inherited traits and should become more aware of three of their own inherited traits. Partners can observe these traits in each other by using mirrors. Students will record which traits (tongue rolling, thumb superiority, and handedness) and count the number of students with each variation of the trait. Stress that one inherited trait is not better or worse than its opposite trait. What other heredity traits do you think would be interesting to check? Students can suggest eye or hair color, height, and ear shape.

Evaluate: Assess Performance:

- Process Skills Checklist: Did students carefully collect, record, and interpret data regarding the incidence of the three traits in their classmates? Did students use graphs to communicate the incidence of each trait? Did they infer that the incidence of these traits is the same in the general population? Did they hypothesize that some inherited traits can be modified with effort?
- Analyze and conclude: In most classes, the majority of students will be tongue rollers, left-thumb superior, and right-handed. If the class is big enough to show a representative sample, the general population will show the same incidence. With effort, some people can change handedness. People can choose to alter some inherited tendencies, such as thumb superiority. Other traits, such as tongue rolling or eye color, are permanent and unchangeable.

Extension: Have students poll a random group of 25 people and see whether they are tongue rollers or non-rollers, left-thumb or right-thumb, and right-handed or left handed. Draw a bar graph and compare it to the one you drew of your class.

## Day 2: Genes, Traits, and the Environment

Engage: Background: Human cells have 23 pairs of chromosomes. When these chromosomes are shuffled during meiosis, they can be recombined in many different ways. The number of possible combinations is 8,388,608! This large number ensures that the set of genes each parent passes on to one child is different from the set that the parents' other children receive. Identical twins are an exception; they each receive an identical set of genes.

Explanation: How do you think parents pass traits such as eye color and hair color to their children? Students may be able to link this process to the cell division they studied in Chapter 1 Reproduction. Why do you think it is useful to know what genes you have inherited from your parents? You would know what traits you might inherit, including the tendency to develop certain genetic disorders or diseases.

- Connect to the activity the previous day. How would a father pass on his ability to roll his tongue to his son? His sperm cell, carrying the dominant gene for tongue rolling, could become part of a fertilized egg (zygote), which would develop into his son. His son would then be able to roll his tongue.
- Thinking Critically: Why do you think scientists are trying to learn more about how genes affect development? Research is helping them find ways to eliminate certain heredity problems and better understand how organisms develop. Explain how two sisters can have the same shaped eyes but different eye color. Through the shuffling and recombining of genes from both parents, the sisters can inherit eye shape from one parent but eye color from either parent.
- Drawing conclusions: Why do identical twins look so much alike? They developed from the same fertilized egg (zygote), so they have exactly the same genes. Why do you think some identical twins have different personalities and interests? They are influenced by their environment.
- Making Comparisons: What factors might prevent someone who has inherited musical ability from becoming a musician? Not being exposed to music would make it impossible for the person to become a good musician. A hearing impairment might make becoming a musician difficult. Many environmental factors could interfere with the development of musical talent. Identical twins have the same genetic information. Yet one twin can be taller than the other. Explain how this can happen. Environmental conditions, such as good diet or exposure to harmful conditions, can cause one twin to either grow more than the other or grow less than the other.

Expansion: Science, Technology, and Society: Dinosaur Genes

- What to do: Tell students that a group of scientists believe they found dinosaur DNA in ancient bones unearthed from a Utah coal mine. Scientists have also been trying to obtain dinosaur DNA from insects that became trapped in clear, hard amber millions of years ago. Amber is the source of dinosaur DNA in the fictional book and movie *Jurassic Park*. Have students share what they recall about DNA if they have seen the movie or read the book?
- What's the Result? Ask students what they would like to find out if they were studying dinosaur DNA. Encourage them to draw pictures or write a description of what they would hope to find. Allow time for them to share their work with their classmates.

### **Day 3:**

**Evaluate:** Students might enjoy working in groups of three to four to create puzzles. Tell each group to cut a piece of heavy paper into eight to ten puzzle pieces. On each piece, they should write an inherited trait, such as eye color or blood type. Groups can then exchange puzzles and try putting them together. Discuss how the pieces represent the genes that work together to determine a person's traits.

- Close the investigation: Answer the investigation wrap up questions.
- Challenge- Organize students into small groups and ask them to work together to answer this question: If a tomato plant were growing poorly, how could you determine whether the problem was environmental or heredity? Students might suggest examining another plant growing near the first to see whether it is growing poorly, looking for signs of insect pests, or trying to transplant the plant to a different environment.
- Following up- Baseline Assessment- look again at which traits students thought were inherited and which traits might be due to environmental conditions. Invite students to make any changes in the class chart based on what they learned in the investigation. Clarify any misunderstandings. Reteaching- Ask students, working in pairs, to diagram the relationships among cells, chromosomes, genes, and DNA. Label all four structures. Combine pairs into groups of six and ask them to compare their drawings and present the clearest one to the class.

### **Day 4: How are Traits Inherited?**

**Engage:** Discuss why some children look more like one parent than the other?

**Exploration: Scrambled Genes** Students focus on the ways that genes combine and should recognize the vast number of possible gene combinations. Students will use disks divided into two groups- mother and father. The four disks will represent genes for four different traits. Each side of the disk will be marked with a different gene either recessive or dominant of a certain trait. With three circles drawn on a sheet of paper, label these sperm cell, egg cell, and zygote. For the female, shake the cup with the disks for the female parent and empty in the egg cell. Write down the traits that appear. Repeat this process for the male. Record the combination of genes for the zygote.

**Evaluate: Assess Performance:**

- Process Skills Checklist- Did students make and use models successfully? Were they able to match the disks in the zygote to learn how pairs of genes can be combined? Did students record their data accurately? Did students recognize the small probability of predicting specific combinations of genes?
- Analyze and conclude (questions in lab) - Meiosis is the process by which a set of chromosomes is separated into sex cells. Fertilization is the process in which the chromosomes from mother and father are combined in the zygote. They would be siblings. They might vary in a number of traits represented by the combinations of disks.

- Explain to students that meiosis is Greek for less. What becomes less during meiosis? The number of chromosomes. Why must sex cells have less chromosomes? In sexual reproduction, two cells come together to start a new organism. The sex cells must have fewer chromosomes so the new cell has the normal number.

### **Day 5: Inheriting Traits**

Explain: Students focus on ways that dominant and recessive genes can combine and should understand how dominant and recessive genes control inherited traits. Review what students found when they flipped the disks.

- Why is the dominant trait more common in this activity? It is more common because the dominant gene masks the recessive gene, so the dominant trait shows up when either one or two dominant genes are present. The recessive trait only shows up if two recessive genes are present. (In reality, a dominant gene may have lower frequency in a population than a corresponding recessive gene. Thus, a recessive trait, such as type O blood, can be more common than a dominant trait, such as type A blood.)

Evaluate: Assess Performance-

- Process Skills Checklist- Did students carefully collect and record data on the combinations of dominant and recessive genes? Were students able to hypothesize that if both parents pass on recessive genes for blue eyes, their child would have blue eyes?
- Analyze and Conclude- Any zygote with at least one "A" carries a dominant gene; any zygote with at least one "a" carries a recessive gene. Zygotes with one or two dominant genes will be brown-eyed. Only those with two recessive genes will be blue-eyed. Each parent must carry a recessive gene (a) for blue eyes. If both parents pass on a recessive gene to the child, the child will be blue-eyed (aa).

Expansion: Research the number of left-handed people versus the number of right-handed people in a population. Find out if hand preference is determined by a single pair of genes or by a combination of genes. Share your results with your classmates.

### **Day 6:**

Exploration: All in the Family Students focus on how dominant and recessive genes are passed from generation to generation and should understand how different combinations of dominant and recessive genes produce attached and free earlobes. Have student create a pedigree chart for their family or an imaginary family. Students will be tracking free and attached earlobes. Point out that scientists use symbols to distinguish between the dominant and recessive forms of a gene in a pedigree chart: the dominant gene is written with an upper case letter and the recessive form is written in the lower case of the same letter.

Evaluate: Assess Performance-

- Process Skills Checklist- Did students accurately collect and record data? Did they observe patterns in the way ear lobe shapes are inherited? Were students able to hypothesize that free ear lobes are produced by a dominant gene and attached ear lobes are produced by recessive genes?
- Analyze and conclude- Parents with attached ear lobes each carry two recessive genes for attached lobes. They could not pass on any genes for free ear lobes to their children, so none of their children could have free ear lobes. Parents with free ear lobes must carry at least one dominant gene. If either or both parents pass on a dominant gene to a child, the child will have free ear lobes. However, if each parent also has a recessive gene, and if both pass them on to the child, the child will have attached ear lobes. Attached ear lobes are inherited as two recessive genes. Free ear lobes are inherited as one or two dominant genes. They can be attached or free, but each parent must carry a recessive gene for attached ear lobes.

## Day 7:

Explanation: Laws of Heredity

Background:

- Gregor Mendel investigated seven characteristics common to two forms of pea plants in his quest to understand the laws of heredity. In addition to plant height, he studied seed shape, seed color, flower position, flower color, pod shape, and pod color.
- Mendel summarized his findings in three laws, or principles: 1) during the formation of sex cells, paired factors are separated so that a sperm or egg cell contains only one of the two possible factors; 2) each factor is inherited independently of any other; and 3) each inherited characteristic is determined by the interaction of two factors, one from each parent, and the expression of one factor of each pair is dominant over the other. He published his work in 1866.

Guide the Discussion:

- Connect to the activities- Which part of Mendel's process was like combining the disks? When Mendel hand-pollinated the plants, he was combining the two sets of genes. How were results of Mendel's experiments with the height of pea plants similar to the pedigree chart for ear lobes? Both show the presence of dominant and recessive genes and traits in several generations.
- Making Inferences- Why was it important that Mendel used thousands of plants? A large sample size allowed Mendel to apply the laws of probability to make deductions about how inherited traits passed on. How did carrying his experiments through several generations affect Mendel's findings? By observing inheritance through several generations, Mendel was able to recognize that dominant and recessive genes (factors) existed and how they interacted.
- Identifying and Solving Problems- How could you determine whether a tall pea plant carried a recessive gene for shortness? You could cross the tall plant with a short one. If some offspring were short, the tall plant had to carry a recessive gene for shortness. Mendel also discovered that if a parent plant with only smooth seeds and a parent with only wrinkled seeds were crossed, only smooth seeds were produced. Is a smooth shape or a wrinkled shape dominant? How do you know? A smooth shape is dominant. In the offspring, the dominant gene for the smooth shape masked the recessive gene for the wrinkled shape.



- Thinking Critically- How would Mendel's results have changed if the traits he selected to examine blended in pea plants instead of remaining distinct? He might not have discovered the concept of dominant and recessive traits.
- Thinking about the Data- What other human characteristics can you think of besides skin color that appears to be the result of the blending of several genes? People's height and blood type are characteristics that are determined by the interaction of several genes, as is the color of animals' fur and some flowers.

Evaluate: Students can work in groups of three or four. Let each group choose a plant or animal trait, real or imaginary, which has a dominant form and a recessive form. Ask them to create a chart that shows how this is passed from one generation to the next. Provide time for groups to share their charts and receive feedback from classmates.

### **Day 8: Punnett Squares**

Engage: Discussion- explain that in all Punnett squares, capital letters are used for dominant genes and small letters for recessive genes. What are the eye colors of the mother and father in this example (both have brown eyes, since both have a dominant B gene). What do the boxes inside the squares represent? (Most students will say that the boxes stand for offspring). Emphasize that the boxes do not really show offspring but the possibilities for this trait in the offspring of this set of parents. Go through the sequence with students, emphasizing the notion of the possibility at each step. Judging from the possibilities shown in the completed Punnett square, what color would you predict the eyes of a child of these parents would be? (Brown, because three out of four boxes show brown.)

Exploration: Divide the class into four groups. Assign each group one of the following pairs of traits: brown eyes (dominant), blue eyes (recessive), no dimples (recessive), dimples (dominant), curly hair (dominant), and straight hair (recessive). Ask each group to make a Punnett square showing possible combinations with these traits. To make the squares they should use pictures from magazines. The pictures should be labeled with gene combinations and traits. Each group should make at least three squares showing different parental combinations. Encourage group members to divide tasks evenly among themselves.

Exploration: How Sex is Determined- Have students look at the Punnett square on this page. Ask them to identify the gene possibilities from the female parent (XX) and male parent (XY). Then ask students to examine the expected gene combinations of the offspring. What are the chances of the parents having a boy or girl? Equal

Explain to students that Henry XVIII of England divorced or beheaded his wives because they failed to bear him a son. Some gave him daughters, but he blamed his wives for no sons. What assumptions did Henry XVIII make about who determined the sex of children? (He thought women determined a child's sex). Was his assumption correct? (No, a woman has two X chromosomes. A man has an X chromosome and Y chromosome. Only a man can contribute the Y chromosome to produce a boy.)

## Day 9:

### Exploration

Divide the class into five or six groups. Have each group learn about and present a report on new genetic technologies, such as genetic engineering, recombinant DNA, cloning, plant breeding, and birth defects. Assign roles such as researcher, writer, illustrator, reporter, and facilitator.

## Day 10:

### Explanation: Designer Genes

Discussion Starter- Why might scientists want to change or replace genes? Students may answer that changing genes could help to prevent passing on an illness or might help an organism's growth and development.

Have students present short presentations.

### Evaluate:

- Connecting to the Activities- If a dominant gene were spliced into an egg cell that was then fertilized, would the offspring show that trait? Explain your answer. Yes, the gene would be passed on to the zygote along with other genes in the sperm and egg cells.
- Assess Understanding- Invite students to work in small groups to list three areas they think should be open to genetic engineering and three that should not.
- Investigation Wrap-Up- Offspring receive genes in pairs, one from the mother and one from the father. If one or both genes are dominant, the dominant trait will be expressed in the offspring. If both genes are recessive, the recessive trait will be expressed in the offspring. He crossed purebred tall plants with purebred short ones and he hand-pollinated plants to be sure one parent was tall and one was short. All four sections in the square should show the Tt combination. A blue eyed person carries two recessive genes. Therefore, parents with blue eyes do not have the dominant genes for brown eyes to pass on to their offspring.
- Challenge- Ask students to work with partners to create a chart showing the possible offspring of two short pea plants. Have them describe the height of each possible type of offspring.
- Following up-
  - Baseline assessment- Return to the class list of reasons why some children look more like one parent than the other. Ask students which of the reasons were accurate, and guide the class to revise reasons that were incorrect. Guide students to include dominant and recessive genes in the discussion.
  - Reteaching- Assist students in constructing a concept web based on the phrase "inherited traits". Use the Web Activity Support Master to reteach. Students might suggest words and phrases such as controlled by dominant genes, can be influenced by environmental conditions, or produced by two recessive genes.

Students should take the chapter test. Also, to assess performance students should construct a pedigree chart for an imaginary family for a specific hereditary trait and explain how that trait is transmitted through the generations.

**Annotated Bibliography:**

“Chapter 2: Heredity”. Discovery Works Teaching Guide Unit D: Continuity of Life. Houghton Mifflin Science. Boston: 2003, 28-47.

This teacher’s edition contains lesson plans to teach heredity. It contains newer and more interactive lessons to explore heredity.

“Chapter 4: Heredity”. Science Teacher’s Edition 6. Addison- Wesley Publishing Company. New York: 1989, 84-105.

This is a teacher’s edition book to teach different science units, including heredity. This includes slightly older information and more historical information about heredity.

## **Teacher's Guide for Implementation of Task**

### **Prior Knowledge Required of Student:**

Students will need to understand the process of reproduction learned in the previous unit.

### **Time Allotment:**

10 days of 42 minute classes

### **Student Groupings:**

Students will be put into 4 groups of 3 students. Special education students will be grouped with two “buddies” to help them work through the explorations.

### **Materials/ Resources Needed:**

- 4 small mirrors
- 8 paper cups
- 8 sets of disks of 4 different colors (2 sets of 4 different colored disks for each group)
- 4 markers
- 4 large sheets of paper
- 4 markers
- 4 disks

### **Teacher Preparation Prior to Unit:**


The teacher must check materials in the kit and restock any necessary materials. Teachers will need to purchase new disks (for the flip disk lesson) and add new paper for the students. Teachers should check markers to make sure they still work.

### **Implementation of Specific Activities:**

There are certain safety precautions that should be taken including: reviewing safety cautions with students, reminding students to handle mirrors carefully to avoid breakage, and review safety precautions for working with scissors. For English language learners, students

should write specific traits and attach simple pictures to the disks. In addition, make sure students recognize that each offspring of the pea plants inherit one chromosome from each parent. Therefore, encourage students to draw a diagram of two generations of pea plants and have students identify the plants as parents, offspring, tall, and short in both their native language and English. As a materials note, it may be easier to use tagboard chips or coins as disk instead of paper disks which may not be sturdy enough for repeated flipping.

### Language Usage Icon:

	<p style="text-align: center;"><b>Language Usage</b></p> <p>Whenever you see this picture, it is important to make sure that what you have written is clear and complete and that you have used correct spelling, grammar, punctuation, and capitalization.</p>
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### Websites for Teacher Background Information:

Sohn, Emily. "Double Take". Science News for Kids. Society for Science and the Public. 2010.  
<<http://www.sciencenewsforkids.org/articles/20081210/Feature1.asp>>.

"What's Color Blindness?". KidsHealth. Nemours. 2010.  
<[http://kidshealth.org/kid/talk/qa/color\\_blind.html](http://kidshealth.org/kid/talk/qa/color_blind.html)>.

"What is a Gene?". KidsHealth. Nemours. 2010.  
<[http://kidshealth.org/kid/talk/qa/what\\_is\\_gene.html](http://kidshealth.org/kid/talk/qa/what_is_gene.html)>.

"Why am I left-handed?". KidsHealth. Nemours. 2010.  
<<http://kidshealth.org/kid/talk/qa/lefties.html>>.

<http://www2.edc.org/weblabs/Punnett/punnettsquares.html>.

[www.eduplace.com](http://www.eduplace.com)

CD-ROM "Peas in a Pod" Continuity of Life, Investigation 2

### Literature Connection:

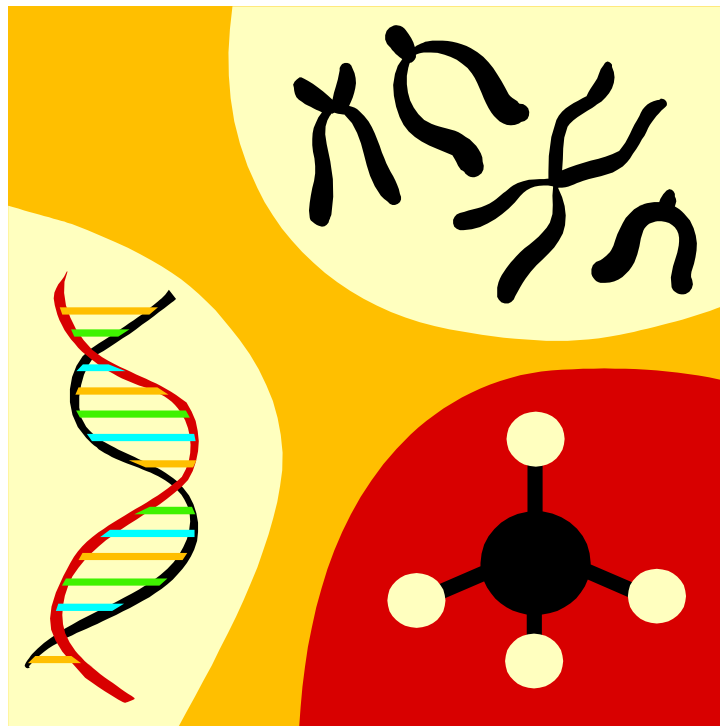
Bornstein, Sandy. What Makes You What You Are: A First Look at Genetics.

Dash, Joan. The Triumph of Discovery.



# What Can You Do?

## Student Data and Answer Booklet



Name: \_\_\_\_\_

Date: \_\_\_\_\_

## What Can You Do?

### Engagement

What do you know about heredity? What have you learned about genes? How does heredity affect you? Take a few minutes, fill out the KWHL chart, and respond to the questions below.

What I <b>KNOW</b> ...	What I <b>WANT</b> to know...	<b>HOW</b> will I find information...	What I <b>LEARNED</b> ...





Why does everyone in the classroom look different (except identical twins) from each other?

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In what ways might children from the same family be alike or different?

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We will investigate inherited traits and become more aware of your own inherited traits. As you go through the exploration, keep in mind **what are inherited traits?**

### Exploration

1. Get into groups of 3. You will be assigned the roles: principle investigator, materials manager, and recorder/reporter according to a sticker on the student data book.

Students with a hand sticker will be Principle Investigator. The tongue means a student

will be the Recorder and Reporter. Lastly, the students with ear stickers will be Materials Manager. The job details are listed below:

**Principle Investigator-** “PI” - is in charge of all operations associated with the group activity. This person should check the assignment, communicate the directions to the group, provides assistance to other group members, and conducts group discussion.

**Materials Manager-** “MM”- obtains and dispenses materials for the activity. They should set up and operate activity equipment in cooperation with the “PI”.

**Recorder and Reporter-** “R&R”- is in charge of collecting and recording information on the group worksheet. Also, the “R&R” reports results to the class.

2. Collect the necessary materials. For this experiment, each group needs a mirror.






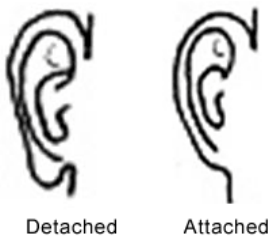


**Be Careful!!** Handle the mirrors carefully to avoid breaking it.

3. You will collect data on various traits. Stick out your tongue and try to roll up the edges to form a tube. In the table below, mark whether or not you can perform this task.
4. Next, fold your hands together and see which thumb naturally falls on top. Are you left-thumb superior or right-thumb superior? Record your data in the chart.
5. Are you left-handed or right handed? Record.
6. Do you have a widow’s peak or a straight hairline? Record.

7. Are your earlobes attached or detached? Refer to the pictures for help. Record.
8. Do you have a cleft chin? Record.
9. Do you have dimples? Record.
10. Do you have freckles? Record.

### My Traits Chart

Physical Characteristics	Yes, I have this trait.	No, I do not have this trait.
Tongue Rolling 		
Left thumb superior 		
Right handed		
Widow's Peak 		

<p>Detached Earlobes</p>  <p>Detached      Attached</p>		
<p>Cleft Chin</p> 		
<p>Dimples</p> 		
<p>Freckles</p>		

11. As a class, share your data to create a chart for the whole class. Record the class data in the chart below.

Physical Characteristics	Number of Students in the Class with the Trait
Tongue Rolling	
Left-thumb Superior	
Right handed	
Widow's Peak	
Detached Earlobes	
Cleft Chin	
Dimples	
Freckles	

12. Make a graph to show the number of people with each trait in the space below.

**13.** Find the frequency of each trait in the class by using the following equation:

$$(\text{Number of Students with Trait} / \text{Number of students in the class}) \times 100 = \underline{\hspace{2cm}}\%$$

Tongue Rolling

Left-thumb Superior

Right handed

Widow's Peak

Detached Earlobes

Cleft Chin

Dimples

Freckles

### Explanation



What were the results of the class data? Were there more tongue rollers or non tongue rollers? What about the other traits? \_\_\_\_\_

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Is one inherited trait better or worse than its opposite trait? Explain your answer. \_\_\_\_\_

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If these traits are inherited, what can you infer about the frequency of these traits in the general population? \_\_\_\_\_

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Hypothesize whether non-rollers can learn to roll their tongues. Can people change which thumb naturally falls on top when their hands are folded? Can righties learn to be lefties? Can people alter **all** traits? Explain your hypothesis. \_\_\_\_\_

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What other hereditary traits do you think would be interesting to explore? \_\_\_\_\_

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## Expansion

Read the article in your Student Resource Book titled “What is Color Blindness?” Then answer the questions below.

What is color blindness? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What are cones and how do they affect your eyes? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What do you think it would be like to be color blind? What problems would you have in your daily activities? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

How does this article on color blindness relate to the exploration done in class today? \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_



### Expansion: Take Home

For this expansion, you should take home your Student Data Book and follow the procedure.

1. Poll a random group of 20 people- members of a school club or sports team- and see whether they have the traits we explored today. Fill out the chart below.

	<b>Tongue rollers</b>	<b>Left Thumb superior</b>	<b>Left handed</b>	<b>Widow's Peak</b>	<b>Attached Earlobes</b>	<b>Cleft Chin</b>	<b>Dimples</b>	<b>Freckles</b>
<b>1</b>								
<b>2</b>								
<b>3</b>								
<b>4</b>								
<b>5</b>								
<b>6</b>								
<b>7</b>								
<b>8</b>								
<b>9</b>								
<b>10</b>								

2. Draw a bar graph and compare it to the one you drew of your class data.

3. Calculate the frequency of the traits in the population you polled.

Tongue Rollers

Non Rollers

Right thumb superior

Left thumb superior

Right handed

Left handed

Widow's Peak

Straight Hair line

Attached Earlobes

Detached Earlobes

Cleft Chin

Smooth Chin

Dimples

No Dimples

Freckles

No Freckles

4. You may also collect data and create graphs of other inherited traits, such as eye color or blood type.

Answer the Question:

Does your data show the same results as the class data? How do they compare? \_\_\_\_\_

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### **Evaluation**

Reflection:

What makes you unique from your other classmates? What makes you similar to your classmates? \_\_\_\_\_

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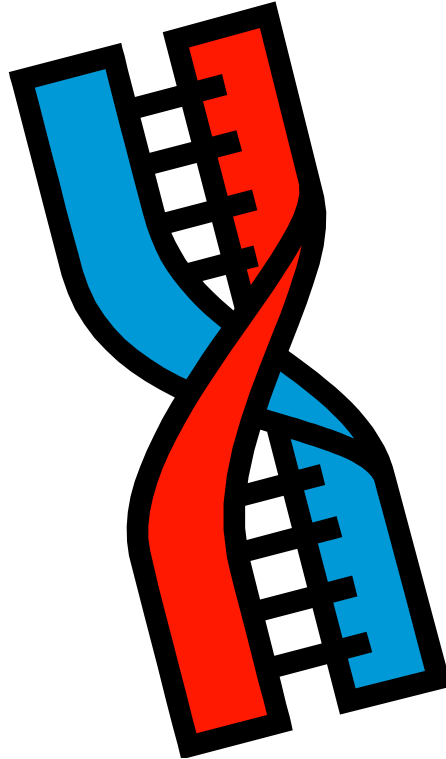
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# What Can You Do?

## Student Resource Booklet

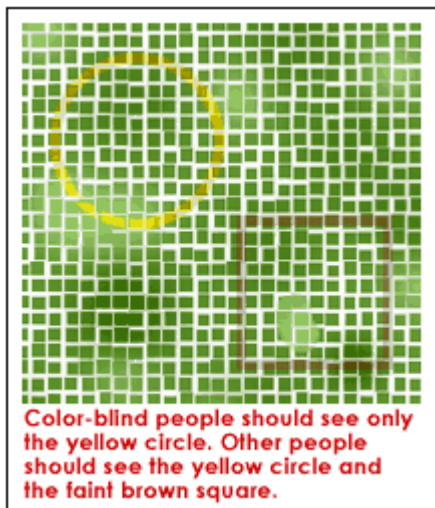


Name: \_\_\_\_\_

Date: \_\_\_\_\_



If your clothes don't match, someone might have teased you about being color-blind. But some people really **are** color-blind. It doesn't mean they can't see any color at all, like a black and white movie. It means that they have trouble seeing the difference between certain colors. (Check out the image on the right to see how well you see colors.)



Being color-blind can make it tricky to match your shirt and pants, but it's not a serious problem. People who are color-blind can do normal stuff, even drive. Most color-blind people can't tell the difference between red or green, but they can learn to respond to the way the traffic signal lights up. The red light is generally on top and green is on the bottom.

## Cones and Color

To understand what causes color blindness, you need to know about the **cones** in your [eyes](#). Cones in your eyes? Yes, but they're very small. These cones are cells on your retina, an area the size of a postage stamp that's at the back of your eye.

You have "red," "blue," and "green" cones, which are sensitive to those colors and combinations of them. You need all three types to see colors properly. When your cones don't work properly, or you don't have the right combination, your brain doesn't get the right message about which colors you're seeing. To someone who's color-blind, a green leaf might look tan or gray.

## Color Blindness Is Passed Down

Color blindness is almost always an **inherited** (say: in-**her**-ut-ed) trait, which means you get it from your parents. You get inherited traits through [genes](#) (say: **jeenz**), which determine everything about your body, including how tall you'll be and whether your hair will be straight or curly.

Eye doctors (and some school nurses) test for color blindness by showing a picture made up of different colored dots, like the one above. If a person can't see the picture or number within the dots, he or she may be color-blind.

Boys are far more likely to be color-blind. In fact, if you know 12 boys, one of them is probably at least a little color-blind. So girls, the next time a boy asks you if something matches, you'd better lend him a hand!

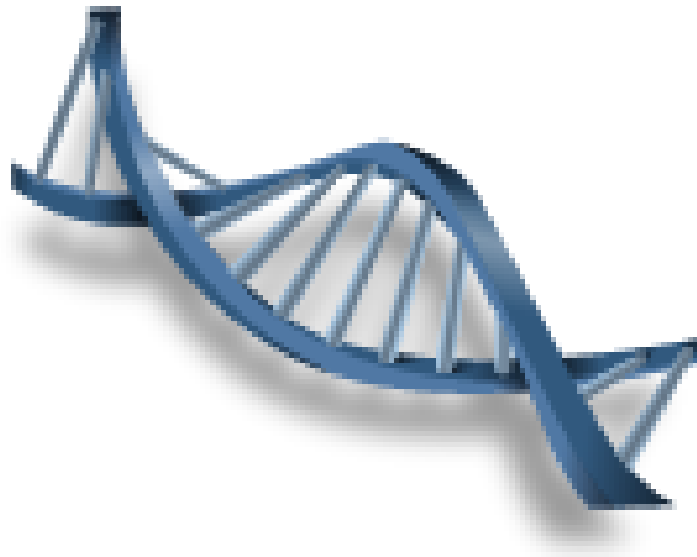
Updated and reviewed by: [Mary L. Gavin, MD](#)

Date reviewed: August 2007

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# Assessment and Evaluation Tools

What Can You Do?



**Hands-On Assessment:**

Students will be using mirrors to examine their traits. They will compare their traits as a class. In addition, they will be able to examine the frequency of certain traits within the population. I will be able to assess whether the students are able to identify physical characteristics and traits as opposed to learned traits.

**Pictorial Assessment:**

The students will be able to use pictures to view traits in a population and compare those traits to their own. Also, students will complete a bar graph to visually see the frequency of traits in the population as well as a sample of the general population. With this, I will be able to assess whether students understand that different traits can be more prominent in society in compared with other traits.

**Reflective Assessment:**

Students will answer explanation questions to examine the information and data they collected in class. Also, students will read a supplemental article to enforce what they learned in class. Another expansion repeats the experiment outside of class and students will answer questions comparing the two explorations. This will help me to assess whether students understand that traits can be inherited and what traits are prominent in society.