

WIND YOUR WAY AROUND YOUR OWN DNA

Primary Learning Outcomes:

Students will observe first hand the DNA in their bodies. Students will learn a simple method of extracting DNA and why each step in the process is necessary. Students will learn how chemical substances can break up the cell structures surrounding DNA.

High School Georgia Performance Standards Addressed

- SCSh2. Students will use standard safety practices for all classroom laboratory and field investigations.
- SCSh4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- SB1. Students will analyze the nature of the relationships between structures and functions in living cells
- SB2. Students will analyze how biological traits are passed on to successive generations.

Middle School Georgia Performance Standards Addressed

- S7CS2. Students will use standard safety practices for all classroom laboratory and field investigations.
- S7CS4. Students use tools and instruments for observing, measuring, and manipulating scientific equipment and materials.
- S7L2. Students will describe the structure and function of cells, tissue, organs, and organ systems.
- S7L3. Students will recognize how biological traits are passed on to successive generations.

Materials:

Kit provides	Teacher provides
Woolite	95% ethanol (cold)
28 x 15 ml Falcon test tubes**	Disposable plastic/paper cups
28 Disposable inoculating loops** OR	Coffee stirrers which are flat at the bottom (not straw like)
7 test tube racks	Clear Gatorade (Powerade does not contain enough salt); salt water can be used to replace Gatorade
28 Small sealable clear plastic bags (can order from Uline.com Cat. # S3933) OR teacher can provide:	Clear film canisters to replace bags (see a photo center such as CVS or Wal-Mart)
28 x 1.5 ml microcentrifuge tubes	Snack bags (optional)
	Ice
	Beakers
	Rubbing alcohol

**** test tubes and inoculating loops can be reused*** for each class**

Materials to be assembled for a class of 28 students (7 groups of 4 students each):

7 test tube racks
 28 graduated Falcon test tubes
 14 beakers (7 for ice and 7 for alcohol)
 35 ml soap buffer (recipe follows)
 35 ml 95% or higher ethanol (or isopropyl alcohol)
 ice
 28 microcentrifuge tubes
 28 inoculating loops
 28 disposable cups
 28 small bags or clear film canisters
 Clear Gatorade or salt water

Duration of activity:

Prep time: approximately 20 minutes

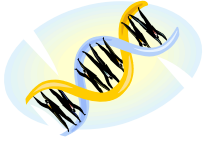
Class time: approximately 10 minutes

Advance preparation:

- Prepare soap solution - add 1.5 g table salt and 10 ml Woolite to 90 ml distilled water. Mix thoroughly. Makes 100 ml buffer.
- Salt water solution (if Gatorade cannot be used)- mix $\frac{1}{2}$ teaspoon salt into 8oz of water
- Activity will be less time-consuming if you have previously filled:
 - Baggies or film canisters with 2-3mL of soap solution, set up in rack
 - Cups with 5mL of Gatorade or salt solution
 - Falcon test tubes with 7- 10 mL of 95% ethanol, keep these on ice.
 - Microcentrifuge tubes filled with 1mL of 95% ethanol (cold)
 - ***To reuse inoculating loops place a beaker with each group containing enough rubbing alcohol to keep the loops sterile.

Additional tips:

- Be prepared with a stopwatch or clock with a minute hand to time swishing. Have everyone start swishing at the same time.
- Have a waste container nearby for cups and liquid waste.
- Since the students can keep their DNA you may want them to place the microcentrifuge tubes in a snack bag so if the top does open no liquid will be spilled.



WIND YOUR WAY AROUND YOUR OWN DNA (DNA EXTRACTION FROM AN ANIMAL)

DNA contains the instructions for making an organism, including YOU! Your DNA determines how you look, what blood type you have, even your tendency to get some diseases. Almost every cell in your body contains identical DNA and the same genes (some cells such as gametes have half as much DNA and mature red blood cells don't have any DNA). A chromosome is a single, long strand of DNA. If the DNA from the 46 chromosomes in one cell of your body could be laid out end-to-end, it would measure 6 feet!!! In this activity, you will isolate your very own DNA from your cheek cells. First, you will break away the membranes surrounding the cells and nuclei, and then you will precipitate the DNA so you will be able to see your own DNA!

PROCEDURE

1. Swish 1 teaspoon (5 ml) of the Gatorade or salt water from the small cup in your mouth vigorously for 30 seconds. Your goal is to slough off as many cheek cells as possible. Your instructor will time you to make sure you have swished long enough.
2. Spit the water with cheek cells back into the small cup.
3. Pour this solution into a bag or film canister containing $\frac{1}{2}$ teaspoon (2-3 ml) of soap solution.
4. Gently mix this solution for 2-3 minutes. Try to avoid creating too many bubbles. The soap solution breaks the cell membranes that are made up of fats - just like soap breaks down grease on your dishes!
5. Tilt the container of soap solution/cells. Pour 1-2 teaspoons (7- 10 ml) of ice cold alcohol (EtOH) down the side of the bag or film canister so that it forms a layer on top of your soapy solution. **DO NOT MIX THIS!!**
6. Let the container stand for 1 or 2 minutes.

7. The white clump that you see is YOUR DNA!!!! Research laboratories use a similar procedure to isolate and study DNA from different organisms.
8. Take a plastic inoculating loop out of the beaker of rubbing alcohol and wipe it dry. Use the inoculating loop to carefully spool the DNA from the ethanol layer. Transfer the DNA to a small microcentrifuge tube (filled with 1 ml of ethanol) for storage.



Original idea for this lab came from Carolyn A. Zanta, UIUC-Hughes Biotechnology Education and Outreach Program (www.life.uiuc.edu/hughes/footlocker)
This activity is a modification of a procedure developed by the Museum of Science and Industry, Chicago

Conclusion and Analysis



1. Are you looking at a single strand of DNA? Yes or no, explain your answer.
2. Compare and contrast the DNA you extracted from the banana and your cheek.
3. What can be the benefits of extracting human DNA? Give at least two.
4. Write a paragraph either agreeing with or arguing against the necessity of genetic engineering in plants or animals. (Hint: Support your point of view)

Information/Definitions

A HUMAN CELL

Each of the 100 trillion cells in the human body (except red blood cells) contain the entire human genome — all the genetic information necessary to build a human being. This information is encoded in over 3 billion base pairs, subunits of DNA. (Egg and sperm cells each contain approx. 1.5 billion basepairs of DNA.)

THE CELL NUCLEUS

Inside the cell nucleus, 6 feet of DNA are packaged into 23 pairs of chromosomes (one chromosome in each pair coming from each parent).

A CHROMOSOME

Each of the 46 human chromosomes contains the DNA for hundreds or thousands of individual genes, the units of heredity.

A GENE

Each gene is a segment of double-stranded DNA that holds the recipe for making a specific molecule, usually protein. These recipes are spelled out in varying sequences of the four chemical bases in DNA: adenine (A), thymine (T), guanine (G), and cytosine (C). The bases form interlocking pairs that can fit together only one way: A pairs with T; G pairs with C.

A PROTEIN

Proteins, which are made of amino acids, are the body's workhorses — essential components of all organs and chemical activities. Their function depends on their shapes, which are determined by the estimated 25,000 genes in the cell nucleus.