

# Teddy Bear Genetics

**Grades:** 9<sup>th</sup>-12<sup>th</sup>

**Duration:** 90 minutes

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## Program Description

Become a genetic counselor and develop a pedigree for a population of bears using Mendelian genetics.

### Grade 9-12 Science and Inquiry

1. Write a testable question or hypothesis when given a topic (SI-H-A1)
2. Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)
5. Utilize mathematics, organizational tools, and graphing skills to solve problems (SI-H-A3)
7. Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4)
14. Cite examples of scientific advances and emerging technologies and how they affect society (e.g., MRI, DNA in forensics) (SI-H-B3)

### Math

#### Grade 9

30. Use simulations to estimate probabilities (D-3-H) (D-5-H)
31. Define probability in terms of sample spaces, outcomes, and events (D-4-H)

#### Grade 10

21. Determine the probability of conditional and multiple events, including mutually and non-mutually exclusive events (D-4-H) (D-5-H)

### Biology

8. Describe the relationships among DNA, genes, chromosomes, and proteins (LS-H-B1)
9. Compare mitosis and meiosis (LS-H-B2)
10. Analyze pedigrees to identify patterns of inheritance for common genetic disorders (LS-H-B3)
11. Calculate the probability of genotypes and phenotypes of offspring given the parental genotypes (LS-H-B3)

### Key Terms:

**Allele** — Alternative forms of a gene for each variation of a trait of an organism

**Diploid** — Cell with two of each kind of chromosome; is said to contain a diploid, or  $2n$ , number of chromosomes

**Dominant** — Observed trait of an organism that mask the recessive form of a trait

**Egg** — Haploid female sex cell produced by meiosis

**Fertilization** — Fusion of male and female gametes

**Gamete** — Male and female sex cells, sperm and eggs

**Gene**— The fundamental physical and functional unit of heredity, which is made up of a sequence of nitrogenous bases that code for a specific protein structure.

**Genetics**— Branch of biology that studies heredity

**Genetic Counseling**— Aims to facilitate the exchange of information regarding a person's genetic legacy. It attempts to:

- accurately diagnose a disorder
- assess the risk of recurrence in the concerned family members and their relatives
- provide alternatives for decision-making
- provide support groups that will help family members cope with the recurrence of a disorder

**Genotype** — Combination of genes in an organism

**Gregor Mendel**—An Augustinian abbot who is often called the "father of genetics" for his study of the inheritance of traits in pea plants. Mendel showed that the inheritance of traits follows particular laws, which were later named after him.

**Haploid** — Cell with one of each kind of chromosome; is said to contain a haploid or  $n$ , number of chromosomes.

**Heredity** — Passing on of characteristics from parents to offspring

**Heterozygous** — When there are two different alleles for a trait

**Homologous Chromosome** — Paired chromosomes with genes for the same traits arranged in the same order.

**Homozygous** — When there are two identical alleles for a trait

**Hybrid** — Offspring formed by parents having different forms of a specific trait.

**Law of independent assortment** — Mendelian principle stating genes for different traits are inherited independently of each other.

**Law of Segregation** — Mendelian principle explaining because each plant has two different alleles, it can produce two different types of gametes. During fertilization, male and female gametes randomly pair to produce four combinations of alleles

**Meiosis** — Type of cell division where one body cell produces four gametes, each containing half the number of chromosomes in a parent's body.

**Phenotype** — Outward appearance of an organism, regardless of its genes

**Punnett Square**—Chart which shows/predicts all possible gene combinations in a cross of parents (whose genes are known). Punnett squares are named for an English geneticist, Reginald Punnett.

**Recessive** — Trait of an organism that can be masked by the dominant form of a trait

**Sexual Reproduction** — Pattern of reproduction that involves the production of subsequent fusion of haploid cells.

**Sperm** — Haploid male sex cells produced by meiosis

**Trait** —Characteristic that is inherited; can be either dominant or recessive

**Zygote** — Diploid cell formed when a sperm fertilizes an egg.

## Connections to Permanent Exhibits:

**Genetic Traits:** This exhibit describes nine genetic traits. What form of each of these traits do you have?

**Check Your Prints:** Examine your fingerprints under a microscope and compare them to common forms.

**DNA-The Language of Life:** Where is DNA found and what shape does it have?

## Web Resources:

### Activity Exchange/Activities-To-Go

Access Excellence

<http://www.accessexcellence.org/AE/ATG/>

Activities-To-Go is a place for all science teachers to share innovative, successful teaching strategies and activities to help students learn the concepts and processes of the life sciences. You may UPLOAD an activity, or do a search by Keyword, Grade Level, Subject and Special Categories, or National Science Education Standards (NSES)

### DNA from the Beginning

Cold Spring Harbor Laboratory &

Dolan Learning Center

<http://www.dnafb.org/dnafb/>

This website is organized around the key concepts of classical genetics, molecules of genetics and genetic organization and control. The science behind each concept is explained by: animation, image gallery, video interviews, problems, biographies, and links to topics.

### Easter Egg Genetics

Access Excellence

<http://www.accessexcellence.org/AE/ATG/data/released/0256-AnneBuchanan/index.html>

This is an example of an activity found on the Access Excellence site. This activity reinforces using Punnett squares to determine genotype and phenotype.

### National Human Genome Research Institute

National Institutes of Health

<http://www.genome.gov/Education/>

This website has a multitude of resources including downloadable videos, pamphlets and activities about the human genome project.

### Reproduction and Heredity

State of Utah Office of Education

<http://www.usoe.k12.ut.us/curr/science/sciber00/7th/genetics/sciber/intro.htm>

This site has a number of genetic activities including genetic terminology, animations on mitosis and meiosis, and a DNA quiz.

### The Biology Project Human Biology

The University of Arizona

[http://www.biology.arizona.edu/Human\\_Bio/human\\_bio.html](http://www.biology.arizona.edu/Human_Bio/human_bio.html)

On this website there is a genetic counseling activity, information about spectral karyotypes, and an activity where students use a family study to learn the concepts and techniques behind DNA profiling, interpret DNA autoradiograms,

### Learn.Genetics-Genetic Sciences Learning Center

The University of Utah

<http://learn.genetics.utah.edu/units/basics/index.cfm>

This website provides students and teachers a tour of the basic information about genetics on a cellular level. It also has activities for building DNA and understands the processes of transcription and translation. There is an activity where students use a DNA to solve a mystery and Explore RNA's roles as an information molecule and biological catalyst. This unit contains an online introduction and detailed PDF monograph.

## Pre-Visit Activities

## Post-Visit Activities