

## Forensic Investigation

\*Note: There are two versions of this presentation: the one entitled “Forensic Investigation” is for if the materials are available to perform an electrophoresis experiment, or to show a Youtube video which covers the experiment; the one entitled “Forensic Investigation – Computers” is an option for if the materials for electrophoresis are not available and instead a class set of computers can be used for a virtual experiment.

### Materials:

- Bottled water
- Clear dish soap
- Food dye (blue was good for contrast)
- Table salt
- Isopropyl alcohol
- Stir sticks (wooden were fine)
- Small rectangular plastic box
- Stainless steel wire (24-18 gauge) and wire cutters if need be.
- 5 – 9 Volt batteries
- 2 – Alligator clip leads
- Styrofoam tray or flat piece
- Measuring spoons
- Baking soda
- Agarose powder (available online or at chemical retailers on-campus)
- Microwave
- Food colouring dyes (3 colours)
- Graduated cylinder or other measuring utensil

**\*Note: IF YOU'RE DOING YOUR OWN ELECTROPHORESIS, prepare the gel ahead of time and have the set-up running as of the start of the presentation. It takes about 45 minutes to run.**

### Introduction:

1. What do scientists do?
2. Where do you find scientists?
3. What is a scientist? What is a biologist?
4. How does this type of science affect your life? What about other types?

## What is DNA?

1. ...stands for Deoxyribonucleic Acid
2. What is DNA made of? *Building blocks called **nucleotides**, which contain a phosphate group, a sugar group, and a nitrogen base: one of **adenine (A)**, **thymine (T)**, **guanine (G)**, and **cytosine (C)**.*
3. Where is DNA found? *In the nucleus of cells.*
4. What is the function of DNA? *It carries the instructions for an organism to develop, survive and reproduce.*
5. Why is it important? *It's what makes us all different, and lets us survive! Our cells could not live and reproduce to replace themselves if there was no DNA.*

## Extracting DNA

1. Explain that we are going to do a DNA extraction from the students' cheek cells. Students may opt to not participate.
2. Instructions:
  - a. Hand out a clear cup to each participant
  - b. Mix 500 mL drinking water with 1 tbsp of salt. *We prepared salt water beforehand while someone was leading the DNA discussion*
  - c. Take 3 tbsp of mixture to another cup. *We gave the students about 1cm of salt water in their cup.*
  - d. Gargle the 3 tbsp salt water. Time for 1 minute. *Some couldn't make it this long, which was fine. Just tell them to not make each other laugh and keep it light so they don't despair about the taste. Tell them it's good for cankers and sore throats!*
  - e. Spit back into cup. *Their cheek cells are now mixed in with the salt water.*
  - f. Stir with 1 drop of soap. *We gave the students their stir sticks with a glob of soap on the end and told them to stir **gently**. This process breaks down the cell membranes.*
  - g. Mix 100mL isopropyl alcohol and 3 drops of food dye. *Again, we prepared this beforehand and went around with a large volume of it while students were stirring.*
  - h. Tilt salt cup and gently pour a 2cm layer on top. *This process shortens and condenses the DNA to make it clump together and become visible.*
  - i. Wait 2.5 mins! *The DNA appears as small, white clumps or strands within the blue solution.*
  - j. Dispose of the solution down the sink, and recycle the cups if possible.

## Gel Electrophoresis

1. What is Gel Electrophoresis? *A method of separation for different mixtures such as DNA or even food colouring. It's used to analyse DNA, RNA, and proteins by separating their constituents out according to their molecules' sizes and charges.*
2. IF YOU'RE DOING YOUR OWN ELECTROPHORESIS, prepare the gel ahead of time and have the set-up running as of the start of the presentation. It takes about 45 minutes to run.
3. Follow the instructions on the following website to set up your electrophoresis: <https://www.youtube.com/watch?v=QWkfXjGohVk>. Note that the agarose is tricky to find. We tried to use other gel bases but they were not effective. This video can also be watched to see the effect of electrophoresis if you do not have the materials required.

### Forensic Investigations

1. What does "Forensic" mean? *The science behind investigating a crime!*
2. How does one become a Forensic Investigator? *You would work mostly in a lab in the area of either forensic biology, chemistry, or toxicology. Usually they have a four year science honours degree in biology, biochemistry, molecular biology, chemistry, or pharmacy depending on their field. Once they have secured a job with a lab, they undergo an understudy period of 9-18 months depending on the strength of their background with regards to law and science.*
3. Why is DNA important in Forensic Investigations? *Everyone's DNA is different, so when you find and test some at a crime scene you can help determine if someone is involved.*
4. What type of 'clues' or 'traces' do Forensic Investigators usually look for in a crime scene? *Answers will vary; fingerprints, hair, skin cells... Might also hear answers such as footprints.*
5. What do we get from these traces? *DNA! Which leads into DNA fingerprinting to identify suspects.*
6. **DNA Fingerprinting** is a procedure that uses gel electrophoresis to determine each person's unique DNA makeup.

### DNA Fingerprinting

\*If you have the computers handy, refer students to the following website: <http://www.pbs.org/wgbh/nova/education/body/create-dna-fingerprint.html>

1. Take students through the activity, trying to keep them all going at a similar pace. The concepts are very well-explained, but make sure you try it beforehand and look deeper into anything you don't feel comfortable explaining.

2. (If available) Afterwards, revisit the real gel electrophoresis set-up to see if things have changed.

**Sources:**

1. DNA information: <<https://www.genome.gov/25520880>>
2. "Gel Electrophoresis and Forensic Science: Biotechnology Science Fair Project": <https://www.youtube.com/watch?v=QWkfXjGohVk>
3. "Create a DNA Fingerprint": <http://www.pbs.org/wgbh/nova/education/body/create-dna-fingerprint.html>