

Lab: DNA Extraction from Human Cheek Cells

Introduction

DNA...you hear about it all the time. DNA is used every day by scientists and lawyers to help in criminal investigation, paternity suits, cloning, etc. Your DNA is your “genetic fingerprint”—this means that your DNA is like no one else’s in the world! The procedure that we will use to see your DNA includes the same basic processes that researchers use to isolate, analyze, and manipulate DNA in a laboratory setting (although the DNA isolated here is not nearly as “pure” as the research lab version).

DNA is a nucleic acid, made of carbon, hydrogen, oxygen, nitrogen, and phosphorous. DNA can be considered the hereditary “code of life” because it possesses the information that determines an organism’s characteristic and is transmitted from one generation to the next. You receive half of your genes from your mother and half from your father. Day to day, DNA’s job is to direct the functioning within the cells of your body.

DNA is in the nucleus of almost every cell in your body. The length of DNA per cell is about 100,000 times as long as the cell itself. However, DNA only takes up about 10% of the cell’s volume. This is because DNA is specially packaged through a series of events to fit easily in the cell’s nucleus. The structure of DNA, the double helix, is wrapped around proteins, folded back onto itself, and coiled into a compact chromosome.

Individual chromosomes can be studied using microscopes, but the double helix of a chromosome is so thin that it only be detected through innovative, high-tech procedures. Chromosomal DNA from a single cell is not visible to the naked eye. However, when chromosomal DNA is extracted from multiple cells, the amassed quantity can easily be seen and looks like strands of mucous-like, translucent cotton.

We will first collect cheek cells by swishing a sports drink in our mouths and using our teeth to scrape cells off our cheeks. (The more vigorous and the longer that you swish, the more cells are removed, and the more materials you’ll have from which to extract DNA.) Then, we will lyse the cell membranes by adding a detergent based cell lysis solution, which allows the DNA to be freed. DNA is soluble in water, but much less soluble in alcohol. Thus, alcohol will be slowly added, and DNA will precipitate to the sports drink/alcohol interface, and you will be able to see your own DNA! The white, stringy material is thousands of DNA molecules stuck together (with some proteins too).

Materials and Methods

1. Label your 15mL test tube with a piece of tape and your initials
2. Obtain a small cup of sports drink and swish it around in your mouth for 1 full minute. As you swish, gently and continuously scrape the sides of your cheeks with your teeth to help release your cheek cells.
3. Spit the drink (with your collected cheek cells) back into the small cup.
4. Pour the contents of the cup into your labeled test tube (discard the cup).
5. Holding the test tube at an angle, use the provided plastic pipet to add 2mL of cell lysis solution to your collected cheek cells.
6. Cap your test tube, and invert it 5-8 times. (This mixes the lysis solution with the cheek cells.)
7. Allow this to stand for 2 minutes.
8. Using the provided pipet, add the cold alcohol *by letting it run gently down the side of the test tube (hold the test tube at an angle)*. Add the alcohol until your total volume reaches 12-13mL. You should have 2 distinct layers. DO NOT mix the cheek cell solution with the alcohol!!!
9. Watch as wispy strands of translucent DNA begin to clump together where the alcohol layer meets the cheek cell solution. (It kind of looks like cobwebs extending upward.)
10. Place your 15mL test tube in a test tube rack and let it stand undisturbed for 15 minutes. During this time the DNA will continue to precipitate out.
11. Optional—use a plastic pipet to transfer your DNA into a smaller test tube. To do so, place the pipet near the DNA and draw the DNA into the pipet (along with some alcohol). Do not move your pipet up and down into the bottom layer.

Discussion Questions

***Please answer on your own paper in complete sentences where you restate the question in your answer.

1. What are the subunits that make up DNA?
2. Describe the structure of the DNA molecule.
3. Describe how long strands of double-helical DNA fit into the nucleus of a single cheek cell.
4. What was the purpose of using the cell lysis solution?
5. Why does the DNA become visible once the alcohol is added?
6. If DNA is so thin, how is it that we are able to see it during this simple lab exercise?
7. Why is DNA referred to as your genetic fingerprint?
8. How is your DNA similar to the strawberries? How is it different?
9. Give some examples of how DNA is used everyday.