1. Human Traits

Summary
Genes and DNA are very abstract concepts for students. In order to "hook" them in, I open my genetics and evolution unit with human genetics, specifically looking at the variations in human traits. This allows students' natural curiosity about their identity to draw them into the study of heredity. There are lots of great single gene traits with simple dominance inheritance patterns to explore: earlobe attachment, tongue rolling, cleft chin, etc. There are some polygenic traits that can be explored: hair color, eye color, reach, reaction time, etc. Hair texture (curly, wavy, vs. straight) offers a good example of incomplete dominance. After collecting information from themselves and two others, the population data is collected on several large charts in order to look for and discuss the patterns.

Objectives
Can describe human traits.
Can distinguish between single gene and polygenic traits.
Can use tables to organize data and create histograms to graphically represent data.
Can identify patterns in data and draw conclusions from those patterns.

Vocabulary
Characteristic
Trait
Gene
Polygenic
Histogram

1. Human Traits - Logistics

Time
Introduction - 30 min
Collect, organize and analyze data - 50 to 100 min depending on the depth of your analysis

Grouping
Small groups in class and at home for data collection. Whole class for the analysis of the collected data.

Materials
- Copies of the "Human Traits Survey" handout
- Rulers
- Meter sticks or measuring tape
Setting
Classroom.

1. Human Traits - Background

Teacher Background
If you were asked to describe yourself to a stranger so they could recognize you at the airport, what would you say? What traits make you unique and different from others? The general ways one person can differ from another – height, eye color, hair color, build, complexion, etc. – are called characteristics. The precise description of an individual – 5’2”, brown eyes, brown hair, fairly thin, etc. – are called the person’s traits.

In this activity, students survey themselves and others that aren’t in the school for a wide array of traits. Some are “yes/no” traits – dimples/no dimples, freckles/no freckles, attached earlobes/unattached earlobes, etc. Others are “multiple choice” traits – blond/red/brown/black hair, blue/green/hazel/brown eyes, etc. Others vary even more widely – reaction time, hand span, reach, etc. In fact, most of these when plotted on a histogram will generate a bell curve.

These differences relate to the number of genes controlling that characteristic. Most simple “yes/no” traits are controlled by a single gene. Most “multiple choice” traits are controlled by a small number (2-4) genes. The widely varying traits are governed by a large number of genes.

In running this activity, it is essential to be sensitive to the different family situations your students may be in. In the past, it has been traditional to survey one’s immediate family for a series of traits and generate a family pedigree. However, with the number of divorced, adopted, single-parent, and same-sex families in our schools today, it becomes much more difficult to negotiate a unit on inheritance without hurting someone’s feelings. Therefore, my approach is to ask students to survey any two people from outside the school. If it is possible to survey your biological parents, great! If not, any two people from outside school is fine.

Student Prerequisites
None

1. Human Traits - Getting Ready

Getting Ready
Day 1 - Introduction

1. Make copies of the "Human Traits Survey" handout.
2. Set out rulers, meter sticks and/or measuring tape.

Day 2 - Collect and organize data

1. Fill out the "Human Traits Survey" for yourself.
2. Create 4 large graphs on which to draw histograms of the "Traits measured in centimeters" data. Students will be placing a sticker onto the chart for each person surveyed, eventually creating a bell curve distribution for each trait. The y axis for each trait should be labeled "Number of people".
   - Hand span - Label the x axis between 1-30 cm.
   - Reaction time - Label the x axis between 1-30 cm.
   - Reach - Label the x axis between 150-280 cm in 5 cm units.
   - Broad jump - Label the x axis between 80-220 cm in 10 cm units.
3. Create a summary table on which to synthesize the population data for the "Yes or no/multiple choice traits". Students will put a tally mark beside the applicable trait for each person surveyed.
4. Cut the sheets of sticky dots into smaller sheets with 12 dots per sheet. If you are using multi-colored dots, make sure there are 3 dots of each color per sheet.
5. Write your name (or initials) on 4 dots. Plot those dots onto the histograms where your own data falls.
6. Place a tally mark beside each of your traits on the summary table.

1. Human Traits - Lesson Plan

Lesson Plan
Day 1 - Introduction

1. Pose the following scenario to your students: “An exchange student from England is coming to stay with your family for a month. You go to the airport to pick her up and need to describe yourself to her so that she can find you in the crowd at the airport. In 2-3 sentences, how would you describe yourself?” Solicit volunteers to describe themselves.
2. After 5 or 6 students have shared, draw attention to some of the general categories of responses. Note how some descriptors are biologically based (eye color, ethnicity, hair color, height, etc.), whereas others are environmental (clothing, accessories, dyed hair, etc.). In this class, we will focus on the biological descriptors.
3. Go over the vocabulary. “Characteristics” are the general category of descriptions (height, eye color, etc.) whereas “traits” are the precise description of an individual’s characteristics (5’2”, blue eyes, etc.).
4. Pass out the human traits survey. Read the instructions together, then answer any questions about
the survey.
5. Allow students to work individually or in pairs to survey their traits.
6. Completion of the survey for individuals not in your classes should take place as homework that evening.

Day 2 – Collect and organize data

1. Give each student a sheet with 12 sticky dots.
2. Have students write the name (or initials) of each person they surveyed on the dots. Each person surveyed should end up with 4 dots total. If using multi-colored dots, each person should have their name on a dot of each color.
3. Describe to the students how a histogram is constructed with the range of possible traits on the x axis and the number of people in a given category on the y axis. Show students how to add their dots to the charts, making sure they understand how the dots stack one on top of the other.
4. Describe to the students how to add a tally mark to the summary table beside the traits for themselves and the people they surveyed.
5. Allow students time to add their information to the graphs and tables.
6. If you have multiple classes, you may want to postpone the analysis and discussion part below until after all classes have added their information to the tables.

Day 3 – Analyze data

1. This is the opportunity for your students to look at the tables and graphs and look for patterns the different kinds of traits. Before you begin, make sure students know how to find an average, median, range, outlier and percentage. Use a few examples to help them with the statistics.
2. Either as a class or in small teams, summarize the data – you may wish to have students create a summary table, pie chart, histogram or other graph in their lab notebook. What was the average broad jump distance? What was the range? Were there any outliers? What percentage of people were blue eyed? What percentage had freckles?
3. Look for patterns. Do the 4 histograms look the same in shape (they should all form a bell curve distribution)? What would histograms look like for the yes/no/multiple choice traits? What would the histograms look like for other traits that were not surveyed like height, age, favorite color, hair length, test scores, etc.?
4. What is the source of all these differences between people (genes and environment)? Discuss the contribution of genetics (nature) versus environment (nurture). With broad jump distance as an example, how much is determined by genetics and how much is determined by environment like practice?
5. From here, there are many different ways to take the discussion:

   - Discuss the difference between the traits measured in centimeters versus the yes/no/multiple choice traits. How many possible outcomes were there for traits measured in centimeters? If the yes/no/multiple choice traits were plotted on a histogram,
what would the histogram look like? What is the biological difference between these 2 categories (traits measured in centimeters depend on many genes while yes/no/multiple choice traits depend on a small number of genes)?

- Discuss the evolutionary advantage of different traits. Is there an advantage to having a broad hand span? Is there an advantage to having a small hand span?
- Lead the discussion into a description of basic Mendelian genetics. For each of the yes/no traits, one trait is dominant and the other is recessive (see Making Babies lab for additional information). Eye color and hair color are more complicated because they are determined by multiple genes. Hair texture is more complicated because it is determined by codominance. Discuss how each person has 2 genes for each trait, one from mom and one from dad. The combination of these genes is what determines your traits.

1. Human Traits - Assessment

Assessment

1. Collect Traits Survey forms.
2. Collect lab notebooks with students’ summary tables and graphs.
3. Give students a data set for a trait like height or SAT scores and ask them to generate a histogram independently.

Going Further

1. Enter into a more serious discussion of Mendelian genetics and the allele combinations that determine various traits. See Making Babies lab for a one potential way to lead this discussion.
2. Have students to compare one population to another. Are the adults surveyed different than the kids? Ask a nearby school (or different classroom within the same school) to conduct the same survey and compare your results. Another way to investigate this type of information is through the CIESE Collaborative Project. They have compiled a very large database of population genetic information from schools around the world concerning the following traits: earlobe attachment, white forelock, dimples, hitchhikers thumb, bent pinkie, mid digit hair. Their database may be downloaded in Excel format from their website.

1. Human Traits - Sources and Standards

Sources
The idea for this activity was inspired by Katie Ward, a superwoman science teacher from Aragon High School. Another traits survey activity for the classroom with a slightly different twist can be found
through the NASA Explores website.

Any resource list I might compile would be incomplete next to the genetics resource list created by 42Explore.

**Standards**
Grade 7
Genetics
2. A typical cell of any organism contains genetic instructions that specify its traits. Those traits may be modified by environmental influences. As a basis for understanding this concept:
c. Students know an inherited trait can be determined by one or more genes.
d. Students know plant and animal cells contain many thousands of different genes and typically have two copies of every gene. The two copies (or alleles) of the gene may or may not be identical, and one may be dominant in determining the phenotype while the other is recessive.