Teacher Guide: An Inventory of My Traits

ACTIVITY OVERVIEW

Abstract:
Students take an inventory of their own easily-observable genetic traits and compare those inventories with other students in groups. Students then make data tables and bar graphs showing the most and least common traits in their group.

Module:
Introduction to Heredity (Grades 5-7)

Key Concepts:
Traits are observable characteristics that make individuals unique. Though we may have the same traits as others, the combination of our traits makes us different. Some traits are common while others are not.

Prior Knowledge Needed:
How to properly construct and read bar graphs

Materials:
Student handouts

Appropriate For:
Ages: 10 - 12
USA grades: 5 - 7

Prep Time:
20 minutes

Class Time:
30 minutes

Activity Overview Web Address:
http://gslc.genetics.utah.edu/teachers/tindex/
overview.cfm?id=traitinventory

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I. PEDAGOGY

A. Learning Objectives
- Students will learn a number of easily observable genetic traits.
- Students will compare the traits they have with the other students in the class.
- Students will learn that some traits are common while others are not.
- Students will construct and read a data table and bar graph.

B. Background Information

Basic information students need to understand:
Physical traits are observable characteristics. While each of us shares some of our traits with many other people, our own individual combination of traits is what makes each of us look unique.

More advanced information:
Physical traits are determined by specific segments of DNA called genes. Multiple genes are grouped together to form chromosomes, which reside in the nucleus of the cell. Every cell (except eggs and sperm) in an individual's body contains two copies of each gene. This is due to the fact that both mother and father contribute a copy at the time of conception. This original genetic material is copied each time a cell divides so that all cells contain the same DNA. Genes store the information needed for the cell to assemble proteins, which eventually yield specific physical traits.

Most genes have two or more variations, called alleles. For example, the gene for hairline shape has two alleles – widow's peak or straight. An individual may inherit two identical or two different alleles from their parents. When two different alleles are present they interact in specific ways. For many of the traits included in this activity, the alleles interact in what is called a dominant or a recessive manner. The traits due to dominant alleles are always observed, even when a recessive allele is present. Traits due to recessive alleles are only observed when two recessive alleles are present. For example, the allele for widow's peak is dominant and the allele for straight hairline is recessive (Figure 1). If an individual inherits:
- Two widow's peak alleles (both dominant), their hairline will have a peak
- One widow's peak allele (dominant) and one straight hairline allele (recessive), they will have a widow's peak
- Two straight hairline alleles (recessive), their hairline will be straight.
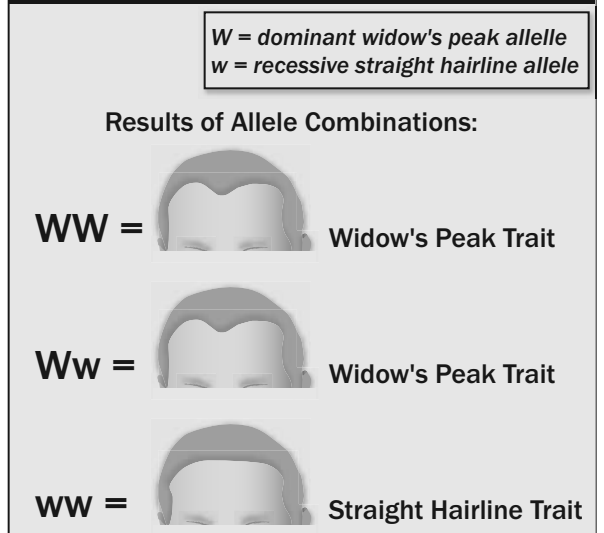
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A widespread misconception is that traits due to dominant alleles are the most common in the population. While this is sometimes true, it is not always the case. For example, the allele for Huntington's Disease is dominant, while the allele for not developing this disorder is recessive. At most, only 1 in 20,000 people will get Huntington's; most people have two recessive, normal alleles.

Most human genetic traits are the product of interactions between several genes. Many of the traits included in this activity, however, are part of the small number that may be due to only one gene (and its alleles). More information about these traits is listed below[1]. Note that scientists usually use the shorthand of a "dominant trait" rather than saying that a trait is due to a dominant allele. A pictorial reference and a description of some of the traits is available (see *Comparing Inherited Human Traits* in Additional Resources).

Figure 1: Inheritance Patterns of the Widow's Peak Trait

W = dominant widow's peak allelle
w = recessive straight hairline allele

Results of Allele Combinations:

WW =   Widow's Peak Trait

Ww =   Widow's Peak Trait

ww =   Straight Hairline Trait

- *Gender* – Females have two X chromosomes, while males have an X and a Y chromosome. Maleness is determined by a specific region of the Y chromosome (for more information see "How do chromosomes determine the gender of an individual" in the "Turner Syndrome" section of *What Can Our Chromosomes Tell Us?* (see Additional Resources). Femaleness results from the lack of this region.
- *Earlobe attachment* – Some scientists have reported that this trait is due to a single gene for which unattached earlobes is dominant and attached earlobes is recessive. Other scientists have reported that this trait is probably due to several genes.
- *Thumb extension* – This trait is reportedly due to a single gene; straight thumb is dominant and hitchhiker's thumb is recessive.
- *Tongue rolling* – Tongue rolling ability may be due to a single gene with the ability to roll the tongue a dominant trait and the lack of tongue rolling ability a recessive trait. However, many twins do not share the trait, so it may not be inherited.

[1] Unless otherwise noted, all information is from Online Mendelian Inheritance in Man (http://www.ncbi.nlm.nih.gov/omim/).

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- ***Dimples*** – Dimples are reportedly due to a single gene with dimples dominant (people may exhibit a dimple on only one side of the face) and a lack of dimples recessive.
- ***Handedness*** – Some scientists have reported that handedness is due to a single gene with right handedness dominant and left handedness recessive. However, other scientists have reported that the interaction of two genes is responsible for this trait.
- ***Freckles*** – This trait is reportedly due to a single gene; the presence of freckles is dominant, the absence of freckles is recessive[2].
- ***Hair curl*** – Early geneticists reported that curly hair was dominant and straight hair was recessive. More recent scientists believe that more than one gene may be involved.
- ***Cleft chin*** – This trait is reportedly due to a single gene with a cleft chin dominant and a smooth chin recessive.
- ***Allergies*** – While allergic reactions are induced by things a person comes in contact with, such as dust, particular foods, and pollen, the tendency to have allergies is inherited. If a parent has allergies, there is a one in four (25%) chance that their child will also have allergy problems. This risk increases if both parents have allergies[3].
- ***Hairline shape*** – This trait is reportedly due to a single gene with a widow's peak dominant and a straight hairline recessive.
- ***Hand clasping*** – Some scientists report that there may be a genetic component to this trait while others have found no evidence to support this.
- ***Colorblindness*** – Colorblindness is due to a recessive allele located on the X chromosome. Women have two X chromosomes, one of which usually carries the allele for normal color vision. Therefore, few women are colorblind. Men only have one X chromosome, so if they carry the allele for colorblindness, they will exhibit this trait. Thus, colorblindness is seen more frequently in men than in women. See the Additional Resources for a website containing color vision tests

For the purpose of this activity, students do not need to know about DNA, genes, alleles, or dominant and recessive interactions, However, this information may be helpful to you to answer some of the more advanced questions that students may have during the course of the activity. Additional information can be found in the *Basics and Beyond* section of the Genetic Science Learning Center website at http://gslc.genetics.utah.edu/units/basics/. See, in particular, *Tour of the Basics*.

[2] Rostand, J and Tétry, A . *An Atlas of Human Genetics* (1964) Hutchinson Scientific & Technical, London.
[3] "All About Allergies", The Nemours Foundation (http://kidshealth.org/parent/medical/allergies/allergy_p2.html).

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C. Teaching Strategies

1. Timeline

- One day before activity:
    - Make copies of student pages S-1, S-2, and S-3 - one per student
- Day of activity:
    - Discuss traits with students
    - Carry out activities as per the instructions on student pages S-1, S-2 and S-3

2. Classroom Implementation

- Begin by demonstrating or explaining one of the traits listed in *An Inventory of My Traits* (page S-1) and ask students who possess this trait to stand. Point out the relative numbers of students standing and sitting for the trait. Continue this process with 2-4 more traits.

    Teaching Note: A pictorial reference and a description of some of the traits highlighted in this activity is available (see Additional Resources)

- Discuss with students that traits are the observable characteristics that make each of us unique. Though some traits are common in a population (your class), the overall combination of an individual's traits makes them unique.

- Divide students into groups of four or more and have them complete *An Inventory of My Traits* (page S-1).

    Teaching Note: You may need to demonstrate or explain traits that were not discussed during the introduction.

    Teaching Note: This activity asks students to compare their own traits with the people they can see around them rather than with family members. This is in an effort to remain sensitive to the fact that not all students know or have access to biological family members with whom they can compare their traits. Also, a student may not have been told that a parent is not a biological parent.

- After students complete the *Inventory*, have them tally their group information on the *Data Table* (page S-2) and draw a bar graph (page S-3, *Graphing*).

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3. Extensions

• You may collect the traits data from the whole class by creating a large wall chart and having a representative fill in the data from each group (using tick marks for easy counting later). Once all of the data have been collected, you can have the students make a bar graph from the whole-group data, or you can make a large graph as a class.
Carry out the following activity with students to help them see that although they share traits with others in the class, their own combination of traits makes them unique.

   - Ask students to predict how many traits they would have to look at on the Inventory in order to identify any given classmate as unique.
   - Select a volunteer who would like to determine his or her uniqueness.
   - Ask all students to stand.
   - Have the volunteer say one of their traits at a time, beginning with question 1 on the Inventory and continuing in sequence. For each trait, direct all students who do not share that trait to sit down; students who share the trait remain standing. Once a student sits down, they do not get up again.
   - Continue in this way until the volunteer is the only one standing. Count the number of traits it took to distinguish the volunteer from everyone else in the class. Compare this number with the students' predictions.
   - Repeat with several additional volunteers.

• Follow this activity with the *Generations of Traits, A Tree of Genetic Traits,* and *Traits Bingo* activities (see Additional Resources).

• *Math Extension:*
Choose several of the traits listed in Table 1, below. Have students calculate the frequency of traits in the entire classroom population. Students can then compare their calculated frequencies with those for the general population.

1. List the selected traits on the chalk/white board or on large chart paper.

2. Create a Frequency table by having students place tally marks for each listed trait.

Example: **Observable Trait**	**Number of Students with Trait**
Hitchhiker's thumb	/////
Straight thumb	///// ///// ///// /
Can roll tongue	///// ///// /////
Can not roll tongue	///// /

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3. Show students how to calculate the frequency of each trait:

Number of students with the trait x 100 = _____%
Number of students in the class

Example: Hitchhiker's thumb (Class size =21)

$$\frac{5}{21} \times 100 = 24\%$$

4. Compare the frequency of traits in the classroom population with the frequency in the general population (see Table 1):

Table 1: Frequencies of traits in the general population*

Trait	Frequencies
Gender	Female – 50% Male – 50%
Thumb extension	Straight thumb – 75% Hitchhiker's thumb – 25%
Tongue rolling	Can roll tongue – 70% Can not roll tongue – 30%
Handedness	Right handed – 93% Left handed – 7%
Hand clasping	Left thumb on top – 55% Right thumb on top – 44% No preference – 1%
Color vision	Normal females – almost 100% Colorblind females – less than 1% Normal males – 92% Colorblind males – 8%

*Frequencies for traits are from Online Mendelian Inheritance In Man (http://www.ncbi.nlm.nih.gov/omim/).

4. Assessment Suggestions:
• Ask students to identify the most and least common trait in their group, or the class as a whole
• Use the bar graph (page S-3) as an assessment.

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5. Common Misconceptions:
- Students may think that they inherit traits from aunts, uncles, cousins and siblings because family members point out the resemblance between students and their relatives. However, traits can only be inherited from parents, and by extension, grandparents.
- Some students think that the most common traits are "better". In fact, these traits simply show up more frequently in the human population.
- Some students think that dominant alleles or traits are always the most common. However, the frequency with which a trait is observed depends on the frequency of the alleles for that trait in the population. A dominant trait may be quite rare, while a recessive trait may be the most common one observed.

II. ADDITIONAL RESOURCES

A. Activity Resources - linked from the online Activity Overview:
http://gslc.genetics.utah.edu/teachers/tindex/overview.cfm?id=traitinventory

- Website: *Tour of the Basics* – an animated introduction to DNA, genes, chromosomes, proteins, and inheritance
- Website: "How do chromosomes determine the gender of an individual?" in the "Turner Syndrome" section of *What Can Our Chromosomes Tell Us?*
- Website: Medline Plus Health Information – tests for colorblindness
- Teacher Guide: *Comparing Inherited Human Traits* – a pictoral reference and description of several traits
- Teacher Guide: *Generations of Traits*
- Teacher Guide: *A Tree of Genetic Traits*
- Teacher Guide: *Traits Bingo*

III. MATERIALS

A. Detailed Materials List

- Student pages S-1, S-2 and S-3 – one per student
- Writing implements (pens or pencils) – one per student
- Large chart paper (optional, for Math Extension) – one sheet

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IV. STANDARDS

A. U.S. National Science Education Standards
<u>Grades 5-8</u>:
• Content Standard A: Science As Inquiry - Abilities Necessary To Do Scientific Inquiry; use appropriate tools and techniques to gather, analyze and interpret data.
• Content Standard C: Life Science - Reproduction and Heredity; every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from on generation to the other.
• Content Standard C: Life Science - Reproduction and Heredity; the characteristics of an organism can be described in terms of a combination of traits.

B. AAAS Benchmarks for Science Literacy
<u>Grades 3-5</u>:
• The Living Environment: Heredity - some likenesses between children and parents, such as eye color in human beings, or fruit or flower color in plants, are inherited.
<u>Grades 6-8</u>:
• The Human Organism: Human Identity - human beings have many similarities and differences.

C. Utah Elementary Science Core Curriculum - Grade 5
Intended Learning Outcomes:
Students will be able to:
1. Use Science Process and Thinking Skills
    a. Observe simple objects, patterns, and events and report their observations.
    b. Sort and sequence data according to the criteria given.
    d. Compare things, processes, and events.
4. Communicate Effectively Using Science Language and Reasoning.
    a. Record data accurately when given the appropriate form (e.g., table, graph, chart).
    b. Describe or explain observations carefully and report with pictures, sentences, and models.
    e. Use mathematical reasoning to communicate information.

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Standard V: Students will understand that traits are passed from the parent organisms to their offspring, and that sometimes the offspring may possess variations of these traits that may help or hinder survival in a given environment.
Objective 1: Using supporting evidence, show that traits are transferred from a parent organism to its offspring.
a. Make a chart and collect data identifying various traits among a given population.

V. CREDITS

Activity created by:
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This activity was adapted from: "Alike But Not The Same" in *Human Genetic Variation*, NIH Curriculum Supplement Series (1999). Available at http://science-education.nih.gov/customers.nsf/highschool.htm.

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An Inventory of My Traits - Survey

How similar are you to others in your group? Complete this inventory and compare with the inventories of the people in your group.

1. I am a: ☐ Male ☐ Female

2. I have detached earlobes ☐ Yes ☐ No

3. I have hitchhiker's thumb ☐ Yes ☐ No

4. I can roll my tongue ☐ Yes ☐ No

5. I have dimples ☐ Yes ☐ No

6. I am right-handed ☐ Yes ☐ No

7. I have freckles ☐ Yes ☐ No

8. I have naturally curly hair ☐ Yes ☐ No

9. I have a cleft chin ☐ Yes ☐ No

10. I have allergies ☐ Yes ☐ No

11. I have a widow's peak ☐ Yes ☐ No

12. I cross my left thumb over my right when I clasp my hands together. ☐ Yes ☐ No

13. I can see the colors red and green (I am not color blind) ☐ Yes ☐ No

An Inventory of My Traits - Data Table

Once you and your group have compared your traits, fill in the data table below by counting the number of people who marked "yes" and the number people who marked "no" for each trait. Write these numbers in the spaces provided.

TRAIT	YES	NO
Detached earlobes		
Hitchhiker's thumb		
Tongue rolling		
Dimples		
Right-handed		
Freckles		
Naturally curly hair		
Cleft chin		
Allergies		
Widow's peak		
Cross left thumb over right		
See the colors red and green		

Name_____ Date_____

An Inventory of My Traits - Graph

Make a bar graph showing how many people in your group answered "yes" for each trait. Be sure to label each trait under the bar you draw for it.

# of students

6

5

4

3

2

1

Trait