

## Body Blueprints : The Basics of Heredity

### Description

Investigate the basics of heredity and discover how the genes you inherited from your parents determine much of who you are. Review the structure of DNA to see how genetic information is organized. Find out which students have dominant or recessive traits by conducting experiments with your class. Museum specimens from our Hamann-Todd Human Osteological Collection (the world's largest documented collection of modern human skeletal remains!) will be used to illustrate how our concepts of human taxonomy have changed since the advent of DNA technology.

**NOTE:** A small packet of P.T.C. (phenylthiocarbamide) taste papers will be sent to you for use during our connection.

### Objectives

- Identify cells as the basic unit of life, and deoxyribonucleic acid as the molecule within a cell nucleus that provides the instructions for life processes.
- Describe the characteristics of an organism in terms of a combination of inherited traits.
- Understand that in sexual reproduction an egg and sperm cell unite, with some traits being inherited from each parent, so the offspring is not identical to either parent.
- Recognize that similarity between parent and offspring can be either inherited or learned.
- Use a Punnett Square to predict possible inherited traits in offspring.

### Ohio's Learning Standards

**Grade 6:** Life Science- Cellular to Multicellular

- Cells are the fundamental unit of life.
- All cells come from pre-existing cells.
- Cells carry on specific functions that sustain life.

**Grade 8:** Life Science- Species and Reproduction

- The characteristics of an organism are a result of inherited traits received from parent(s).

### National Health Education Standards

**Grade 6-8:** Standard 1

- Students will comprehend concepts related to health promotion and disease prevention to enhance health.

## Before Your Program & How to Set Up Your Room

- Arrange your room so all students can see and hear us clearly during the connection.
- A small packet of P.T.C. (phenylthiocarbamide) taste papers will be sent to you for use during our connection. Your museum educator will tell you when to pass these papers out to the class.
- Print a copy of the attached “Genes, Traits, Alleles, and Inheritance” handout for each student—we will be using it during the connection to test some student traits!

## Vocabulary

**allele** - alternative form of a gene.

**cell** - the basic structural and functional unit of all living things; they may exist as independent units of life, such as bacteria, or may form colonies or tissues as in higher plants and animals.

**chromosome** - a packet of tightly wound DNA found within a cell nucleus.

**deoxyribonucleic acid (DNA)** - the material found primarily in a cell’s nucleus that carries the instructions for making all the structures and functions of an organism.

**diploid** - cells containing two copies of each chromosome, one from each parent organism.

**dominant** - an allele that expresses itself even when heterozygous. Also the trait controlled by that allele.

**gene** - a section of DNA that determines an inherited characteristic.

**genetics** - the field of science that looks at how traits are passed down from one generation to another, through the genes.

**genotype** - the genes that an organism possesses.

**heredity** - the transmission of characteristics from parent to offspring, by means of their genes.

**heterozygous** - having different alleles for a particular gene.

**homozygous** - having same alleles for a particular gene.

**nucleotide** - subunits that join together in long chains to make DNA, known as adenine (A), cytosine (C), guanine (G), and thymine (T).

**nucleus** - central part of a cell that contains chromosomes; control center of the cell.

**phenotype** - observable traits of an organism that may be determined by genes, environment or a combination of both.

**Punnett square** - a diagrammatic representation of cross breeding used to predict the probable offspring of a set of parents.

**recessive** - an allele that is not expressed in the heterozygous condition. Also the trait controlled by that allele.

**trait** - a distinguishing characteristic or feature.

## Extension Activities

- 1) After our program, you can use the attached “Genes, Traits, Alleles, and Inheritance” handout to continue classroom observations of students’ features. It’s fun to ask the class if anyone has unusual physical abilities, like super-flexible joints (and let them demonstrate!). Have the class do some research on traits like these, and whether they have been determined to be genetic or environmentally linked.
- 2) **“Make-A-Baby” Punnett Square Activity.**
  - a. Each student needs two pennies, a piece of paper, and a pencil.
    - i. Have the class brainstorm a list of traits for humans. You can use some from our provided worksheets, or have fun inventing silly ones. Write this master list on the board. An example could be “free ear lobes vs. attached ear lobes”.
    - ii. Determine which of your traits are dominant or recessive. Mark each one on the board so all the students are using the same rules of genetic inheritance for their ‘babies’.
  - b. Have the students now draw their ‘baby’ by going down the list of traits and determining which one their baby inherits by flipping their pennies. Heads = dominant, Tails = recessive. Remind them that the only way their babies can express a pure recessive trait is by having both pennies land tails-up.

## Online Resources for Teachers and Students

Click the link below to find additional online resources for teachers and students. These websites are recommended by our Museum Educators and provide additional content information and some fun activities to share with your class.

CMNH Educators regularly review these links for quality. Web addresses often change so please notify us if any links have issues.

Cleveland Museum of Natural History <https://cmnh.org/edlinks>

## Genes, Traits, Alleles and Inheritance

Genes are sections of DNA that code for proteins. Proteins then combine to make traits that we can observe. Like many organisms, humans have two copies of DNA molecules in their cells. One copy comes from the male parent, and one copy comes from the female parent.

There can be many different versions, or *alleles*, of the same gene, but only one of these versions in any given pair of genes will turn on to signal production of the protein for that trait. The process that determines which allele gets expressed is called *dominance*.

Dominant alleles are commonly denoted using capital letters, such as “H” for curly hair, while a matching lower case letters represents recessive alleles, e.g. “h” for straight hair. Alleles that are dominant will be expressed whenever they are present in a pair, so “HH” and “Hh” gives curly hair, while recessive versions of genes signal protein production only when paired with a matching recessive allele for that trait, or “hh” for straight hair.

Geneticists use knowledge of dominance and gene variation to study how traits are passed on from parents to offspring. This is called *inheritance*.

### Our Favorite Genes

This table lists several human traits that have dominant and recessive alleles. Use this information to find out who has dominant and/or recessive traits.

Trait	Dominant	Recessive
Hair curl	Curly	Straight
Hair whorl on crown of head direction	Clockwise	Counter-clockwise
Roll tongue	Can roll tongue	Can't roll tongue
Hairline	Widow's peak	No widow's peak
Facial dimples	Facial dimples	No facial dimples
Ability to taste PTC	Able to taste PTC	Unable to taste PTC
Earlobe shape	Earlobe hangs, free lobe	Earlobe attaches at base
Hair on mid-digit of fingers	Have mid-digital hair	No mid-digital hair
Bent end of thumb when extended	No bend when extended	Bends when extended, “Hitchhiker's thumb”
Little finger bends to middle when extended	Bent tip of little finger	Straight tip of little finger
Shape of chin	Cleft chin	No cleft chin
Eyebrow size	Broad brows	Slender eyebrows
Eyebrow shape	Separated eyebrows	Joined eyebrows
Shape of eyes	Almond eyes	Round eyes
Freckles	Freckles	No freckles
Position of thumb when interlocking fingers	Left thumb on top of interlocking fingers	Right thumb on top of interlocking fingers