



Our Genetic Diversity

LESSON

GRADE LEVEL 10

CATEGORY Earth, Ecosystems and Ecology

TOPIC Diversity and Genetics

LENGTH

Two class sessions:
Part 1: one period or less
Part 2: homework
Part 3: one period

MATERIALS

- Genetic wheel for each student
- Example of Genealogical Tree

SETTING

Indoors

GROUP SIZE

One class

SUBJECTS

Science

SKILLS

Observation, personal research, data recording and analysis, graphic layout, evaluation

KEYWORDS

Genetics, genes, biodiversity, genetic traits, phenotype and genotype, DNA, genetic expression, dominant trait, recessive trait, homologous chromosomes, alleles, heterozygous, homozygous, dominant and recessive alleles, intermediate inheritance, co-dominance, genealogy

Overview

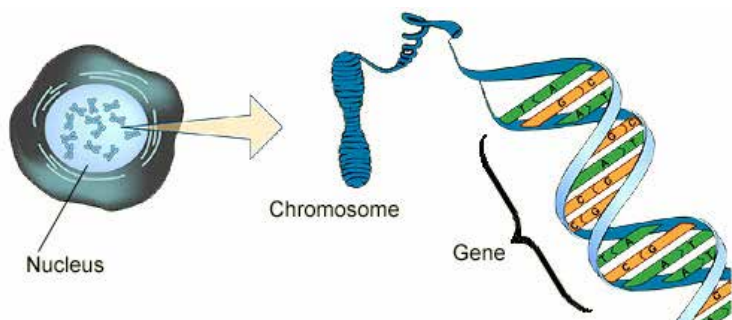
We will examine our genetic diversity by first playing a game that demonstrates our genetic uniqueness. Then you will investigate how a trait is inherited in your family, or a family that you know.

Objectives

- Enhance appreciation of genetic diversity within the class and our families
- Research, document, analyze, and evaluate a personal genealogy
- Define and use key terms about inheritance that support an understanding of basic genetics.

Background

Biodiversity within a species is referred to as genetic diversity. Some species are more genetically diverse than others, which usually has a lot to do with the geography of their distribution. Genetic diversity is essential to all organisms because it leads to variations between individuals of a species. Evolution is based upon the successful reproduction of the variants best adapted to their environment, thus passing along the genes that work best. The expression of genetic diversity results from the messages different genes give to guide the development of an organism.



http://www.bbc.co.uk/schools/gcsebitesize/science/add_aqa_pre_2011/celldivision/celldivision1.shtml

Genes, which are segments of DNA that constitute part of the chromosomes in the nucleus of your cells, get passed down from generation to generation, and determine or influence the expression of a given trait. An expressed trait is called a phenotype; the organism looks like or behaves a certain way. The genetic code that leads to the phenotype is called the genotype.

Because chromosomes come in pairs, called homologous chromosomes, the genes in the chromosomes also come in pairs, called alleles. The exception is the “pair” of the sex chromosomes, X and Y, because the Y is much smaller than the X, so a number of genes on the X chromosome do not have a partner. Only one of the homologous pairs of chromosomes from each parent gets passed down to the next generation. If a particular allele is homozygous, or the same on each of the pair of homologous chromosomes, you may have received either chromosome. For instance, if one of your parents is homozygous for the allele that prescribes hair colour, that’s the allele that you received. However, about 13% of the time in humans, alleles can be heterozygous. That means that for a given trait, such as eye colour, you may possess the dominant allele (which gives you brown eyes) and the recessive allele for blue eyes. Your eyes will be just as brown as someone

homozygous for brown eyes, because that dominant allele blocks the expression of the recessive allele for blue eyes. Not all genes come in dominant-recessive pairs. Some heterozygous pairs yield phenotypes half-way between one phenotype and another, such as occurs in sickle-cell anemia. This is called intermediate inheritance, or codominance.

A genealogy is a family tree. We can examine how traits pass along from generation to generation using a genealogical tree. Sometimes we can decipher the mode of inheritance of a given trait. Ultimately, all of life is one big family tree, and scientists are becoming more and more accurate in determining the relationships among life forms. The more closely related you are, whether in your family or in the family of life, the more similar will be your DNA, which is the code of your genes.

The Activities

Part 1

Genetic Wheel: Diversity in Our Class

Warm-up

We humans express a great deal of diversity, and this exercise highlights some of this. Take a look around you, and notice some of the obvious traits that vary amongst your classmates, then note some that you share.

Procedure

The accompanying Genetic Wheel allows you to establish your uniqueness! Beginning in the centre, shade the trait that best describes you, until you reach the rim of the wheel. You will find your number. Upon completion, find a location that allows you to form a line with your classmates, arranging yourself from lowest number to highest number. Now form your line into a circle. Those closest to you should share some traits with you.

Assessment

1. Does that mean that with those closest to you share certain genes with you? Explain.
2. Does that mean that they are more closely related to you than others? Discuss.
3. What significance, if any, is there in the differences that you observe?
4. What patterns, if any, do you notice, in similarities and differences around your circle?
5. What if the members of one half of the circle became a breeding unit separate from members of the other half. Considering other obvious differences along with the traits in the wheel, what traits would be most common in the descendants of the first group? The second group?
6. Differences in genes arise by mutations, so we are all mutants. Discuss why some mutations result in making some genes more common than others.
7. Try the wheel with your family.



Part 2

The Inheritance of a Trait in Your Family

Warm-up

The Genetic Wheel activity showed your individual variation for a number of traits. The purpose of this assignment is to examine the inheritance pattern of a trait that varies in your family, or a family that you know. For instance, if some of your family members have brown eyes and some blue eyes, eye colour would be a good trait to follow. You may choose a trait that you followed in the Genetic Wheel, or another that you research. For some of these traits, the mode of inheritance is clear, while for others it is not.

Procedure

Select a trait that varies in your family, or a family that you know. You will collect data from at least three generations, so you might need to ask your parents about your grandparents.

Make a genealogical tree, as illustrated. Include a title describing the trait that you analyzed. A box indicates a male, and a circle, a female. A horizontal line between a male and a female indicates that they are partners. A downward vertical line between partners leads to offspring. Brothers and sisters are connected with a horizontal line above them. Write the

name of each individual under each box or circle. Inside the boxes and circles, write the code for the genotype (e.g., Bb; see below). Shade the boxes and circles to indicate phenotypes. Make a legend to explain what the shading represents.

Coding of genotype: Letters represent a pair of alleles. For example, a blue-eyed person would have a genotype of bb, where “b” represents a recessive allele for eye colour, located on one of the pair of homologous chromosomes and where “B” represents the dominant allele. Individuals receive one, and only one, of the alleles from each of their parents. Since an allele comes from each of the parents, the offspring has two: a pair of alleles. When making your genealogical tree, note that you won’t always be able to enter a complete genotype.

Assessment

1. Why were you asked to follow a trait that varies in your family?
2. Why is a trait called dominant or recessive?
3. Sometimes people with the same genotype for a trait express a different phenotype. Why might that be?
4. We used brown and blue eye colours for examples, but we all know that there are more eye colours than that. How can we explain that?

Modes of Inheritance of Traits on the Genetic Wheel

Trait	Phenotype	Dominant Genotype	Recessive Genotype	Other
gender	male or female	--	--	male = XY female = XX
eye colour	dark or light	dark, BB or Bb	light, bb	
hair colour	dark or light	dark, DD or Dd	light, dd	
handedness	left or right	--	--	many genes involved
hair type	curly or straight	curly, CC or Cc	straight, cc	
hairline	widow's peak or strait hairline	--	--	inheritance mode unclear
tongue rolling	roll or not	roll, RR or Rr	not roll, rr	not this simply inherited



Part 3

A Closer Look at Your Genealogy

Warm-up

Now we look more closely at your genealogical tree, to troubleshoot it, and make sure that we understand the mechanisms of simple inheritance.

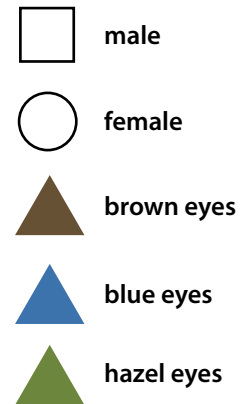
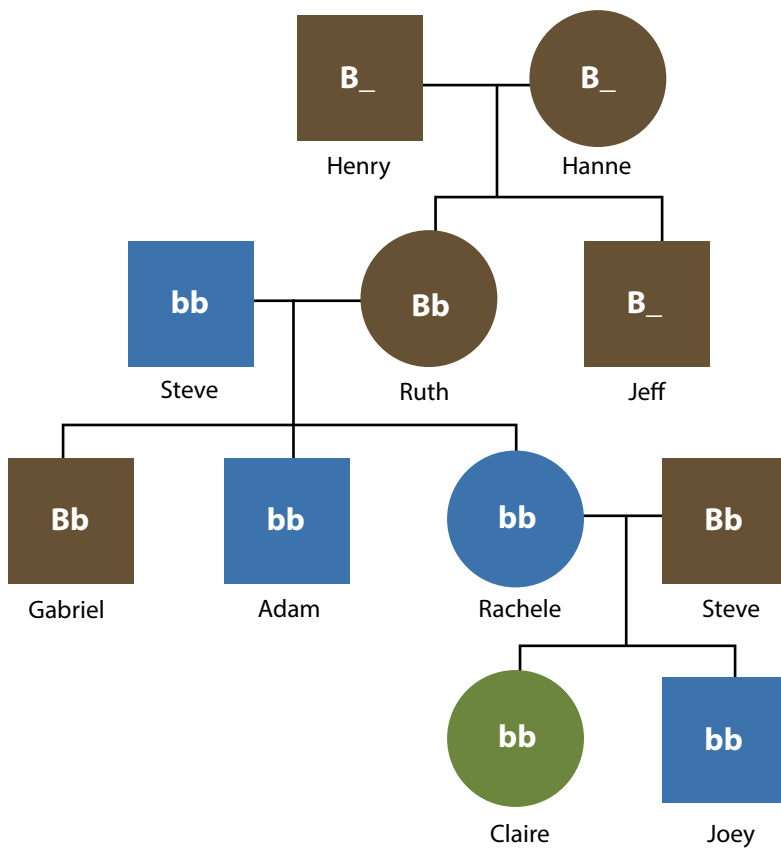
Procedure

Bring out your completed genealogical tree. Begin by working in pairs, checking one another for the accuracy of your genealogies, using the example provided. You should show at least three generations, and must include at least two phenotypes. If you run into puzzles, consult another pair of students. There may be parts that don't work out. Propose hypotheses to explain discrepancies. Write down points that require further clarification. Convince one another that you understand how inheritance works.

Assessment

1. Explain to one another the meanings of these terms: genealogy, homologous chromosomes, alleles, genotypes, phenotypes, heterozygous, homozygous, dominant and recessive alleles.
2. Using the genealogical tree example, predict the possible genotypes and phenotypes of Adam if you didn't already know him.
3. Point out where inheritance appears to be a case of simple dominant/recessive genes.
4. Suggest other modes of inheritance in cases where dominant/recessive does not explain your observations.
5. Where does your DNA come from (who are your ancestors)?

Genealogical Tree of Eye Colour in My Family



Note: Claire's genotype may not be correct. Likely she inherited genetic modifiers: genes that modify the expression of the primary eye-colour.



