Trina Allen Tienne Myers Cheryl Spencer July 25, 2006
Biology 501

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Lesson Plan: GENOTYPE AND PHENOTYPE

Pacing
Two 45- minute class periods

RATIONALE:

According to the National Science Education Standards, (NSES, pg. 155-156), " In the middle-school years, students should progress from studying life science from the point of view of individual organisms, to recognizing patterns in ecosystems and developing understandings about the cellular dimensions of living systems."

Some aspects of middle-school student understanding should be noted. This period of development in youth lends itself to human biology. Now is the time to begin the study of genetic traits (i.e. what offspring get from parents). **The topic of the lesson is: Genotype and Phenotype**. This topic can be addressed as a natural part of the study of human reproduction. Concerning **heredity**, younger middle-school students tend to focus on observable traits, and older students have some understanding that genetic material carries information. "By the end of the eighth grade, students should know that … in organisms that have sexes, typically half of the genes come from each parent." (Benchmarks for Science Literacy- Project 2061 pg. 108)

PURPOSE

The purpose of this activity is to further student understanding of how genotype translates into phenotype as they build and then examine the traits of a new population of offspring. This will be achieved by simulating genetic inheritance through modeling. Research has shown that meaningful hands on inquiry-based lessons are a more effective method of achieving scientific literacy. Students often hold onto misconceptions about inheritance, even after instruction. Some of the misconceptions addressed by this activity include:

- Many students believe that traits are inherited from only one parent.
- Many students believe that recessive traits are rare and

dominant traits are more common.

AUDIENCE

This lesson is designed for middle school students in grades 6-8. It should be used with groups of 3-4 students. Students are familiar with the scientific method and should apply that knowledge to this model-making lab. Inclusion strategies can be adapted for English language learners, learning disabled, attention deficit disorder, developmentally delayed, as well as students at the advance level.

CONTEXT

Prior Knowledge

These are the topics that should be covered prior to this lab activity

- The relationship between traits and heredity
- The experiments of Gregor Mendal
- The difference between dominant and recessive traits
- How genes and alleles are related to genotypes in offspring
- Constructing and interpreting a Punnett square.
- How probability can be used to predict possible genotypes in offspring.

Subsequent Lessons

These are the topics that should follow the activity:

- The difference between mitosis and meiosis.
- How chromosomes determine sex.
- Why sex-linked disorders occur in one sex more often than in the other.
- Interpret a pedigree

ENDURING UNDERSTANDING:

- Students understand that every organism has a set of genetic instruction that determines its inherited traits.
- We can understand biological phenomena by analyzing them at multiple levels from the molecular to the population level.

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Essential Questions

Some people have brown eyes, some have blue, and some have green. Some people have earlobes attached directly to their head, while others have earlobes that hang loose.

- Where do people get their different traits?
- How are traits passed from one generation to the next?
- How does genotype influence phenotype?

Students will record their initial thoughts in their Science Journals with the expectation that they will revisit these questions at the conclusion of the lesson.

Major Concepts: These are some of the fundamental concepts related to this activity that students should know.

- Traits are inherited characteristics of an organism.
- Heredity is the passing of traits from one generation to another.
- Genetics is the study of how traits are passed from parent to offspring.
- Genotype is the genetic makeup of an organism.
- Phenotype is the physical appearance of an organism.
- Allele is one pair of genes that determine a specific trait.
- Phenotype is the result of genotype

Standards Addressed

NATIONAL STANDARDS

Unifying Concepts and Processes (UCP)
UCP 1. Systems, order, and organization.
UCP 2. Evidence, models, and explanation

Science As Inquiry (SAI)
SAI 1. Abilities necessary to do scientific inquiry
SAI 2. Understandings about scientific inquiry

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Life Science Content Standards (LS)

LS 2c. Every organism requires a set of instructions for specifying its traits. Heredity is the passage of these instructions from one generation to another.

LS 2e. The characteristics of an organism can be described in terms of a combination of traits.

STATE STANDARDS

Biological Science

3.3.7 C Know that every organism has a set of genetic instructions that determines its inherited traits.

OBJECTIVES:

1. Explain how genes and alleles are related to genotypes and phenotypes.
2. Distinguish between dominant and recessive traits.

INSTRUCTIONAL STRATEGIES

Teacher Preparation

Prepare 14 small paper bags to represent paired parent alleles for each of seven characteristics as follows:

Characteristics: antennae color, body segments, tail shape, legs, nose color, foot color, and number of eyes.

1. Label each pair of bags with one of the seven characteristics. For each characteristic, label one bag "Mom" and the other bag "Dad" (e.g. tail shape-Mom, tail shape-Dad).
2. Use the table labeled Genotype and Phenotype, located on the Bug Builders Data Sheet, to decide the genotype of each parent. For example, the dad has green antennae, which is a recessive trait (rr). Therefore his antennae bag should only contain alleles with "r".
3. Cut 1 inch squares of paper to represent alleles. Use seven colors of paper – a different color for each characteristic. Cut enough squares so that each student will receive two alleles for each trait.

4. Label half of the paper squares for each characteristic with capital letters to indicate dominant alleles. Label the other half with lower case letters to indicate recessive alleles.
5. Place an equal number of alleles into each bag according to parent genotype.

Safety Caution: Students should review all safety cautions before beginning this activity. Students should use caution with toothpicks, push pins, map pins, and should not eat any of the materials used.

LESSON

Day 1

Engage 15 minutes

Ask students to notice the differences in eye color, hair color, and earlobes among their classmates. Have them count the number of students with each trait and record the results in their science journals using a data table for each trait. The tables for eye color and earlobes will each have two columns. Have students calculate the ratios of attached to unattached earlobes and brown to blue eyes. Students may have eyes that are a color other than blue or brown, and this could be noted in a third column. Have the class discuss the results. (Note: A class of students is not a scientific sample and may not yield statistically significant results.)

Explore

Question for students: If there are two forms of each of the seven traits, how many possible combinations are there? Students record question and answers in their journals.

Model-making lab –please refer to lab activity sheets
Students will complete steps 1-5 (refer to lab activity sheet)

Day 2

Model-making lab –please refer to lab activity sheets
Students will continue at step 6 to construct offspring and complete analyze section of the activity sheet.

EXTENSION LESSON

(Several days so students have time to complete their surveys).

Design Your Own**,** "Tracing Traits," Students trace an inherited trait through their own family or another family and determine how the trait passed from generation to generation. Students gather data from family members and construct a pedigree to show that data. Both inquiry labs and the data sheets can be used as an assessment tool for grading.