# Cracking the Code of Life

## Classroom Activities

See Your DNA | Mystery Message | Case Studies

## See Your DNA

Materials | Procedure | Activity Answer | Links & Books | Standards

**Objective**
To extract human DNA from cheek cells.

### MATERIALS for each team

- copy of "See Your DNA" student handouts (PDF or HTML)
- 2 teaspoons (10 ml) 0.9 percent salt water (2 teaspoons table salt in one quart/liter of water)
- disposable paper or plastic cup
- large test tube (or any clear tube that can be sealed with a rubber or cork stopper)
- 1 teaspoon (5 ml) 25 percent mild detergent or dishwashing soap, e.g., Woolite or Palmolive (1 volume detergent or soap + 3 volumes water)
- 2 teaspoons (10 ml) 95 percent ethanol, chilled on ice
- small clear tube with seal

### MATERIALS for teacher

- slide of cheek cells stained with methylene blue

### PROCEDURE

1. If possible, before doing this activity, make and show a slide of some cheek cells and stain it with methylene blue so that students can see the shape of the nucleus of the cheek cell.
2. Provide each student with a copy of the "See Your DNA" student handout and a set of materials. Before students begin, make sure they understand and will follow guidelines for maintaining sterile conditions.
3. Have students prepare their saltwater and detergent solutions. When they are done, have each student swill two teaspoons of the saltwater solution in their mouths for 30 seconds. Make sure that students swish the solution around for the full 30 seconds. This will remove dead cells lining the mouth and provide students with a source of their own DNA.
4. Have students spit their solution into a disposable plastic cup and then pour it into a large test tube containing 1 teaspoon (5ml) of the detergent solution.
5. Students should cap the test tube and **gently** rock it on its side for 2-3 minutes. It is important that students are not too vigorous while mixing. DNA is an extremely long molecule. Physical abuse can break it into smaller fragments, a process known as shearing.
6. After gently rocking the solution, have students uncap the tube and then slightly tilt it and **carefully** pour 1 teaspoon (5ml) of the chilled ethanol down the inside of the tube so that it forms a layer on the top. Again, it is very important that the students take care in adding the ethanol so that the alcohol floats above the soapy solution already in the tube.
7. Tell students to allow the tube to stand for one minute. Then, have them use a thin acrylic or glass rod to slowly move some of the ethanol into the soap layer. The alcohol/soap interface is where most of the DNA will precipitate out of the soap solution. Have students twirl the rod to spool the DNA strands around it. If too much shearing has occurred, the DNA fragments may be too short to wind up, and they may form clumps instead. Students can try to scrape these out.
8. After students have wrapped as much DNA on the rod as they can, have them remove the rod and scrape or shake the DNA into a small tube with the remaining ethanol. Tell students that the DNA in their test tubes came from the nucleus of their cells, specifically, the 46 chromosomes in the nucleus.
9. Now that students have their DNA, what will they do with it? Will they grant consent for its use or keep it private from everyone? How will they guarantee this? Work with students to draft a policy statement concerning their own DNA.

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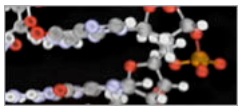
TEACHER'S GUIDE
Cracking the Code of Life



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*Video is not required for this activity.*

**Genetic Variation**
View this Teachers' Domain video segment (6m 34s) to learn about the genetic similarities and differences among organisms, and how far away we are from understanding how genes work together.

**Use of Ethanol**
Closely supervise students' use of ethanol and instruct students that they cannot take the ethanol home.

## ACTIVITY ANSWER

DNA is only about 50 trillionths of an inch long. The reason it can be seen in this activity is because students are releasing DNA from a number of cells. This happens when the detergent or dishwashing liquid breaks, or lyses, the membranes around the cell and around the nucleus. Once released, the DNA from the broken open cells intertwines with DNA released from other cells. Eventually, enough DNA intertwines to become visible to the eye as whitish strands. Tell students that one strand of DNA is so thin (.0000002mm) they would never be able to see it without using a microscope.

Detergents break open cells by destroying the fatty membrane that encloses them. This releases the cell contents, including DNA, into the solution. Detergents also help strip away proteins that may be associated with the DNA.

DNA is not soluble at high ethanol concentrations, so it precipitates out as long strands. Salts, such as sodium chloride, also greatly aid in precipitating DNA. The ethanol also causes gases dissolved in the water to be released, which may be observed as small bubbles.

This procedure may not work well if the researcher has eaten corn flakes for breakfast. Presumably this is because the corn flakes have scoured too many buccal cells from the inside of the mouth. Repeating may give low yields if most of the loose buccal cells have already been harvested.

## LINKS & BOOKS

**Books**

Baker, Catherine. *Your Genes, Your Choices: Exploring the Issues Raised by Genetic Research.* Washington, D.C.: AAAS, 1999.
Describes the Human Genome Project, the science behind it, and the ethical, legal, and social issues raised by the project.

Marshall, Elizabeth L. *The Human Genome Project : Cracking the Code Within Us.* Minneapolis, MN: Econo-Clad Books, 1999.
Explores the process and technology used in sequencing a portion of the human genome. A chance to see the process of science through the eyes of the scientist. The author connects the discoveries in the human genome with the ethical implications they pose for society.

Reilly, Philip R. *Abraham Lincoln's DNA and Other Adventures in Genetics.* Cold Spring Harbor, NY: Cold Spring Harbor Laboratory Press, August 2000.
Offers wide-ranging tales of crime, history, illness, and ethics to illustrate principles and issues of human genetics.

Sayre, Anne. *Rosalind Franklin and DNA.* New York, NY: W. W. Norton & Company, Inc., July 2000.
Offers a true life account of Franklin's work in elucidating the structure of DNA and explores the difficulties often faced by women in science. Franklin's research was central to the Nobel Prize-winning discovery of DNA, and Watson and Crick's discovery relied heavily on her pivotal X-ray crystallography data.

Watson, James D. *The Double Helix: A Personal Account of the Discovery of the Structure of DNA.* New York, NY: Simon & Schuster, 1998.
Chronicles the original story behind the race to discover the structure of DNA as seen through the eyes of James Watson.

**Articles**

Crick, Francis, and James Watson. "A Structure of Deoxyribonucleic Acid." *Nature.* Volume 171. 1953, Pages 737-738.
The seminal paper on the discovery of the structure of DNA.

"Outlook 2000: Inventing the Future." *U.S. News & World Report,* January 3, 2000.
Special double issue includes different articles about the Human Genome Project, which explain how the secrets of DNA may help cure illnesses and arrest aging, as well as outline the benefits and perils of genetic testing.

**Web Sites**

NOVA Online—Cracking the Code of Life
http://www.pbs.org/nova/genome/
Provides program-related articles, interviews, interactive activities, resources, and more.

Genes and Disease
http://www.ncbi.nlm.nih.gov/disease/
Shows what diseases have been mapped on which chromosomes. The Map Viewer presents a graphical view of the available human genome sequence data as well as cytogenetics, genetic, physical, and radiation hybrid maps.

The Human Genome Project
http://www.genome.gov/10001772
Provides background information on the Human Genome Project from the National Human Genome Research Institute. Several links provide more detailed resources describing the history and goals of the Human Genome Project.

Genetics Resources
http://www.library.vcu.edu/tml/bibs/genetics.html
Offers list of links with descriptions to more specific subject areas in the topic of genetics and medicine.

## STANDARDS

The "See Your DNA" and "Mystery Message" activities and the "Case Studies" activities align with the following National Science Education Standards:

**Science Activities: Grades 5-8**

**Science Standard C:**
**Life Science**

**Reproduction and Heredity**

**Molecular Basis of Heredity**

**Case Studies: Grades 5-8**

**Science Standard F:**
**Science in Personal and Social Perspectives**

**Science and Technology in Society**

**Case Studies: Grades 9-12**

**Science Standard F:**
**Science in Personal and Social Perspectives**

**Science and Technology in Society**