Explore Student Guide

Heredity

Background

What do you think of when you hear the word inheritance? Do you think of people who inherit a china plate from a grandmother's collection, a grandfather's watch, or maybe even a car from someone?

Your most important inheritance comes from the passage of genetic instructions from one generation to the next. This process is called heredity. Heredity determines who will have blue, brown or green eyes, if your hair will be curly or strait, and even unseen things like your blood type. Recall that in a eukaryote cell, genetic material is found within the membrane bound nucleus. Genetic material is not bound within a nucleus in a prokaryotic cell, instead it is found free within the cytoplasm. Whether an organism is a prokaryote or a eukaryote, heredity is the process by which genetic instructions pass from one generation to the next.

Answer the background questions in the *Student Journal*.

Part I: What are Genetic Instructions and Traits?

Genetic instructions control how traits are passed from one generation to the next. Genetic instructions are like a set of directions and traits are like the results of following the directions. For example, directions (genetic instructions) are needed to assemble a working model airplane. The ability of the model to fly (trait) and the way the model looks (trait) are the result of following the directions for the assembly of the model plane.

Cells follow genetic instructions provided by deoxyribonucleic acid, or DNA, that determines their form and function. For example one cell may be directed to be a red blood cell, another to be brown eye pigment, while a third may be directed to form bone cells. DNA forms strands that are made up of smaller pieces, or segments, called genes. It is these genes that govern the many traits of an organism.

Traits are inherited qualities of an organism and can be divided into three types:

1. physical traits such as height, eye color or hair color
2. behavioral traits such as protective instincts
3. predisposition to a medical condition such as cancer, heart disease, sickle cell anemia, or diabetes.

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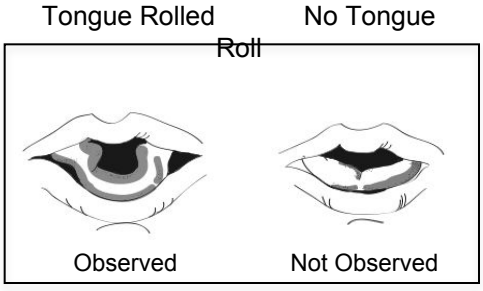
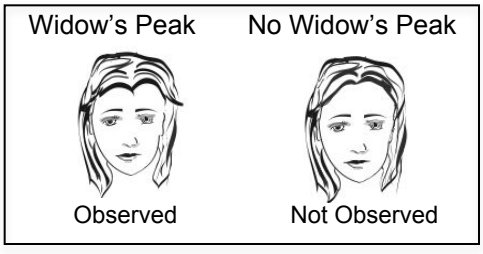
Part I: What are Genetic Instructions and Traits?, continued

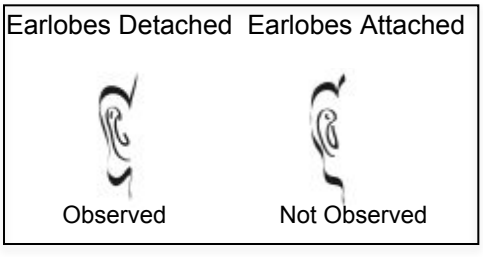
The same trait can be shared by many organisms yet it is the combination of traits that makes every individual unique. Investigate some traits that may or may not be shared by your classmates.

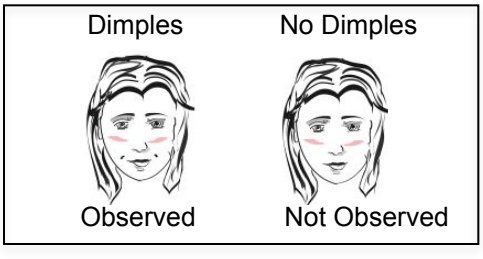
Procedure:

1. Your teacher will describe a trait as shown in the graphics. If you have the trait, move to the "Yes" side of the classroom. If you do not have the trait, move to the "No" side of the classroom.
2. Record the number of students with or without each trait on the class data table.
3. Answer the questions in your *Student Journal* and copy the data from the Class Trait Data Table into your *Student Journal.*
4. Use the data to make a pie graph of the percentage of the class with or without each trait.









Part II: Pass It On

Not all inherited traits are so easily observed. Other unseen traits also contribute to unique individuals, for example: blood types or the way information is processed in the brain. Human traits and diversity result from the differences in a mere .1% of genetic material. It is amazing that 99.9% of the genes governing the many traits of the human organism are identical, yet that small percentage, .1%, is what makes every human unique.

Genes are tightly packed and stored in chromosomes within the nucleus of eukaryotic cells and are also stored in chromosomes freely floating in the cytoplasm of prokaryotic cells.

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Part II: Pass It On, continued

When the process of heredity occurs asexually from a single parent, the offspring receive an exact duplicate of the parent's genetic material. When the process of heredity occurs from the sexual reproduction of two parents, the offspring receives half of the genetic material from the mother and half from the father.

Chromosomes are found in pairs in eukaryotes, and are different in number for various organisms. For example: humans have 23 pairs of chromosomes (46 in total), carp fish have 52 pairs (104 in total) and broad beans have 6 pairs (12 in total).

This means that humans pass 23 individual chromosomes from one parent (mother) and 23 individual chromosomes from the second parent (father) to form the 23 pairs of chromosomes in the offspring. The result is an offspring that shares some traits from each parent, but are not identical to either parent. The exact chromosome a parent passes on to form a pair in an offspring is random, yet each pair must receive one from the mother and one from the father.

In this activity, you investigate how traits are inherited by passing the gene containing chromosomes from one generation to the next. Use your *Student Journal* as a reference.

Procedure:

1. Color one set of the 23 paired chromosomes from parent #1 red.
2. Color the second set of the 23 paired chromosomes from parent #1 gray.
3. Color one set of the 23 paired chromosomes from parent #2 yellow.
4. Color the second set of the 23 paired chromosomes from parent #2 blue
5. Produce an offspring from parent #1 and parent #2. Obtain 2 pennies for each pair of students. One student is parent #1 and the second student is parent #2.
6. Parent #1 tosses a penny. If it is heads color the first chromosome red on the top line of Offspring A. If it is tails, color the first chromosome gray on the top line of Offspring A.
7. Then parent #2 tosses a penny. If it is heads, color the first chromosome yellow on the bottom line of Offspring A. If it is tails, color the first chromosome blue on the bottom line of Offspring A.

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Part II: Pass It On, continued

8. When both students complete the coloring in their *Student Journals*, the first pair of chromosomes has been successfully passed from one generation to the next for Offspring A. Continue with the same process for the remaining 22 pairs of chromosomes to provide Offspring A with a complete set of 23 pairs of chromosomes, one from parent #1 and one from parent #2.
9. Next produce a second offspring (a brother or sister) from parent #1 and parent #2. Repeat the entire process with your partner to produce Offspring B with random chromosomes by using the coin toss method. Remember that which individual chromosome the parent passes from the pair is random but the offspring must receive one from each parent, #1 and #2.
10. Answer questions 1-3 in your Student Journal before moving on to the next set of color-coded chromosomes.

Finally, see how traits are passed from one generation to the next by the genes that are stored in the chromosomes through the process of heredity.

Procedure

1. Choose Offspring A or Offspring B and allow them to grow up. Carefully copy their color-coded genetic instructions to the space provided in your *Student Journal* labeled: Grown-up Offspring Becomes Parent #3.
2. Color one set of the 23 paired chromosomes from parent #4 orange as shown in your *Student Journal*.
3. Color the second set of the 23 paired chromosomes from parent #4 brown as shown in your *Student Journal*.
4. One student becomes the grown up parent #3 and the second student becomes parent #4.
5. Use the coin toss method again to color code 23 pairs of chromosomes to produce a new generation, Offspring C.

Complete Part II and the Reflections and Conclusions questions in your *Student Journal*.