GRADES 6–8

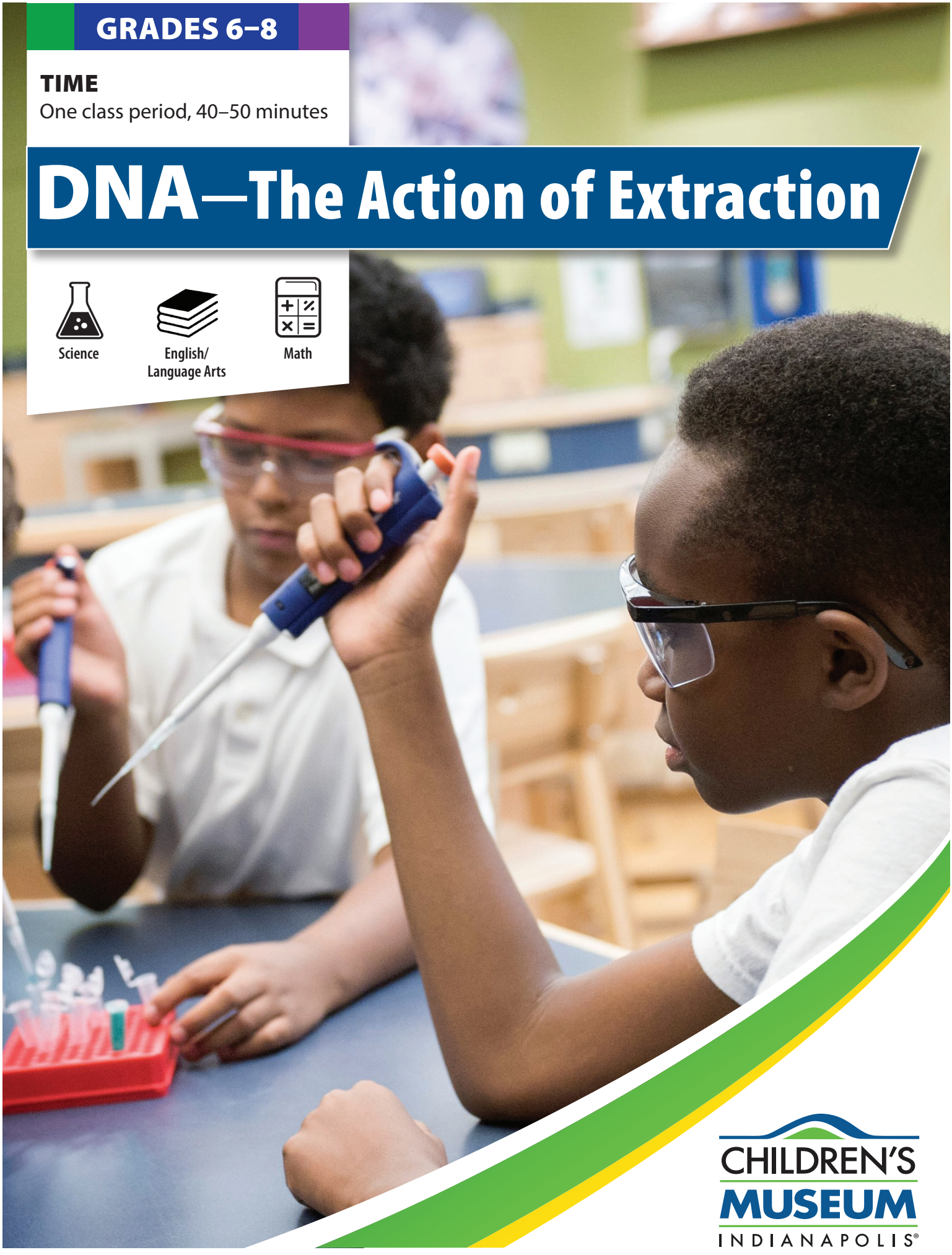
TIME
One class period, 40–50 minutes

DNA—The Action of Extraction

Science

English/
Language Arts

Math



CHILDREN'S MUSEUM INDIANAPOLIS®

DNA Extraction — How It Works

The DNA in raw wheat germ is located in the nucleus of the cell. Participants must first get to the DNA before they can extract it. Each step in the procedures plays an important part.

The warm water softens the cell and nuclear membranes so that they can be opened to get to the DNA. The water temperature is also important because at 50°C–60°C it denatures the enzymes that would cut the DNA into fragments. If the DNA were cut into fragments, it would be too short to be visible. At 80°C the DNA itself would denature and then participants would not be able to do the activity.

The detergent pulls the fatty lipid membranes that surround the cell and nucleus apart to release the DNA. It works much like dishwashing soap that cuts through the fatty grease on dishes.

The DNA is floating around in the solution and cannot be seen. Cold alcohol precipitates it out of solution so it can be seen.

Extending Experience

ENGLISH/LANGUAGE ARTS

Ask participants to research the history, benefits, and problems of genetic modification. Participants will learn that genetic engineering is found everywhere in their day-to-day life. They may be surprised to discover that many of the foods that they eat are genetically modified. While this scientific breakthrough proved beneficial in many ways, serious questions have been brought up about the impacts of such engineering. Encourage participants to think about the ethics of genetic modification through journaling or writing a defense paper stating their point of view on the topic.

HISTORY OF SCIENCE

Although gene editing is a fairly new scientific discovery, it has rapidly changed the way that humans live. Discuss with participants how genetic modification has changed, and is still changing, the way that humans eat, how they cure medical conditions, and how farming and migration patterns are affected.

GENE TRANSFER

Once scientists have extracted the DNA they then have to purify it and isolate the gene of interest. They use special enzymes that work like scissors to cut that gene out from the rest of the DNA. There are several different methods used to transport the gene into the plant cell. One method is to use *Agrobacterium*, a type of bacteria that injects part of its DNA into plants. Scientists replace part of the bacterium's DNA with the desired gene. It then becomes a "gene shuttle," transporting the desired gene into the plant cell. Once inside the cell, the gene can join the DNA of the plant. The plant cells are treated with chemicals that cause them to start growing into whole new plants. This is a special property of plants; most animal cells cannot regenerate this way. When they get big enough, the young plants are transferred to soil. Eventually the plants with the gene of interest are crossed with commercial varieties of the plant. Many plants with the gene must be created so they can be studied.

VOCABULARY

- **DNA (deoxyribonucleic acid)**
- **extraction**
- **genes**

SIMPLE SUBSTITUTE

No wheat germ? No problem! Grab some strawberries for a similar experience.

- 5 ml dish soap
- 50 ml water
- 5 g salt
- 3 or 4 strawberries (cut off stems)
- Resealable plastic bag
- Strainer
- 10 ml cold rubbing alcohol

Mix dish soap, water, and salt together. Place the mixture in a plastic bag along with 3 or 4 strawberries and close bag tightly. Gently smash fruit in the bag with hands to release DNA, and then strain. Place juice mixture in a beaker and slowly pour in cold alcohol. Watch as small DNA blobs form at the top of the fruit mixture!

Extracting DNA From Wheat Germ

Read all instructions before beginning the lab activity. Remember to wear safety glasses at all times. Avoid contamination. *Participants with wheat allergies should wear protective gloves at all times!

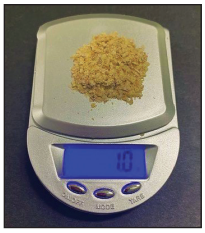
PROCEDURES

- Show participants a wheat plant and ask them what they think it is. Have them create a list of foods that they have eaten this week that contain wheat.
- Remind participants that wheat is a plant, a living thing with cells and **DNA** which contains **genes**. So yes, there is DNA in our food! Instruct participants to extract wheat germ DNA by following the directions below.
- Help participants to understand that the DNA they have extracted came from the wheat germ. They also need to understand that they broke open billions of cells and extracted the DNA from all of those cells. The reason the DNA glob is visible to the naked eye is because of the amount of DNA involved. This is not just one or two strands, but the strands that were in each of the billions of cells that they opened.
- Discuss with participants what the scientists in a biotechnology lab might do with the DNA once it is extracted. **Extraction** of DNA is just the first process in genetic engineering. Guide participants through the procedure outlined below.

ADULT TIPS

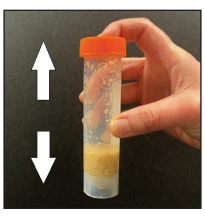
- Have participants use science journals or lab notebooks to record observations and notes.
- Do not use toasted wheat germ. Toasting can destroy the DNA.
- A glass stirring rod or long cotton swab can be used to isolate the DNA instead of a wooden stick.
- Be sure participants shake gently in Step 3. It helps to minimize the amount of foam to be removed in Step 7.

1 Measure 1 gram of wheat germ and pour it into a test tube.

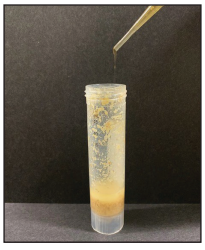


2 Add 20 ml of room-temperature water.

3 Stopper the test tube and shake for 1 minute.

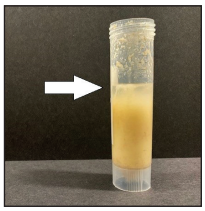


4 Using the pipette, add 1 ml of dishwashing detergent to the test tube.

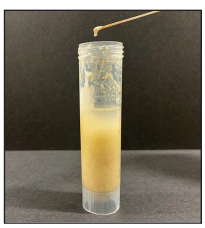


5 Tilt the test tube at a 45-degree angle and slowly add 10 ml of ice-cold rubbing alcohol, so that the alcohol floats on top of the water.

6 Observe the white glob forming where the water and alcohol meet.



7 Remove the white glob with a wooden stick by inserting the stick into the test tube just below the glob, slowly twirling or spooling it, and carefully pulling it out.



DNA—THE ACTION OF EXTRACTION

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 as individual creative space experiences or in combination to create a cohesive unit. Lessons are optimized when used in connection with museum field trips.

In this experience, participants extract **DNA** from wheat germ. The tools and techniques participants are exposed to in this lesson can be found in The Children's Museum ScienceWorks Gallery. Visitors to the gallery encounter technology, chemistry, science, and ecology through interactive experiences. A visit to the world class STEMLab and SciencePort encourages visitors to study, record, and analyze their observations. Learn more about our resources at childrensmuseum.org

INDIANA ACADEMIC STANDARDS

Science: Life Science: 6.LS.4, 7.LS.1, 7.LS.2, 7.LS.4, 7.LS.5

English/Language Arts: Writing: 6.W.5, 7.W.5, 8.W.5

Math: Data Analysis, Statistics, and Probability: 6.DS.3, 7.DSP.1, 8.DSP.5

OBJECTIVES

Participants will:

- Understand the basic function and structure of DNA
- Demonstrate how DNA is extracted from a wheat germ
- Learn about the building blocks of DNA
- Discover the importance of genes to living organisms
- Analyze how cells carry important genetic codes
- Describe the components of DNA

FOCUS QUESTIONS

- Why are we different from each other, but similar to our parents?
- What is DNA? What is DNA made of?
- Where is DNA found in the cell?
- Can DNA be extracted from organisms?
- Why would scientists want to extract DNA?

MATERIALS

- Gloves (for participants with allergies)
- Safety glasses (1 pair/participant)
- Paper towels

Per Group:

- 1 gram of raw wheat germ
- 100 ml test tube with stopper
- 20 ml of water
- 1 ml pipette
- 1 ml liquid dishwashing detergent
- 10 ml of ice-cold rubbing alcohol
- 1 wooden stick

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