

# DNA and Genetics

Grade Levels: 6-12

Duration: 90 min

Design a robust learning experience by selecting resources from this guide that fit the needs of your students. Reinforce learning before, after, and even during your visit by diving deeper into some of the science and engineering concepts.

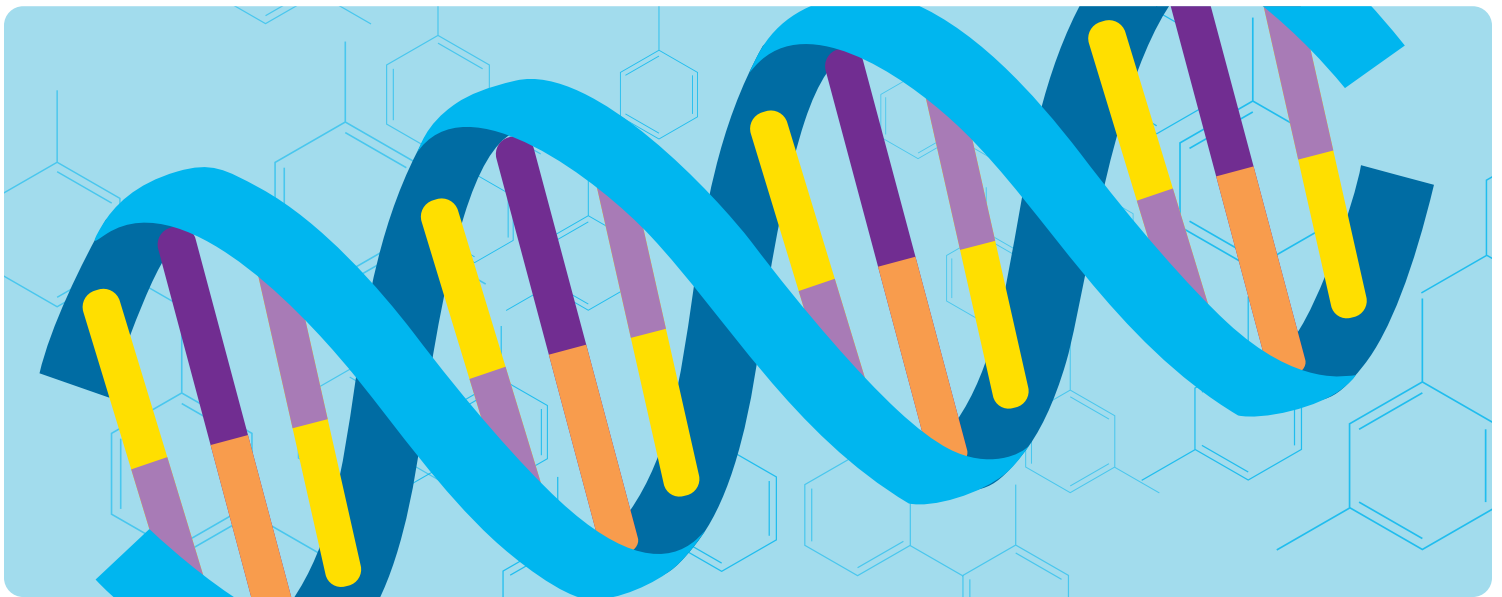


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## When to implement

The following icons indicate when resources should be implemented for the greatest benefit to your students' experience in the lab.

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### Concepts/Skills

DNA sequence, genotype, phenotype, structure and function, cause and effect

### Objectives

Students will:

- Provide evidence that living things are made of cells by examining prepared slides of human and animal cells.
- Understand how some human traits are determined by DNA sequence, and explain the correlation between phenotype and genotype.

## Vocabulary

These are words and concepts that we will discuss in the lab. Your students' experience will be enhanced if they are familiar with these terms prior to your visit. If you need inspiration for vocabulary activities, please see our Vocabulary Choice Board activity.

Term	Definition
<b>Allele</b>	An alternate form of the same gene or same genetic locus (location of specific gene).
<b>Cell</b>	The basic structural unit of all organisms.
<b>Chromatin</b>	A complex of DNA and protein found within the nucleus of a cell — condenses to form chromosomes.
<b>Chromosome</b>	Compact transportable structures composed of chromatin.
<b>Dominant</b>	One of a pair of alternative alleles that masks the effect of the other when both are present in the same cell.
<b>DNA (deoxyribonucleic acid)</b>	The genetic material of living organisms; makes up chromosomes of each cell; the “blueprint” or “recipe” for life.
<b>DNA Sequence</b>	The exact order of the 4 bases (A, T, G, C) in a given DNA template
<b>Gene</b>	The basic physical unit of heredity.
<b>Genotype</b>	The genetic make-up of an individual with particular emphasis on a particular gene (i.e., XX is the genotype for a female).
<b>Nucleus</b>	A large, membrane-bound structure within a living cell, containing the cell's hereditary material and controlling its metabolism, growth and reproduction.
<b>Phenotype</b>	The physical outcome/presentation of a genotype with emphasis on a particular gene. (Female is the phenotype for the genotype XX).
<b>Phospholipid bilayer</b>	A semi-permeable, two-layer membrane that comprises the cell membrane.
<b>Punnett Square</b>	A diagram used to predict the outcome and probability of genotype and phenotype of a breeding experiment.
<b>Recessive</b>	One of a pair of alternative alleles whose effect is masked by the activity of the second when both are present in the same cell.
<b>Trait</b>	A genetically determined characteristic or condition, like hair-color, dimples or sex.

## Related Texts

The following titles may provide students with a greater contextual understanding of the field of chemical preservation and give additional opportunities to incorporate science and engineering into Language Arts lessons. We are not endorsing the following authors but feel that the information presented in these texts may benefit your students and enhance their learning experience.

Age Range	Title and author	Text Type	Description
<b>Grades 9-12</b>	"The Stuff of Life: A Graphic Guide to Genetics and DNA" Mark Schultz.	Narrative	This entertaining comic book provides an in-depth introduction to the history of and science of genetics.
<b>Grades 5-8</b>	"Science Quest: Double Helix: The Quest to Uncover the Structure of DNA" Glen Phelan	Reference	A brief but informative view of the quest to understand the structure of DNA. It traces the story from Gregor Mendel and his pea plants to Crick and Watson.
<b>Grades 2-6</b>	"Have a Nice DNA (Enjoy your Cells)" Frank Balkwill and illustrated by Mic Rolph	Reference	One in a series of books that uses a unique brand of simple but scientifically accurate commentary and colorful graphics to lead readers on an exploration of the world of cells, proteins and DNA.
<b>Grades 7-12</b>	"The Genomics Age" Gina Smith	Reference	The book explores the recent leaps in the understanding of DNA through the use of scientifically informative, yet easy-to-understand plain English. It covers how discoveries in the field of DNA and genetics might change our lives and investigates the social, moral and ethical questions that accompany topics such as anti-aging, stem cell research, and "designer" babies. Easily select chapters for study or read the whole thing.
<b>Grades 9-12</b>	"How to Clone a Mammoth: The Science of De-Extinction" Beth Shapiro	Reference	Could extinct species, like mammoths and passenger pigeons, be brought back to life? The science says yes, and Beth Shapiro shows you how. This is the science behind engineering extinct traits from the genetic "blueprints" collected and mapped from remains.

## Exhibit Connections

Use this section to make connections between learning from the lab and exhibits and programs found in The Tech Interactive's galleries.



### BioDesign Studio

BioDesign Studio engages guests in interactive exhibits that spark imagination and confidence with the burgeoning fields of synthetic biology, bioengineering, biological design and DIY biology.



### Engineer Bacteria Color Factories

At Living Colors Lab, students will use lab techniques to insert specially engineered DNA into safe E.coli bacteria, which will promote the bacteria to produce different colors under certain circumstances. Students will have the opportunity to see DNA in action and how it can be used to engineer specific results. The techniques used in this activity are very similar to those that are used in science labs to produce insulin from non-human cell cultures.

Check out our fish tank in the BioDesign prep lab! It houses GloFish which, like the bacteria in Living Colors Lab, have had their DNA engineered to produce fluorescent colors.



### Play with the Building Blocks of Life

At Creature Creation Station, students use digital building blocks that represent the three basic parts of DNA: a gene (what), RBS (how much), and a promoter (when). DNA pieces must be put together in the correct sequence (when-how much-what) or the DNA doesn't "work" to create the creature. Once released the creature interacts with other creations to go about its functions.

How many different combinations of DNA blocks can you create? Even with limited DNA blocks, there are many possible combinations to create new creatures!





## Lab-Related Activities



The following activities can be implemented either before or after the lab and are meant to bridge the learning from the lab to the classroom.

Activity	Description	Time
<b>Dino DNA</b> 	Through this activity, pairs of students will play with dominant and recessive alleles to create a new creature.	45-50 minutes
<b>Evolutionary Puzzles</b> 	This lesson uses problem-solving and logical thinking to introduce students to phylogenetic trees. Students will create, organize, and structure data to explore patterns of heredity.	60 minutes



Looking for other hands-on activities and resources to use in your classroom? Check out our [education resources](#) page!



## Writing Prompts



The following writing prompts and questions are just a few examples of journal topics you can use to incorporate writing into your students' lab experience. These prompts can be used in conjunction with any classroom writing journal.

### Pre-visit prompts



- What is your favorite thing about yourself (personality, laugh, sense of humor, physical trait, etc.)? Do you think this is a genetic trait? Why? Do you see this trait in your parents? Siblings? Grandparents?
- If someone in your family was diagnosed with a genetic disease, would you have a genetic test to see if you could get the same disease? Why or why not?

### Post-visit prompts

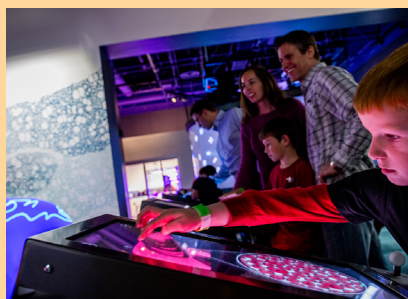


- Since we now have the technology to use genetic fingerprinting to catch criminals, should we make every U.S. resident provide a blood sample for genetic fingerprinting to the government, making it easier to catch criminals? Write one paragraph explaining why this should happen and one paragraph explaining why this should not happen.
- All humans share approximately 99.9% of the same DNA. If we share this much, why do you think all people aren't more alike? Explain.

## Next Generation Science Standards

DNA and Genetics supports the following NGSS:

Grades	Life Sciences	Disciplinary Core Ideas	Crosscutting Concepts	Science and Engineering Practices
<b>Grade 6-8</b>	MS-LS1-1 MS-LS1-3	LS1.A LS3.A LS3.B	Structure and Function Cause and Effect	2, 3
<b>Grades 9-12</b>	HS-LS1-1 HS-LS3-1 HS-LS3-3	LS1.A LS3.A LS3.B	Structure and Function	2, 3



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