GRADES 6–8

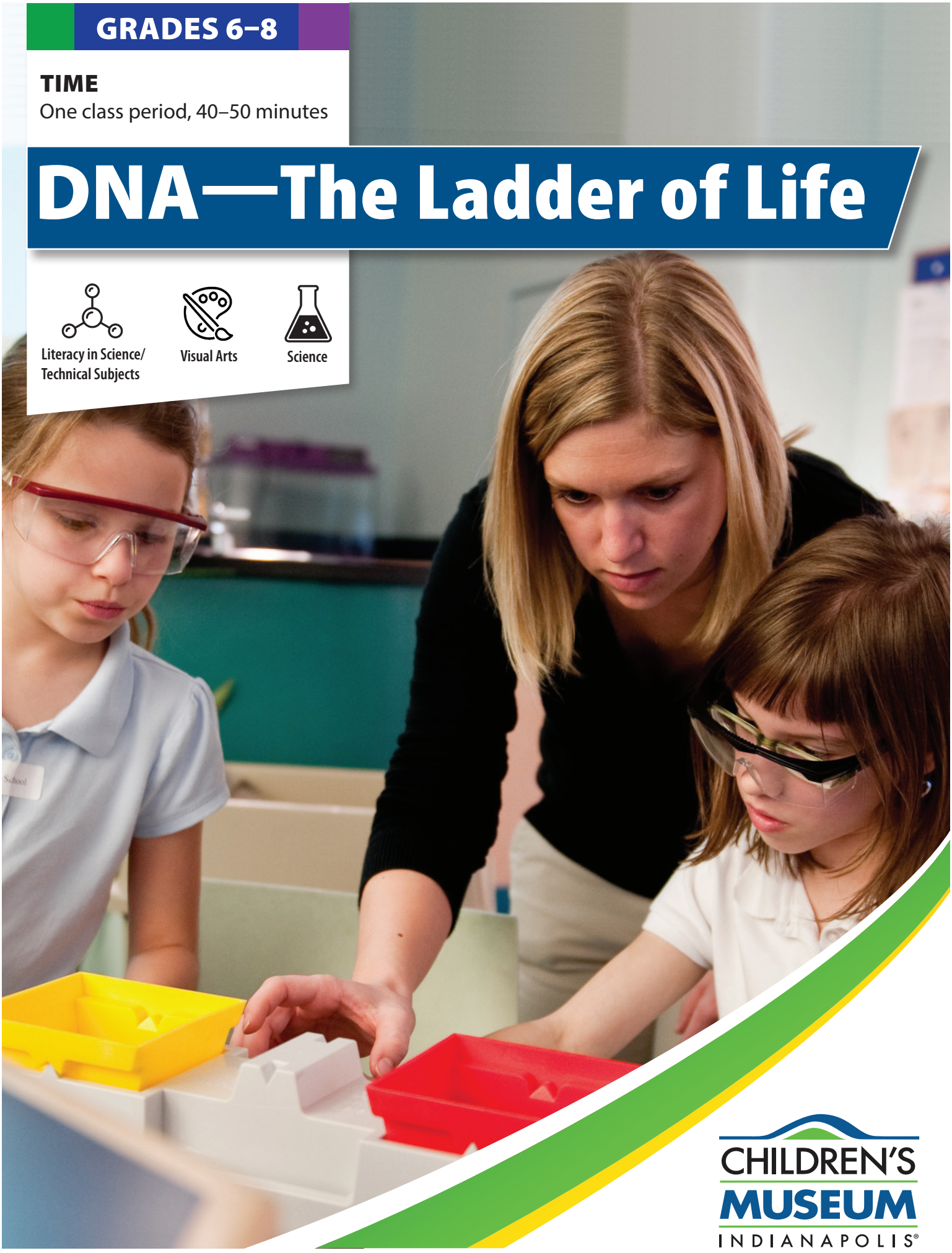
TIME
One class period, 40–50 minutes

DNA—The Ladder of Life

Literacy in Science/ Technical Subjects

Visual Arts

Science



CHILDREN'S MUSEUM INDIANAPOLIS®

DNA—THE LADDER OF LIFE

The Children's Museum's lessons are designed to weave creative space experiences and museum education together. All lessons are interdisciplinary and can be used asindividual creative space experiences or in combination to create a cohesive unit. Lessons are optimized when used in connection with museum field trips.

This lesson models the DNA molecule and how it controls life. Participants identify the DNA bases adenine, thymine, guanine, and cytosine. Participants create a DNA model using pasta to show how these four bases form base pairs. The tools and scientific processes participants use in this lesson can be found in The Children's Museum ScienceWorks gallery. Participants use all five senses as well as technology, chemistry, math, and other tools to help them study, record, and analyze their observations in the world-class STEMLab and SciencePort. Learn more about our resources at childrensmuseum.org.

INDIANA ACADEMIC STANDARDS

Literacy in Science/Technical Subjects:
8.LST.3.1, 6-8.LST.4.1, 6-8.LST.7.1

Visual Arts: VA:Re7.1.3a, VA:Re.7.1.4a, VA:Re7.1.5a, VA:Re8.1.3a, VA:Re8.1.4a, VA:Re8.1.5a

Science: Engineering 3-5.E.1
Physical Science: 5.PS

OBJECTIVES

Participants will:

- Define DNA
- Use basic materials to make a model of DNA
- Understand the basic design of a DNA strand
- Discover how DNA plays a role in genes

FOCUS QUESTIONS

- What is DNA made of? How do we know this?
- Where is DNA found in the cell?
- What makes each of us unique?
- Why are we different from each other but similar to our parents?

MATERIALS

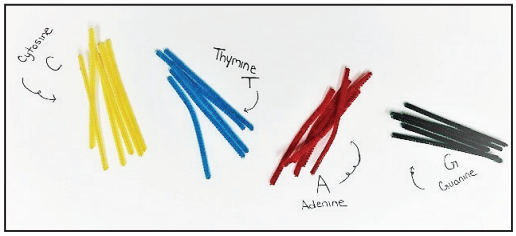
- Multiple colors of pipe cleaners
  - Pipe cleaners of four different colors (5 to 10 each of red, blue, green, yellow) cut into 5-inch pieces and separated into buckets by color, per participant
  - 2 long white pipe cleaners for the sides, per participant
- 2 thick wooden sticks, per participant
- 1 box of dry wagon wheel pasta
- 1 box of dry penne pasta

Decoding DNA

PROCEDURES

- Write the code 4-5-15-24-25-18-9-2-15-14-21-3-12-5-9-3-1-3-9-4 on the board and challenge participants to decode the numbers using the alphabet sequence with A=1, B=2, C=3 and so on. (The code spells **deoxyribonucleic acid**.)
- Elicit from participants what they know about DNA. Explain that DNA code is like a blueprint for each living thing. Sequences of **genes** formed by **base pairs** in our DNA carry our genetic code in chromosomes. The specific combination of the base pairs determines who, how, or what something is. Show participants a model of a DNA strand and read the information in the sidebar titled "The ABCs of DNA."
- Emphasize that DNA is a double-stranded helix. It is like a twisted ladder. Provide participants with the key:

  A = **adenine** = red
  T = **thymine** = blue
  G = **guanine** = green
  C = **cytosine** = yellow



** Remind participants of the following rule: A pairs with T, and G pairs with C.*

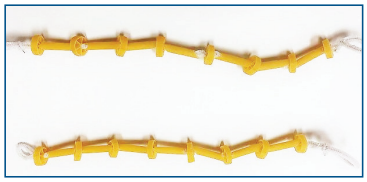
- Guide participants through the procedure outlined below.

ADULT TIPS

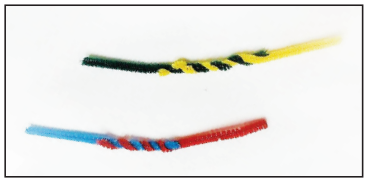
DNA Facts

- The sequences formed by the base pairs in our DNA carry our genetic code in chromosomes.
- We are each unique because of individual variations in the sequence of the base pairs.
- There are millions of different combinations that can be made using only four base pairs.
- The DNA models created in class are many, many times larger than a real DNA strand.
- A human DNA strand is approximately 6 feet long, but it is so small and tightly coiled that it can fit inside the nucleus of a single cell.

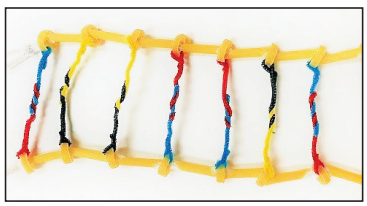
1 Direct participants to construct a DNA strand using eight wagon wheel and seven penne pasta pieces on each side. Distribute two large white pipe cleaners to each participant and explain that they represent the two sides (sugar phosphate backbone) of a DNA strand.



2 Draw participants' attention to the four buckets containing red, blue, green, and yellow pipe cleaners. Instruct participants to connect the coordinating colors together to create base pairs.



3 Tell participants to attach the ends of the base pairs to the wagon wheels directly across from each other.



4 Ensure participants have attached a dowel to the top and the bottom of the strand. After DNA models have been created successfully, participants can twist their dowels to show a **double helix**.

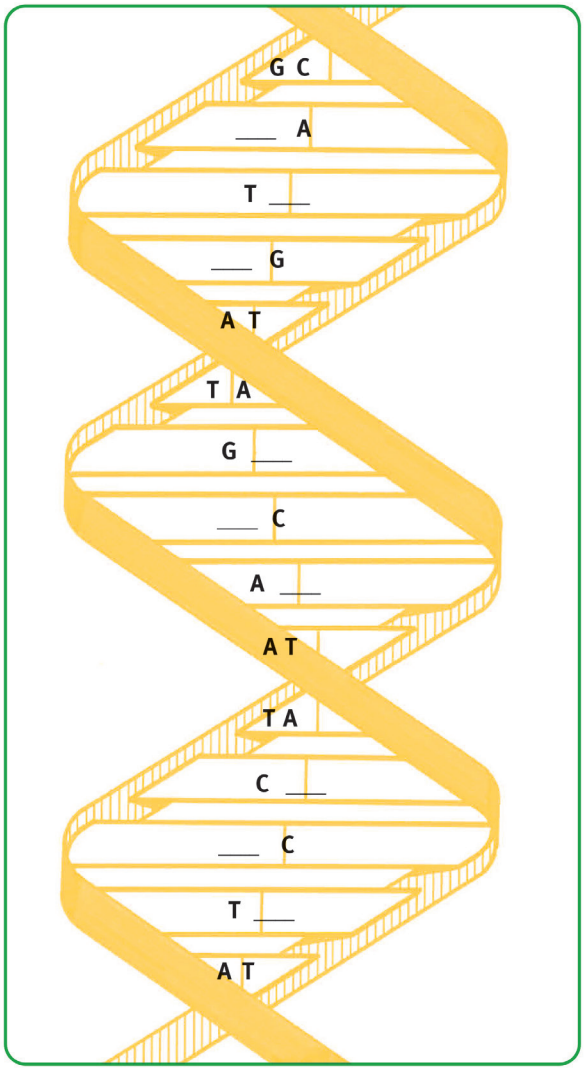
Challenge participants to locate other participants in the creative space with an identical DNA strand and discuss their findings. Ask: Why would it be difficult to find a match for your DNA in real life?

The ABCs of DNA

DNA (deoxyribonucleic acid) is the master molecule of life! It controls many of life's processes. DNA molecules are large and complex, and store a vast amount of information. The nucleus of every cell in your body contains about 6 feet of DNA coiled up inside of it. If you were able to magnify DNA, it would look like an extension ladder. Imagine holding the ladder at each end and twisting the ladder in two different directions. This would form a helix. Its appearance is much like that of a twisted stairwell. Each rung of the ladder is made up of two chemicals attached in the middle. Each rung contains a different combination of chemicals. The chemicals that make up the rungs are called bases. There are four bases: adenine, thymine, guanine, and cytosine. Adenine always forms a base pair with thymine and guanine always forms a base pair with cytosine.

VOCABULARY

- **adenine**
- **base pair**
- **cytosine**
- **double helix**
- **gene**
- **guanine**
- **thymine**



EXTENDING EXPERIENCE

Reading and Research

Do your participants ever wonder if we could bring extinct animals back to life? Can they imagine seeing Mastodons or Sabretooth Tigers when they go to the zoo? The idea may not be as far-fetched as previously thought. There is fascinating research today regarding DNA manipulation and how ancient DNA could be used to bring back extinct animals. Have participants research the theories and the scientific discoveries, including the article "Bringing Them Back to Life" from National Geographic. Instruct participants to image what it would take to bring these animals back to life and how issues may arise from manipulating DNA.

ADAPTING FOR ALL LEARNERS

For remedial learners, practice filling in the genetic code on the diagram above to understand the pattern in the ladder before conducting the procedure. Encourage them to color code, create a rhyme or song, or work with a partner to create a human chain where they hold hands.

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