

DETECTIVE NOTES

Case File: 07



DNA

Key Questions:

- What is DNA? And what contains DNA?
- How can DNA be helpful to investigators when solving a crime?

Desired Outcomes:

- Students can explain what DNA is.
- Students can explain what contains DNA and what does not.
- Students can explain how important DNA is to investigating crime.

Activities and Timelines (30 minutes)

Introduction 10 minutes
What is DNA, and How to Use it as Evidence?

Main Activities 15 minutes
DNA Team Puzzle

Conclusion 5 minutes
Exit Pass

Resources

- Resource 7-1: What Contains DNA? - Images
- Resource 7-2: Exit Pass
- Resource 7-3: DNA Fingerprinting Video

Extension Activity

- Strawberry DNA Extraction Experiment
- Optional Video Resource 7-3: DNA Fingerprinting Video

Introduction

10 minutes

- **Ask:** Who likes chocolate chip cookies? What do we need to use in order to know what ingredients we need to make chocolate chip cookies?
 - ▷ **Answer:** a recipe!
- **Ask:** Did you know that DNA is like a recipe for our bodies? Who knows what DNA stands for?
 - ▷ Write on board: DNA stands for **d**eoxyribo**n**ucleic **a**cid.
- **Explain:** DNA is a large molecule that is found in all living cells. Our body is made up of trillions of cells. Each cell has its own job. DNA communicates to each cell what its job is.



- **Explain:** DNA looks like a twisted ladder and is packed with chromosomes. Chromosomes contain all the information that makes you unique – the colour of your hair, eyes, shape of your nose etc. and are inherited from your mother and father.
- **Brainstorm:** Ask students to discuss with their peers sitting close to them - What items do they think an investigator could collect DNA from?
- **Ask** for student answers and compile a class list of answers on the white board.



Teacher's note: the following is a list of answers with some discussion/teaching points that you can use:

- **Hair:**
 - ▷ A microscopic examination of hair may reveal tissue at the root. If this is the case, it would suggest that the hair was ripped out forcibly instead of falling out naturally. In order to get DNA from hair, investigators need to find hair that has the tissue (or the root) still attached. Hair that was shed naturally does not contain DNA.
- **Blood:**
 - ▷ Your blood is made up of 4 different parts – red blood cells, white blood cells, plasma and platelets.
 - ▷ Only white blood cells have DNA within whole blood. However, because of how tiny the different components of blood are, a drop of blood the size of a dime has more than enough white blood cells for an investigator to extract DNA.
- **Skin**
- **Fingernails**
- **Saliva:**
 - ▷ The DNA that is found in saliva is contained in cells shed from the inner lining of your mouth. Saliva itself does not contain DNA.
- **Tears**
- **Explain:** DNA can be found on most anything that comes from a body. We can find DNA in things like blood, hair and skin. We would not find DNA on something like a chair, or a pop can. However, if someone opened a pop can and took a drink, we could get DNA from the saliva they left. Similarly, we can't get DNA from the shirt you are wearing. However, if we find hair that was plucked from your head on your shirt, we could use that to extract DNA.

Main Activity

15 minutes

- **Materials:**
 - ▷ 2 copies of Resource 7-1
- **Teacher Prep:**
 - ▷ Print 2 copies of Resource 7-1
- **Explain:** We are going to be playing a game to determine if you can tell which items contain DNA.
- **Divide** the class into 2 groups (maintaining physical distancing).
- **Place** two copies of Resource 7-1: What Contains DNA Images on two desks in the front of the room.
- **Instructions:**
 - ▷ Each group must determine which photographs represent a source of DNA.
 - ▷ Groups will line up in single file; each in front of the stack of images placed face down.
 - ▷ One-at-a-time students must flip over an image, decide if it is a source of DNA or not, and sort it into a pile, left (DNA) or right (not DNA), then return to the back of their line.
 - ▷ The group with the greatest number of correct pictures wins. If the groups are tied, the fastest group wins.



- **Ask** questions to prompt discussion:
 - ▷ Example: Why would tire treads not contain DNA?
 - ▷ Can students think of any examples wherein there could be a source of DNA on tire treads (such as blood)? In this case, the DNA comes from the blood and not the tire tread itself.



Teacher's note: This activity can also be completed as a group by looking through the pictures on a smartboard or screen and deciding collaboratively whether the images represent a source of DNA or not.

Conclusion

5 minutes

- **Explain:** DNA analysis was first used in a criminal case in 1987 and since then has become one of the primary sources of evidence that forensic officers look for at the scene of a crime. When a crime is committed in Alberta, the DNA samples are sent to a crime lab for analysis. The typical waiting time to receive results is four – six weeks, although this time can be reduced for priority cases.
- **Optional: Hand out** Resource 7-2: Exit Pass for students to complete.

Optional Extension Activity: Strawberry DNA Extraction

30 minutes

- **Materials:**
 - ▷ Resealable plastic bag
 - ▷ 3-4 strawberries (fresh, or frozen that have been thawed)
 - ▷ 2 tsp dish detergent
 - ▷ ½ cup warm water
 - ▷ 2 plastic cups
 - ▷ 1 coffee filter (have an extra on hand, just in case!)
 - ▷ ½ cup COLD rubbing alcohol (91% or higher, place in freezer beforehand)
 - ▷ Popsicle stick, toothpick, or coffee stirrer
- **Instruct:**
 - ▷ Remove leaves from strawberries. If using frozen strawberries, make sure they are thawed.
 - ▷ Place strawberries into plastic bag, seal bag up, and gently crush/squish/squash the bag! Squish the strawberries for about 1 minute, or until most of the lumps are gone.
 - ▷ Now you are going to make the solution that will help extract the DNA from the strawberries.
 - ▷ In one cup mix: 1 tsp salt, 2 tsp dish detergent, and ¼ cup warm water.
 - ▷ Add this solution to the bag with the strawberries, reseal the bag, and gently squish for another minute. Try to avoid making too many soap bubbles!
 - ▷ Place a coffee filter in the second plastic cup. You may need a second person to help with the next part.
 - ▷ Open the bag and slowly pour the strawberry mixture in to the coffee filter.
 - Be patient! You might need to wait for some of it to drain before adding the rest of the mixture. Carefully twist the coffee filter and gently squeeze the remaining liquid in to the cup.
 - ▷ Tilt the cup and slowly pour cold rubbing alcohol down the side. Add as much rubbing alcohol as there is strawberry mixture. Do not mix or stir!
 - ▷ You should see two layers form in the cup. Watch for a cloudy substance to form in the top layer – that's the strawberry DNA!
 - ▷ After a couple of minutes, use your popsicle stick and pick up the DNA.
- **Conclusion Questions:** What were the two layers that formed when you added the rubbing alcohol? How is DNA useful for police officers?





Teacher's note: Try this activity again but use a different easy-to-mash fruit, like a banana.

- **Explain:** DNA fingerprinting is when forensic officers analyze DNA (found in hair, skin, saliva, etc.) in a lab to find out who it belongs to. This helps detectives solve crimes. This short video is going to explain how DNA is collected and analyzed.
- **Watch** Resource 7-3: DNA Fingerprinting Video.

Curriculum Links

Science: Evidence and Investigation

General Learner Expectations:

- 6-8: Apply observation and inference skills to recognize and interpret patterns and to distinguish a specific pattern from a group of similar patterns.
- 6-9: Apply knowledge of the properties and interactions of materials to the investigation and identification of a material sample.

Specific Learner Expectations:

- SLE 1: Recognize evidence of recent human activity.
- SLE 3: Recognize that evidence found at the scene of an activity may have unique characteristics that allow an investigator to make inferences about the participants and the nature of the activity and give examples of how specific evidence may be used.
- SLE 4: Investigate evidence and link it to a possible source.

