

What Genes Do



Key Concepts:

- ▶ To understand that, as a result of genetics, offspring are very much but not exactly — like their parents.
- ▶ To define and describe “genes.”
- ▶ To compare and contrast inherited traits using different combinations of genes.

Grade Level: 1–7

Education Subject: Science

Success Indicators:

After participating in this activity learners will be able to:

- ▶ Explain why offspring share some traits with their parents and not others.
- ▶ Define and explain the difference between “dominant traits” and “recessive traits.”

Materials and Methods

Preparation Time: 30 minutes

Lesson Time: 30 minutes

Space: Any

Materials:

- ▶ Pencils or pens
- ▶ Writing paper
- ▶ Five colors of pipe cleaners in two lengths (at least one per learner of each color and length)
- ▶ Ten paper bags
- ▶ Construction paper
- ▶ Markers or crayons
- ▶ Flip chart (or chalkboard or whiteboard)

Background Information:

You’ve probably noticed that offspring often resemble one or both of their parents. This is true for every living thing, whether plant or animal. In the 1860s, Gregor Mendel, an Austrian monk, decided to study pea plants to find out why parents pass along some but not all of their traits to their offspring. He looked at single characteristics — for example, plant height — instead of trying to figure out the whole genetic picture at one time. By working carefully, Mendel discovered the following fascinating facts:

The information for deciding traits is carried in something Mendel called “units” (which we now call “genes”). Genes tell organisms how to build and manage cells. Mendel figured out that parent pea plants each have two units that code for seed shapes, height, color and other characteristics, and that each parent plant passes one unit for each trait to the plants in the next generation. (Mendel didn’t actually see these genes because they’re microscopic, and microscopes hadn’t been invented yet.)

This genetic information keeps its identity from generation to generation. Mendel figured out that parents pass units (genes) to their offspring, which pass the units down to their offspring and so on.

The information for some traits is dominant over that of others. Mendel found that some offspring had unexpected phenotypes, or physical traits. He explained this by using the terms “dominant” and “recessive.” A dominant unit (gene) is always expressed in offspring. A recessive unit (gene) may or may not be.

Instructions:

Preparation time:

1. Read the activity and gather the supplies from the materials list.
2. Recreate the chart that follows on a flip chart or the chalkboard or whiteboard.

Building a Person From the Genes Up

Pipe cleaner color	Trait	Dominant (long pipe cleaners)	Recessive (short pipe cleaners)
Red	Eye color (Br/br)	Brown eyes	Blue eyes
Blue	Tongue-rolling ability (To/to)	Can roll tongue	Cannot roll tongue
White	Earlobe attachment (E/e)	Attached	Unattached
Yellow	Gender (XX/Xy)	2 longs = female, 1 long + 1 short = male	
Green	Number of fingers (F/f)	Five	Six or more fingers

3. Label and fill 10 bags, five representing Mom's genes and five representing Dad's genes. In each case, the number of pipe cleaners in each bag should equal or exceed the number of learners or teams.

- ▶ **Bag M1** (Mom's eye color genes):
Mom has brown eyes because she received a dominant brown-eye gene from her mom and a recessive blue-eye gene from her dad. Fill the bag with 50 percent long red pipe cleaners and 50 percent short red pipe cleaners.
- ▶ **Bag D1** (Dad's eye color genes):
Dad has blue eyes (recessive). Fill the bag with 100 percent short red pipe cleaners.
- ▶ **Bag M2** (Mom's tongue-rolling ability genes):
Mom can roll her tongue because she received a dominant tongue-rolling gene from her mother and a recessive tongue-rolling gene from her father. Fill the bag with 50 percent long blue and 50 percent short blue pipe cleaners.
- ▶ **Bag D2** (Dad's tongue-rolling ability genes):
Like Mom, Dad can roll his tongue because he received a dominant tongue-rolling gene from his mother and a recessive tongue-rolling gene from his father. Fill the bag with 50 percent long blue and 50 percent short blue pipe cleaners.
- ▶ **Bag M3** (Mom's earlobe attachment genes):
Mom has attached earlobes because she received dominant earlobe attachment genes from both of her parents. Fill the bag with 100 percent long white pipe cleaners.
- ▶ **Bag D3** (Dad's earlobe attachment genes):
Dad also has attached earlobes and also received dominant earlobe attachment genes from both of his parents. Fill the bag with 100 percent long white pipe cleaners.
- ▶ **Bag M4** (Mom's gender genes):
All females have two "X" chromosomes. Fill the bag with 100 percent short yellow pipe cleaners.
- ▶ **Bag D4** (Dad's gender genes):
All males have one "X" and one "Y" chromosome. Fill the bag with 50 percent short and 50 percent long yellow pipe cleaners.
- ▶ **Bag M5** (Mom's finger genes):
Mom has five fingers on each hand and no genes for extra fingers. Fill the bag with 100 percent long green pipe cleaners.
- ▶ **Bag D5** (Dad's finger genes):
Dad has six fingers on each hand because he received two genes for extra fingers from his parents. Fill the bag with 100 percent short green pipe cleaners.

4. Line up the 10 bags on a table or desk at the front of the room.

Lesson time:

1. Tell the learners that they're going to make a human using pipe cleaners. The pipe cleaners will represent the genes that control the various traits their humans will inherit. Tell them that the traits were chosen as examples because they're coded for by single genes, and that many other traits are coded for by more than one gene. These traits are also affected only by the genes and that there are many traits that are affected by both genes and environmental conditions and nutrition as well.
2. Have the learners (or a representative from each team, if they're working in teams) take turns picking one pipe cleaner from each bag.
3. Next have them lay out their pipe cleaners, and using the chart you prepared earlier, determine what traits their humans have. **(Note:** You also could have the students draw their humans, indicating what specific traits are represented.)
4. Have the learners or teams share their humans' phenotype (physical traits) and genotype (genetic) information. Record this information on a flip chart or board.

Check for Understanding:

Ask the group the following questions.

- ▶ **Why do offspring generally look like their parents?** (*Because both parents contribute genes to their offspring.*)
- ▶ **Could two brown-eyed parents have a blue-eyed offspring?** (*Yes. The gene for blue eyes is recessive, but if both parents carry it, their offspring may inherit it.*)
- ▶ **How could Mendel produce a short plant from tall ones?** (*By crossing two plants that both carried the recessive gene for plant height [t].*)
- ▶ **What would happen when two short plants are bred?** (*All of their offspring would be short because it would be genetically impossible for those two plants to produce tall plants. The genes for short plants are recessive, so two parents with the recessive phenotype cannot produce tall offspring — the dominant phenotype.*)
- ▶ **How could you apply the information from this lesson in real life?** (*Livestock producers use genetic information all the time to help them decide which females to breed with which males and which animals to keep and which to cull (remove from the herd or flock). Animals with undesirable recessive traits would be culled.*)
- ▶ **How might environmental factors influence a person's phenotype?** (*Nutrition, exercise and other factors influence wellness and appearance.*)
- ▶ **What environmental factors might change how a human looks or develops?** (*Poor nutrition can affect height, weight, color, strength of bones and teeth, and other traits. Vigorous exercise and play can help develop muscles.*)

Adaptations for learners K-4

To adapt this activity for children aged 5 to 8, follow these steps.

- ▶ Discuss how parents and children are alike.
- ▶ Explain that human bodies and all other living things are made of cells, which contain information that determines how children look.
- ▶ Define the word "genes" as the messengers that carry the information about how people look, much as a child would carry a note to a teacher. Stress that we can't see genes because they are very, very small.
- ▶ Ask how many learners have blue eyes. How many have brown eyes? Other colors? Now give each child a sheet of construction paper that matches his or her eye color, and have him or her make a large eye using this paper. Suggest that learners can draw eyelashes and pupils on the eyes, if they wish. Help them punch a hole near the top of their construction paper eyes.
- ▶ Ask the children to find out their parents' eye colors for the next meeting or class. (Note: adopted children may use their adopted parents' eye color. Explain that all humans are related through common, ancient ancestors.)
- ▶ After the children have discovered their parents' eye colors, have them make appropriately colored construction paper eyes for their parents. Help them punch holes near the tops of their parents' paper eyes, too.
- ▶ Give each child two pieces of string or ribbon and one pencil. Have the learners tie the two parental eye cutouts about 5 centimeters (2 inches) below the pencil, next to each other. (Note: You may need to help some of the younger children tie knots.)
- ▶ Now give each child one longer piece of string and have them tie their own eye cutouts to their pencils so that they hang below the parental ones.
- ▶ Hang the eye mobiles around the room. Discuss the various examples (such as that two brown-eyed parents may make a blue-eyed child or a brown-eyed child, but two blue-eyed parents always make a blue-eyed child).

Michigan Grade Level Content Expectations:

All grades: Generate questions based on observations (S.IP.01.12, S.IP.02.12, S.IP.03.12, S.IP.04.12, S.IP.05.11, S.IP.06.11, S.IP.07.11); communicate and present findings of observations and investigations (S.IA.01.1, S.IA.02.13, S.IA.03.13S.IA.04.13, S.IA.05.13, S.IA.06.13, S.IA.07.13).

Grade 1: Identify characteristics (for example: body coverings, beak shape, number of legs, body parts) that are passed on from parents to young (L.HE.01.11).

Grade 5: Explain that the traits of an individual are influenced by both the environment and the genetics of the individual (L.HE.05.11); distinguish between inherited and acquired traits (L.HE.05.12).

- ▶ **Are the physical characteristics demonstrated in this activity an example of inherited or environmental influence on phenotype?** *(These traits are all example of traits that are 100 percent controlled by genes. So they are all inherited.)*
- ▶ **What is a gene?** *(A hereditary unit that carries and stores the information that helps control various physical, mental and behavioral characteristics in living things.)*
- ▶ **What are recessive genes?** *(Genes that are not expressed when combined with dominant ones.)*
- ▶ **Give some examples of recessive traits in humans.** *(Blue eyes, inability to roll the tongue, unattached earlobes, more than five fingers on each hand.)*