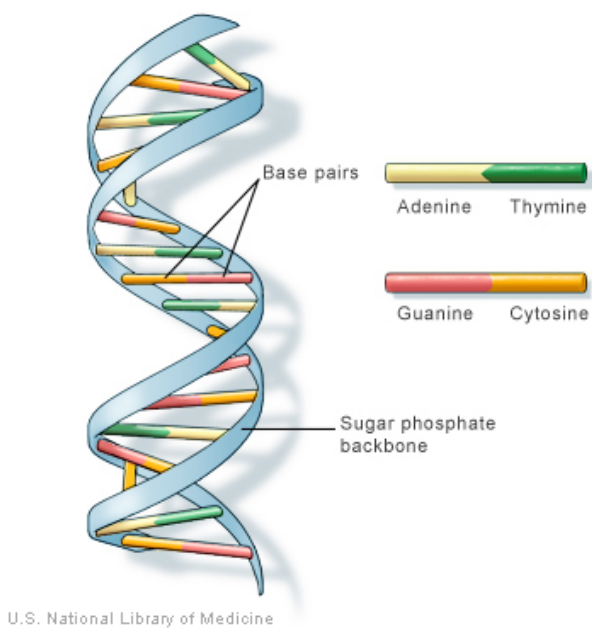
*Funding provided by The Leon Lowenstein Foundation*

# *DNA Extraction*
Student Handout

## Background information
DNA, or deoxyribonucleic acid, is the hereditary material in humans and almost all other organisms, including plants, fungi, animals, and bacteria. DNA contains the biological instructions that make each species unique. DNA, along with the instructions it contains, is passed from adult organisms to their offspring during reproduction. Nearly every cell in a person's body has the same DNA.

Most DNA is located in the cell nucleus (where it is called nuclear DNA) surrounded by a wall, called a nuclear envelope. The nucleus sits in the middle of a cell. The whole cell is surrounded by a plasma membrane, which serves as a barrier keeping the cell's contents inside protected from the outside environment. Because the cell is very small, and because organisms have many DNA molecules per cell, each DNA molecule must be tightly packaged. This packaged form of the DNA is called a chromosome. DNA spends a lot of time in its chromosome form. But during cell division, DNA unwinds so it can be copied and the copies transferred to new cells. DNA also unwinds so that its instructions can be used to make proteins and for other biological processes.

### Nucleotides and the Double Helix
The information in DNA is stored as a code made up of four chemical bases: adenine (A), guanine (G), cytosine (C), and thymine (T). Human DNA consists of about 3 billion bases, and more than 99 percent of those bases are the same in all people. The order, or sequence, of these bases determines the information available for building and maintaining an organism, similar to the way in which letters of the alphabet appear in a certain order to form words and sentences.




DNA bases pair up with each other, A with T and C with G, to form units called base pairs. Each base is also attached to a sugar molecule and a phosphate molecule. Together, a base, sugar, and phosphate are called a nucleotide. Nucleotides are arranged in two long strands that form a spiral called a double helix. The structure of the double helix is somewhat like a ladder, with the base pairs forming the ladder's rungs and the sugar and phosphate backbone molecules forming the vertical sidepieces of the ladder.

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**Replication, translation and the cell**
An important property of DNA is that it can replicate, or make copies of itself. Each strand of DNA in the double helix can serve as a pattern for duplicating the sequence of bases. This is critical when cells divide because each new cell needs to have an exact copy of the DNA present in the old cell. Specific chunks of the DNA sequence, called genes, can be translated into proteins, generating all the components required for a cell to function and live. Each gene is like a word in the sentence (or paragraph!) that is a chromosome. It is thought that humans have 30,000 to 40,000 genes in the human genome. There are normally 23 pairs of chromosomes in the human genome. Cells are the basic building blocks of all living things. The human body is composed of trillions of cells. They provide structure for the body, take in nutrients from food, convert those nutrients into energy, and carry out specialized functions.

## DNA fun facts

- There are about 2 meters (6 feet) of linear DNA in each cell of your body!
- James Watson and Francis Crick are often credited with "discovering" the structure of DNA, but their "discovery" would not have been possible without the work of a third scientist, Rosalind Franklin. She took X-ray pictures of DNA molecules, providing the key to solving its structure.
- If the DNA from all the cells in your body was stretched out, it could reach to the sun and back 700 times!

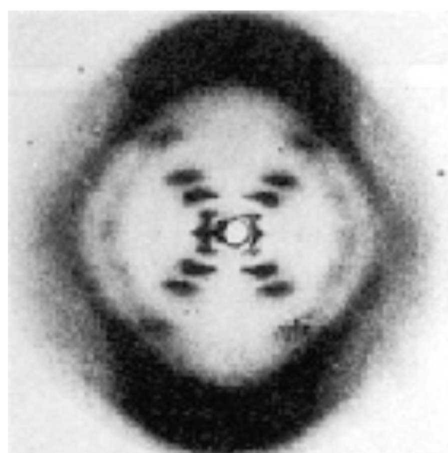

Photo from:
http://www.npr.org/programs/atc/features/2002/oct/darklady/

- Any two individuals differ in only about three million - 3 x 10 6 bases (0.1%).

Fun websites to visit and learn more about DNA:

| | |
|---|---|
| Cells Alive-how big is a cell? | http://www.cellsalive.com/howbig.htm |
| The Mad Scientist Network | http://www.madsci.org/ |
| The Exploratorium | http://www.exploratorium.edu/ |
| Send your friends a DNA-o-gram | http://www.dna2z.com/DNA-o-gram/ |

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**Home-brewed DNA**
(from the 2/24-3/3/03 issue of U.S. News and World Report)

In this lab, you and your partners will isolate DNA using common household items! To keep the strands of DNA intact throughout the isolation, you need to handle everything gently. If you do this, you will be rewarded at the end with long, gooey strings of DNA.

1. Check that you have all the supplies that you will need:

Frozen strawberries (small handful, rinsed)
Canned peaches (2-3 slices, rinsed)
2 plastic cups
water
shampoo
salt
cheescloth
rubbing alcohol (cold)
plastic gloves
wooden stick

2. Put on one glove and squish the produce into one of the plastic cups. Continue to squeeze the pieces until the strawberries/peaches are the consistency of a smoothie (small chunks are okay).

3. Add an equal volume of water (just guess, it doesn't have to be exact).

4. Add 2 small squirts of shampoo and about a teaspoon of salt (measure the salt in your hand). Mix this up *gently* with your gloved hand or stick.

5. Strain the mixture through 1 or 2 layers of cheesecloth into the second plastic cup. Have one lab partner hold the cheesecloth while another carefully pours the mixture in the center of the cheesecloth. Allow the liquid to drip through. After most of the liquid has dripped through, you may gently squeeze the cheesecloth to get more liquid out.

6. Add an equal volume of COLD rubbing alcohol to the clear, pink liquid. Gently swirl the cup. You should see strings of clear DNA form and float to the top. Use the wooden stick to twirl the gooey DNA around and pick it up out of the liquid. This is DNA!

Questions:

1. What is DNA, and where is it found?

2. Is there DNA in your food? How do you know?

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3. What did the DNA look like?

4. If DNA is so small it fits in one cell, how are we able to see it with our eyes after extraction?

5. Were there any differences in the DNA you extracted from the strawberries compared to the peaches? Why do you think there were or were not any differences?

6. What can we do with the DNA we isolate? Why is it valuable that we are able to isolate DNA?

7. Why do we wear gloves when doing science?

8. Based on this lab, why do we shampoo when we shower?

9. Please fill out the evaluations!!