



GENETIC VARIATION

Concepts

Within a population of organisms, individuals will exhibit variation or differences among their features.

Genes are the basic units of heredity and they are what make each individual's characteristics, traits and behaviors different.

HCPS III Benchmarks

SC 7.1.3 SC 7.5.2
SC 7.5.3

Duration

1 hour (or more)

Source Material

Adapted from FOSS
PRISM

Vocabulary

Alleles
Chromosome
DNA
Dominant
Genes
Genetics
Heterozygous
Homozygous
Nucleic Acids
Recessive
Traits
Variation

Exploring Human Traits

Summary

Genetics can be a confusing concept for many students to understand. In order for the class to begin to understand genetics, they will first study variation in human traits. Students will start learning about the study of heredity by surveying their own features. They will learn that they possess single gene traits with simple dominance inheritance patterns such as earlobe attachment, tongue rolling, and bent little finger. Students will work in groups, and after surveying their partners, the data of the class will be collected and patterns of inheritance will be discussed.

Objectives

- Students will describe human traits.
- Students will distinguish which trait they possess for chosen features.
- Students will organize data, calculate percentages, and create graphs.
- Students will identify patterns and discuss conclusions for those observed patterns.

Materials

Rulers (1 per pair of students)

Grid for Vocabulary Bingo, or have each student take out a piece of paper and make their own grid (5 squares down x 5 squares across).

Vocabulary Review Sheet - This can be used as transparency or a handout.

Internet access (if added background material is needed).

Making Connections

In the following two lessons, students will be exploring the concept of genetic variation. This can oftentimes be a difficult topic for people to grasp. For this reason, the follow activities will use their own personal experience of their bodies and other human-based examples (human traits) to begin their studies.

Teacher Prep for Activity

- Xerox "Genetic Variation" readings, grids for Vocabulary Bingo Vocabulary Review Worksheet and Exploring Human Traits Record Sheets for students.
- Xerox a single copy of the Human Traits that can be used for teacher.



Background

With the invention of better microscopes in the late nineteenth century, biologists were able to discover the basic facts of cell division and sexual reproduction. With these new discoveries, scientists began to focus genetics research to understanding how hereditary traits are passed on from parents to their children. **Genetics** is the branch of science that deals with inheritance of biological characteristics. Within a population of organisms there will be **variation** among the individuals in the population and this is the reason for population change and differences. Within a population of sexually reproducing organisms, every individual within that population will be unique and vary in their traits, behaviors and environmental needs. **Genes** are the basic units of heredity and they are what make each individual's characteristics, traits and behaviors different.

Genes are found along the DNA strand. **DNA** (deoxyribonucleic acid) is made up of **nucleic acids**, which are large molecules that hold the story of life. DNA is the specific nucleic acid that deals with determining the genetic code of each individual. Typically, DNA molecules are quite long, approximately 5 cm long and in order to fit within the nucleus of the cell, they are coiled and tightly wound into a structure called a **chromosome**. branch of science that deals with inheritance of biological characteristics.

Organisms have different number of chromosomes, some organisms has as few as two, while some have up to a thousand. Humans have 23 different chromosomes and each of those has an identical partner chromosome. The paired chromosomes that are similar are considered to be homologues and each chromosome has the same genes. These two genes interact with each other to produce the characteristic they are assigned to and the two copies of the genes are called **alleles**. When the two alleles are considered together, they make up a single gene. When a gene is composed of two identical alleles it is considered **homozygous**. When the gene is composed of two different alleles, the gene is **heterozygous**.

Gregor Mendel, a European monk, became known as the “father of modern genetics” for his study of inheritance of traits in pea plants. Through selective crossbreeding of different **traits** (tall, short, purple flower, white flower, smooth seed) of pea plants Mendel discovered the basic principles of heredity. Over many generations of breeding pea plants, Mendel discovered that certain traits show up in offspring without any blending of parent characteristics. For example, when pollen from tall plants was used to pollinate the flowers of short plants, all the offspring were tall. There was no mixing of tall and short plants. In the previous example, the trait of “tall” which exclusively appeared in the first generation (F_1) and reappeared in the second generation (F_2) was identified as the **dominant** trait. The second generation also revealed the “short” trait that was absent in the F_1 generation. This trait that was absent in the F_1 generation but present in the F_2 generation was identified as the **recessive** trait.

Unfortunately, Mendel did not know about DNA, chromosomes, or genes and was unable to understand the biological and physical processes that allowed inheritance to occur and the importance of his work was not recognized until many years later.

Procedure

1) First have students read background information about Genetic Variation. This can either be assigned as homework, or this can be done as a lesson during class prior to this activity. If the



reading is to be assigned as homework, be sure to take a period to go over the information since some of the vocabulary can be complex.

2) Play a round (or two) of Vocabulary Bingo and then review genetics vocabulary sheet as a class.

3) Divide students into groups of two and give each group a ruler (ruler will only be used if the traits that you assign to survey need to be measured). First ask the students if they think there are differences among humans and have them give examples of possible differences. Ask them if there were going to describe a person, for example, if they needed their parents to go pick up a friend that their parents had never met, how would they describe their friend to their parents. Hopefully they say things like “my friend has brown hair, they are tall, they have brown eyes, etc.”. Explain to them that they just described traits about a person. They will now survey their own traits.

4) On the list of traits provided, choose up to five traits and be sure to introduce the traits and go over them with the students. Each feature only has two traits, so each student should have one or the other trait. Let students know that their assignment is to discover which trait they have for each of the assigned features. For example, if the tongue trait is chosen, the student will either be able to curl their tongue or not.

5) Give the students about 10 minutes to observe each other and determine which traits they possess. Have the students record their traits on a piece of paper. They should write which feature they have and the trait, either the dominant or recessive trait. Dominant traits will be symbolized by 2 capital letters (TT) and recessive traits by 2 lower-cased letters (tt). This actually defines the genotype of the trait.

6) Poll the class by having the students come to the board and tally their results. On the board, have each trait written out and next to each trait, each student can make a tick or a check next to the trait.

For example:

Tongue rolling: TT	_____	_____	“5 students”
tt	_____	_____	“2 students”

7) Then determine the percentage of students in the class that have the certain trait.

The class can also be polled using a transparency, having the students raise their hands and report to the teacher which traits they have.

8) Talk about the results. Is there variation among the students? Which traits occurred the most? Are the traits linked? If you can roll your tongue, is your little finger always bent? Summarize the results, determining that there is variation among the students in the classroom.

9) Have the students create a bar graph of their results on the back of their Exploring Human Traits Record Sheet.

Assessments

Completed Vocabulary Bingo.

Exploring Human Traits Record Sheet.



Resources

<file:///Users/universityofhawaiihilonsfprismgk-12/Desktop/GK-12%20Human%20Traits.webarchive>

<http://www.dnaftb.org/dnaftb/1/concept/index.html>

Foss-Populations and Ecosystems

Teacher Resource Extensions:

FOSS Genetic Vocabulary Review Worksheet (included)

When introducing the material, students can visit the web site

<http://www.dnaftb.org/dnaftb/1/concept/index.html> (DNA from the beginning) and choose chapters to explain some of these complex concepts. The animation tab for each chapter is a beneficial way to have students engaged in the material. Chapters 1-5 can be used for the topics of inheritance.

Extension Activities

None.

Culture/Art/Math/Literature Connections

None.



Human Traits:

1. Shape of face (probably polygenic)	Oval dominant, square recessive
2. Cleft in chin	No cleft dominant, cleft recessive
3. Hairline	Widow peak dominant, straight hairline recessive
4. Eyebrow size	Broad dominant, slender recessive
5. Eyebrow shape	Separated dominant, joined recessive
6. Eyelash length	Long dominant, short recessive
7. Dimples	Dimples dominant, no dimples recessive
8. Earlobes	Free lobe dominant, attached recessive
9. Eye shape	Almond dominant, round recessive
10. Freckles	Freckles dominant, no freckles recessive
11. Tongue rolling	Roller dominant, nonroller recessive
12. Tongue folding	Inability dominant, ability recessive
13. Finger mid-digital hair	Hair dominant, no hair recessive
14. Hitch-hiker's thumb	Straight thumb dominant, hitch-hiker thumb recessive
15. Bent little finger	Bent dominant, straight recessive
16. Interlaced fingers	Left thumb over right dominant, right over left recessive
17. Hair on back of hand	Hair dominant, no hair recessive

Exploring Human Traits Record Sheet



Name: _____

Use this tally sheet to keep track of the different traits that your classmates have. Under “Trait” write the different traits that your class has decided to survey, such as Dimples or Tongue Rolling. Under “Dominant” or “Recessive”, record the tally marks or check marks of your classmates. Then determine the percentage of students that are either dominant or recessive for the trait.

<u>TRAIT</u>	<u>DOMINANT</u>	<u>RECESSIVE</u>	<u>% (# ÷ Class total)</u>
Example: Dimples	√√√√√√√√	√√√√	8 ÷ 4 = 2% Dominant
_____ :	_____	_____	_____ (D) _____ (r) = _____ %
_____ :	_____	_____	_____ (D) _____ (r) = _____ %
_____ :	_____	_____	_____ (D) _____ (r) = _____ %
_____ :	_____	_____	_____ (D) _____ (r) = _____ %
_____ :	_____	_____	_____ (D) _____ (r) = _____ %