



Activity 1

Alike, But Not the Same

Focus: Students conduct a classwide inventory of human traits, construct histograms of the data they collect, and play a brief game that introduces the notion of each individual's uniqueness.

Major Concepts: Humans share many basic characteristics, but there is a wide range of variation in human traits. Most human traits are multifactorial: They are influenced by multiple genes and environmental factors.

Objectives: After completing this activity, students will

- understand that they share many traits;
- understand the extent of genetic similarity and variation among humans;
- be able to explain that most human traits are multifactorial, involving complex interactions of multiple genes and environmental factors; and
- understand that genetic variation can be beneficial, detrimental, or neutral.

Prerequisite Knowledge: Students should be familiar with constructing and interpreting histograms.

Basic Science-Health Connection: This opening activity introduces human variation as a topic that can be systematically studied using the methods of science (for example, gathering and analyzing data). This idea sets the stage for Activity 2, in which students consider the significance of human genetic variation at the molecular level.

This activity introduces the module by focusing explicitly on human variation. The primary vehicle is a class inventory of human traits that highlights similarities and differences. Although variation, both phenotypic and genotypic, is the central focus of all five activities in the module, this concept is less explicit in subsequent activities than in this activity.

One goal of the Human Genome Project was to provide the complete sequence of the human genome. Another goal of the genome project is to illuminate the extent of human genetic variation by providing a detailed picture of human similarities and differences at the molecular level. Research indicates that any two individuals are 99.9 percent identical at the level of the DNA. The 0.1 percent where we vary from one another (about 1 out of 1,000 DNA bases) is clearly very important. It is within this small fraction of the genome that we find clues to the molecular basis for the phenotypic differences that distinguish each one of us from all others.

In this activity, students are introduced to the notion that although we are very similar to one another, we also are very different, and our differences reflect a complex interplay between both genetic and environmental factors. This understanding sets the stage for subsequent activities in the module in which students

At a Glance

Introduction

learn about the molecular differences that help explain our phenotypic differences, and also consider some of the medical and ethical implications of scientists' growing understanding of these differences.

Materials and Preparation

You will need to prepare the following materials before conducting this activity:

- plant, fish, prepared slide of bacteria
- Master 1.1, *An Inventory of a Few Human Traits* (make 1 copy per student)
- labeled axes on the board or wall in which students can enter data

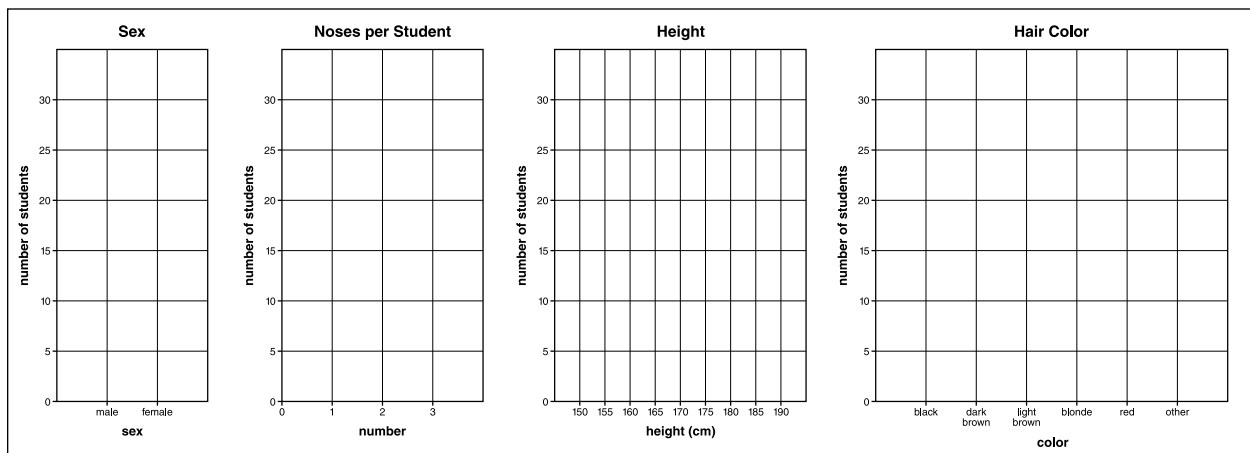
Construct four sets of axes on the board or the classroom wall (use masking tape). Label the axes as shown in Figure 14.

- 120 3 × 5 cards (4 per student; required only if you construct the axes on the wall)
- tape measure (1 per pair of students)
- Master 1.2, *Thinking About Human Variation* (make 1 copy per student)

Procedure

1. Begin the activity by telling the class something like, “If a visitor from another planet walked into this classroom, he might easily conclude that humans all look very much alike.” If students complain that this is not true, answer with something like, “You certainly are more like one another than you are like this plant [point to the plant]. Or this fish [point to the fish]. And for sure, you are more alike than anyone of you is like the bacteria on this slide [wave the prepared slide of bacteria in the air]. Humans—*Homo sapiens*—have a set of traits that define us as a species, just like all other species have a set of traits that define them.”
2. Continue the activity by saying, “Let’s see just how similar you are.” Distribute one copy of Master 1.1, *An Inventory of a Few Human Traits*, to each student and ask students to work in pairs to complete them.

Figure 14 Construct the four sets of axes shown here on the board or on a wall of your classroom.



If students are unfamiliar with the following terms, provide the definitions below.

detached earlobes: Earlobes hang free, forming a distinct lobe.

hitchhiker's thumb: Most distal joint of thumb can form almost a 90 degree angle with the next most proximal joint.

midigital hair: Hair is present on digits distal to knuckles.

cross left thumb over right: Natural tendency is to cross left thumb over right when clasping hands together.

- 3. As students complete the inventory, direct their attention to the four sets of labeled axes you prepared. Ask the students to enter their data at the appropriate place on each set of axes.**

If you constructed the axes on the board, students can use chalk to record their data. If you used masking tape to construct the axes on the wall, ask students to record their data by taping one 3×5 card in the appropriate place on each set of axes.

Tip from the field test: You may wish to give males one color of chalk or 3×5 card to use in recording their data and give females a different color. This strategy will allow the class to determine if any of the three characteristics other than sex (for example, height) shows differences related to sex.

- 4. After the students have finished collecting and recording their data, ask them to look at the four histograms they built and identify what evidence they see in those data that they share many traits with other members of their class.**

Students may answer that all people have only one nose, and all people are only one sex or the other.

- 5. Continue the activity by saying, "But now that I look around the room, it is clear that you are different. What evidence do you see in these data that people are different?"**

Students should recognize that not everyone is the same height and not everyone has the same hair color.

As students look at the data, you may wish to ask them to compare the shapes of the histograms for sex and height. The sex histogram has two distinct peaks because there are only two categories of individuals—female and male. That is, sex is a discontinuous trait. In contrast, height is a continuous trait that has many categories of individuals, ranging from very short to very tall. The shape of the height histogram may begin to approach a bell curve, or normal distribution. It may also have two peaks—a bimodal distribution—with one peak representing the female students and the other peak representing the male students.

- 6. Challenge the students to try to describe just how different they are by**

guessing how many traits they would have to consider to identify any given student in the room as unique. Write the students' predictions on the board.

7. Conduct the game described below with several volunteers.
 - Choose a volunteer to determine his or her “uniqueness” as compared with the other students.
 - Ask all of the students to stand.
 - Invite the volunteer to begin to identify his or her phenotype for each of the 13 human traits listed on *An Inventory of a Few Human Traits*. Begin with the first trait and proceed sequentially. As the volunteer lists his or her phenotype for each trait, direct the students who share the volunteer's phenotype for that trait to remain standing. Direct all other students to sit.
 - Continue in this fashion until the volunteer is the only person still standing. Count how many traits the class had to consider to distinguish the volunteer from all other students in the class. Compare this number with the students' predictions.
 - Repeat as desired with another volunteer.
8. Ask students to work in pairs to answer the questions on Master 1.2, *Thinking About Human Variation*.



Collect and review the students' completed worksheets to assess their understanding of the activity's major concepts.



Increasing evidence indicates that all human diseases have genetic and environmental components. Point out that diseases such as cancer, heart disease, and diabetes as traits that show an interaction between genetic and environmental factors. Students will consider this concept in Activity 4, *Are You Susceptible?*

Question 1 Some human traits can be changed by human intervention and some cannot. Provide examples of each of these types of traits.

Biological sex and blood type cannot be changed. Hair color, skin color, and even height and mental abilities can be changed by human intervention. Students also may suggest that body piercing alters human traits.

Question 2 You probably already know that some traits are genetic and others are environmental. But most human traits reflect an interaction between genetic and environmental factors. Name some traits that might fall into this category and explain why you think they do.

Height, weight, intelligence, and artistic or athletic ability are examples of traits that are influenced by genetic and environmental factors. Some students may mention disorders such as certain types of cancer or even psychiatric disorders. We know that these types of traits are both genetic and environmental because we see evidence that they run in families and because we know we can modify them by changing the environment.

Question 3 Describe some of the benefits of human genetic variation. What are some of the potential problems that it can cause?

Students may mention a number of benefits, such as allowing people to be distinguished from one another and increasing the diversity of abilities, interests, and perspectives among humans. Some students may recognize that genetic variation also benefits the species because it is the basis for evolution by natural selection. Students will consider this aspect of variation in Activity 2, *The Meaning of Genetic Variation*.

Expect students to recognize that just as being different from one another has advantages, it also has disadvantages. For example, genetic variation makes successful tissue and organ transplants more difficult to accomplish than if we were all genetically identical. Students also may note that the existence of real (or perceived) differences among members of a population can allow prejudice and discrimination to exist.

You may wish to point out that research reveals that more variation exists within populations than between them (Figure 15). As noted in *Understanding Human Genetic Variation*, an examination of human proteins demonstrated that about 90 percent of all variation occurred within populations, whereas only 10 percent occurred between populations. That is, we are more “like” people with other ethnic or geographic origins than we might think.

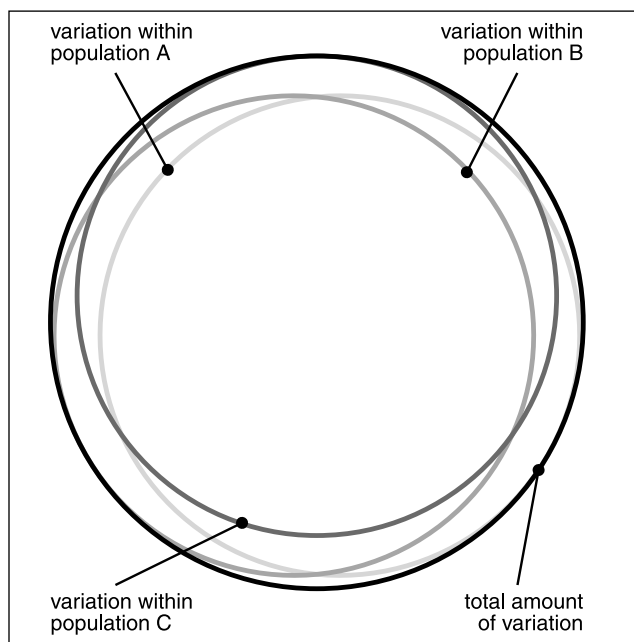


Figure 15 Most variation occurs within populations. A Venn diagram is a useful way to illustrate this idea to students. Note that the amount of genetic information that different populations have in common (areas where circles overlap) is much greater than the amount that is unique (areas where there is no overlap).



These open-ended questions invite students to step back from the activity's details to consider its broader implications. Another way to invite such reflection is to ask students to identify the most important or the most interesting idea they learned as a result of completing the activity.

9. Invite students to summarize the activity's major concepts by asking, "What has this activity illustrated about how one human compares with another human? What has it illustrated about human variation in general?"

Expect students to recognize that humans share many traits. Students also may note that there is a wide range of variation in human traits and one does not have to consider very many traits before a given person's uniqueness is demonstrated. Students should point out that some traits can be changed by human intervention and some cannot, and that although some traits are genetic and others are environmental, most human traits reflect an interaction between genetic and environmental factors (that is, most are multifactorial). You may wish to introduce the term "multifactorial" at this point; students will study multifactorial traits in more detail in Activity 4, *Are You Susceptible?*

Be sure that students generalize their responses to focus on variation in populations, not variation simply between themselves and their partners. Point out that the concept of variation in populations will reappear in different, but less obvious, ways in the other activities in this module.

Potential Extensions

This activity introduces students to several ideas that you may wish them to explore in more depth. For example, assign students to use their textbooks to identify the biological mechanisms that lead to and maintain diversity in populations.

Alternatively, ask students to list some of the advantages and disadvantages of genetic variation in nonhuman populations. Invite them to locate and report on cases where scientists are concerned that it may be diminishing (for example, in domesticated crops and in populations of endangered species being maintained in zoos and other protected settings).

Finally, to extend the discussion of the multifactorial nature of most human traits, challenge students to suggest ways that scientists might investigate the relative contributions that heredity and the environment make to such traits (for example, twin studies or studies of adopted children in relation to their adoptive and biologic parents).