Extracting DNA

Teacher Brief

Purpose
In this lesson, students will learn about DNA extraction and why it is important to the advancement of oral health.

Online Activities Link
DNA Extraction Activity

Exhibit Link
Saliva: A Remarkable Fluid, Bioengineering: Making a New You, Forensics: Solving Mysteries
Each of these sections of the exhibit show how DNA extraction is important to different types of studies. Research in stem cells, gene therapy, and forensic DNA analysis all require the use of extracted DNA.

Background
DNA (deoxyribonucleic acid) is found inside the nucleus of a cell in tight bundles called chromosomes and contains all of our genetic information. Every cell in the human body, except red blood cells, has DNA. Unless you are an identical twin, no one else in the world has the same genetic information as you.

The structure of DNA is a double helix with alternating sugar and phosphate along the sides. DNA is made up of four building blocks or nucleotides (adenine, thymine, cytosine, and guanine) which are arranged in pairs along very long strands. The human genome (complete set of DNA) has about 3 billion nucleotides. The order of the nucleotides in a DNA strand is a sequence.

Each person in the world has a unique sequence. We are all 99.9% the same; but our uniqueness is found in 0.1% of our DNA sequence. This uniqueness in our DNA sequence is what sets us apart from each other. Our DNA can be broken down into smaller parts called genes that are the hereditary units passed from parent to child.

In order to study DNA, researchers must collect samples from people. One of the best DNA samples is saliva because it contains mouth and cheek cells. There are many different ways to get saliva for DNA testing. Saliva can be found on a phone after a conversation, on licked envelopes, toothbrushes, and anything else that may come in daily contact with your saliva and/or mouth.

There are many reasons why scientists use DNA to conduct research. It allows them to locate specific genes that cause diseases and learn how our body works and functions based on our genetic makeup. Gene therapy is a new technique used to replace “bad” genes with “good” genes to find cures for inherited diseases. Additionally, DNA research is looking for ways to improve our oral and overall health.

In this experiment, students will extract DNA from their saliva. Students need to swish with salt water as it helps to separate their DNA from RNA in cells. Dish soap is combined with the saliva water to remove the cell membranes so the DNA can be exposed. Alcohol is used in the last step to remove DNA from the soap-saliva liquid since DNA does not dissolve in alcohol. Scientists use DNA extraction not only for oral health research but to identify people as well..

Note
If your school district does not allow bodily substances to be used, juice from fruits such as kiwis and strawberries, can be used in place of the saliva in this experiment. It will be necessary to add a pinch of meat tenderizer (enzyme) to the saliva cup before adding the alcohol.

Extracting DNA

Lesson Plan

Key Point
DNA is found in most of our cells and can be extracted for scientific study and identification.

Materials

DNA Extraction Activity	Rubbing alcohol	Graduated
Small, clear drinking cups	Water	cylinder/measuring cup
Table salt	Measuring spoons	Tape
Dish soap		

Procedure*

PREP - Place a container of rubbing alcohol in the freezer at least one hour prior to the start of the experiment. Keep the alcohol cold during the experiment or the experiment will not work.

1. Discuss with students where they can get DNA from their body. As a class, try to identify good sources of DNA that are easily obtainable. Explain that saliva is an excellent source of DNA as it contains mouth and cheek cells. Ask students if they have any ideas about how you can extract DNA from a cell.
2. Show students the online DNA Extraction Activity, found on the YSI website (http://www.dentalmuseum.org/ysi/activities/). Discuss each step of the process.
3. Explain to the class that they will be extracting their own DNA from saliva today. Have students work in pairs to complete the experiment. Do each step as a whole class so everyone spends the same amount of time swishing and waiting.
4. Have students work in groups to make a salt water mixture and soap solution. Each group should collect two cups, salt, and soap. A cup for each group member is also needed.
5. Using tape, label the first cup “salt-water mixture.” Measure ½ cup of water (100mL) and put in the cup. Add one tablespoon of salt to the water. Stir until the salt has dissolved into the water.
6. Label the second cup “soap solution.” Measure three tablespoons (45 mL) of water and pour into the cup. Add 1 tablespoon (15 mL) of liquid dish soap (a colored one will work best) to the water. Stir to mix.
7. Measure one teaspoon (5mL) of the salt-water mixture from the first cup. Place the mixture into a cup that is labeled with the student’s name. Swish the salt-water mixture in your mouth for one minute. When the time is up, spit the salt water back into your labeled cup.
8. Measure 1 teaspoon (5 mL) of the soap solution and add to the student labeled cup that has the salt-water mixture and saliva. Swirl the cup for one minute to gently mix.
9. Measure three tablespoons of rubbing alcohol and carefully add it to the student labeled cup. The experiment will work the best if the alcohol is carefully poured down the side of the cup so it does not mix with the soap.
10. Wait one – two minutes. Bubbles and small white strings will begin to appear. This is the extracted DNA.
11. Have partners discuss why DNA extraction would be important to dentistry and oral health. Let each group write their ideas and report their ideas in a whole-group discussion. Make sure to discuss gene therapy, bioengineering, and forensics.

Questions

1. How can we get DNA from our bodies? What are good sources of DNA?
2. Why is saliva a good source of DNA?
3. How is DNA extraction important to dentistry and oral health?

*Adapted from The Museum of Science and Industry, Chicago