DNA in a Bottle

What is DNA and what does it do?

Deoxyribonucleic acid (DNA) is a molecule present in all living things, including bacteria, plants, and animals. DNA carries genetic information that is inherited, or passed down from parents to offspring. It is responsible for determining a person's hair, eye, and skin color, facial features, complexion, height, blood type, and just about everything else that makes an individual unique. But it also contains all the information about your body that is the same in all human beings. In other words, your DNA is like a blueprint for your entire physical growth and development. Your DNA blueprint is a combination of half of your mother's and half of your father's DNA, which is why you have some features from each of your parents. DNA contains four chemical units, referred to by the first letters in their names: A (adenine), G (guanine), T (thymine), and C (cytosine). These four DNA "letters" make up a code for genetic information. The 4 chemical letters of DNA are organized to make messages, called genes, that can be understood by cells. These genes contain the information to make proteins, which are responsible for almost all of your body's structures and functions. A gene is like a recipe, since it contains the all the information needed to make a protein. Your DNA sequence is the particular arrangement or order of the chemical letters within your complete DNA collection, or genome. Scientists have determined that human DNA sequences are 99.9% identical. It is the <0.1% sequence variation from person to person that makes each of us unique. In other words, what makes you different from your classmate is an occasional difference in the letters of your genomes.

Where is DNA found?

The basic units of an organism's body are cells — they make up all of your tissues and organs (i.e., muscles, brain, digestive system, skin, glands, etc.) Cells are compartments with membranes, made of protein and lipids (fats), that keep them separate from other cells. Within cells are further compartments with specialized functions. One compartment, called the nucleus, is like the cell's control headquarters and contains the DNA molecules, which are the master instructions for the functions of the cell. The DNA is organized into 46 tightly coiled structures called chromosomes.

So how do we get the DNA?

To see your DNA, you will collect cells, break them open, and condense the DNA from all of the cells together. You can collect thousands of cells from the inside of your mouth just by scraping it gently and thoroughly with a brush, or even swishing some salt water around in your mouth. The type of cells that line your mouth divides very often, coming off easily as new cells replace them continuously. In fact, these cells are coming off and being replaced all the time. Once you have collected your cells, the cells need to be broken open to release the DNA. Detergent will dissolve the membranes of your cells, just like dish washing detergent dissolves fats and proteins from a greasy pan, because cell and nuclear membranes are composed of fats and proteins. Dissolving the membranes results in the release of the DNA. The process of breaking open the cells is called lysis, and the solution containing the detergent is called lysis buffer. Strands of DNA are so thin that it is not possible to see them when they are dissolved in solution. Think of the long, thin strands of DNA as fine white thread. If one long piece of thread were stretched across the room, it would be difficult to see. To make the thread more visible, you could collect it all together and pile it on the floor. In this laboratory experiment, you will use cold alcohol to bring the DNA out of solution, or precipitate it. Cold alcohol create a condition in which DNA doesn't stay in solution, so the DNA clumps together and becomes a solid mass that you can see.

Procedure:

1. **Obtain for yourself and your partner 2 large micro test tubes, two small micro test tubes, 2 disposable cups with salt solution in them, a dropper with lysis buffer in it, and a dropper with Ethyl alcohol in it and return to your**

desk.

2. **Each of you should take the salt solution in your mouth and vigorously swish it around for at least 30 seconds, and spit enough into the large micro test tube to fill half way. Spit the rest into the sink. Be sure to keep your sample in your hand or label it with a marker.**
3. **Add 1 ml (20 drops) of the lysis buffer to the "cheek" mixture in the micro test tube. Cap and gently invert (turn upside down and right side up) several times. Do not shake!**
4. **Uncap and hold the test tube at a slight angle and carefully add 20-30 drops of the alcohol one drop at a time to form a layer on top of the cheek/lysis layer.**
5. **Hold the test tube upright and watch for a minute or two right at the interface or layer between the alcohol and the cheek/lysis layer. The cloudy white substance is your DNA.**
6. **Use a toothpick and carefully wind or twist it to coil the DNA around the stick, do this until you can see some on your toothpick.**
7. **Add .5 ml (10 drops) of ethyl alcohol to the small micro test tube and carefully transfer the DNA to the tube. You may add a drop of stain to help visualize it at this point. Observe the DNA in the small tube and repeat step #6 until you have a clump of visible DNA in your tube. You may string it on a piece of string for a DNA necklace at this time.**

Questions: (please do not write on this lab, answer questions on your own paper)

1. **Why was it necessary to swish the salt solution around in your mouth vigorously?**
2. **What structure was broken down in the lysis step, and where did that structure go?**
3. **Why would it be important not to vigorously shake the test tube with the lysis mixture in it?**
4. **If alcohol dehydrates (removes the water) from DNA, why would that make it visible?**
5. **If the DNA was invisible in water but appeared in the alcohol as visible strands, what does that tell us about DNA's solubility or ability to dissolve in these two substances?**
6. **How would you extract DNA from a sample of fruit, does fruit have DNA? Write a procedure or extracting DNA from fruit and show it to Mr. Cubbage, if he approves it proceed to with your experiment.**

Going further, if time allows obtain some DNA from either your own samples or from the fruit, and make a wet mount (slide with a drop of water on it, the DNA, and a cover slip, an methylene blue stain) and observe it under the microscope. Remember to start with low power and move up to medium and finally high power. Make a drawing of what you see for extra credit.