Robogals Science Challenge

Minor Challenge Set #3
STEM Field: Biology
Level: Intermediate
Challenge Name: Extracting DNA
Project Cost: 0-20 USD
Materials Required:

- A fruit or vegetable e.g.:
  - Sliced Onion
  - ½ of a Peeled banana
  - 3 Strawberries (remove green stems)
  - 1 Peeled Kiwi
- Surgical spirit or rubbing alcohol (isopropyl alcohol)
- 1 tablespoon Washing Up liquid (dish soap)
- 1 teaspoon Salt
- ½ cup Hot Water

- A spoon or similar for mixing
- A stirrer or similar to pick out the DNA
- A strainer e.g. a tea strainer or coffee filter

- A bowl or resealable food bag for mixing
- A tall glass for seeing the DNA

- Knife and chopping board for cutting (optional)
- Blender for mixing (optional)
- Pen and masking tape for labelling glasses (optional)

Safety:

- Adult supervision is required during experiment

- Although this experiment uses food, you **cannot** eat the experiment! Rubbing alcohol is poisonous.

Duration:

- This challenge takes approximately an afternoon to finish, however, the time guideline is an estimation only, and students and mentors can complete the tasks around their schedules

Introduction:

What do you and a banana have in common? You both have **DNA**!
Every living thing has DNA and normally we cannot see it.
In this experiment we will be able to see the DNA of a banana!

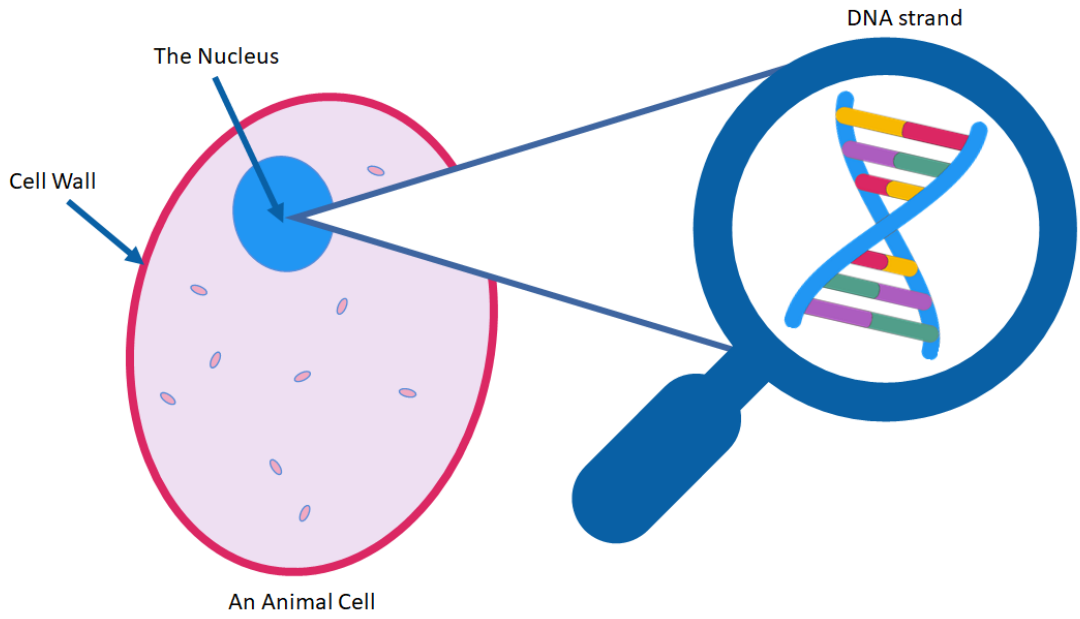
What is DNA?
DNA stands for: **D**eoxyribo**n**ucleic **A**cid

It is a molecule that contains the instructions a living organism needs to survive. It is what gives us our traits like hair colour and eye colour.

A molecule is the smallest particle in a compound. They are made up of atoms that are held together by strong bonds.

Where is DNA found?
DNA is found in the nucleus of every single one of our cells.

The nucleus is the structure that controls the cell and is also known as the “brain” of the cell.



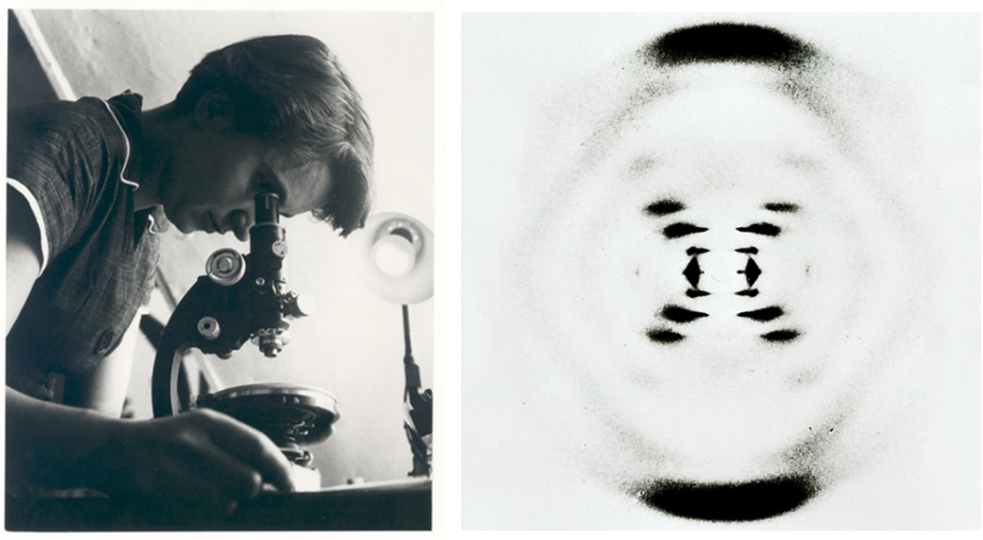
We can find **DNA**, which contains the **instructions**, inside the **nucleus** of cells which **control** what the cell does. The cell has a **cell wall** that keeps everything inside it.

DNA is special because it's what makes us **unique and different**.

What does DNA look like?

Normally we cannot see DNA. Today, we know what DNA looks like thanks to **Dr Rosalind Franklin**.

As part of her research, the first ever photograph of DNA was taken! This photo led to the discovery of the shape of DNA.



Rosalind Franklin and a Photo of DNA

DNA is a **double helix** shape or “twisted ladder”. Each DNA strand is very long, about 2 metres (6 feet) long! But they are too small to see.If we release DNA strands from inside their cells and tangle lots of them together, we will be able to see DNA and even touch it!

Instructions:

1) Put the alcohol in the freezer to keep it cold

2) Peel your fruit and mush it in the bowl or food bag until it looks like a pudding
    - Optional: You can use a blender to mush the fruit

3) Fill a cup halfway with hot water from the kettle

4) Add 1 teaspoon of salt and mix

5) Pour your mixture into your mushed fruit

6) Gently stir the mixture for half a minute

7) Add 1 tablespoon of washing up liquid (dish soap) and **gently** mix

8) Place the strainer on top of your glass. Pour the mixture through the strainer

9) Let the mixture drip through the strainer until all the liquid is in the glass

10) Tilt your tall glass and **slowly** pour the alcohol into the glass down its side. The amount of alcohol you pour should be the same as the amount of the mixture
    - Note: You want the alcohol to sit on top of your mixture and stay seperate

11) Wait 8 minutes

12) Take a look at the layer of alcohol in the glass. Can you see any cloudy material clumped together? This is the DNA!

13) Dip your stirrer into the alcohol and swirl it around to gather the DNA. Take the stirrer out and finally examine the DNA you extracted

Extension

Task A: Solve the Lollipop Thief!

DNA is unique to each of us. Even our fingerprints are unique! Play this game where you help solve the lollipop thief by looking at the fingerprint they left behind. Navigate to the link below on your computer:

https://stories.wgbh.org/create-dna-fingerprint/

Task B: Making Unique Fingerprints

If you are interested in learning more about DNA and the making of fingerprints, you can attempt the Biomedical Engineering - Senior project!

Reflection Questions:

- Are there any improvements you would make to this challenge?
- What real world application/s can you apply this challenge to?
- What are the key science and engineering concepts that relate to this challenge?

- Can you describe the DNA you extracted? What does it look like? What does it feel like?
- Why did we add washing up liquid (dish soap)? Hint: Think about where we find DNA. What is stopping it from moving out of the cell?

- Why did we add salt water? Hint: Remember we cannot see one single strand of DNA by itself.
- Why did we add alcohol? Hint: Where did you see the DNA in your glass?

Submission Guidelines:

- Submit a photo of the experiment setup. Include a short summary that addresses the reflection questions.

> Note: Remember, if you want to upload pictures of your Minor Challenge that also include you, please check if it is OK with your parent or guardian first.

- The submission form is on the Minor Challenges page: https://sciencechallenge.org.au/index.php/minor-challenges/ Fill out the details and make sure you upload your submission.

Learn More! Resources:

- If you want to know more about where DNA comes from, take a look at this website that takes you on the Journey to DNA: Cracking the Code of Life | Journey into DNA

- DNA gives us our unique traits. Does that mean we could make a unicorn?! Watch this video by MIT to find out: #askMIT: Could you make a unicorn by crossing DNA?

- If you enjoyed this activity you might be interested in the field of biotechnology. Watch this video about why Sandra Bustamante became a Research Assistant:

Career Profile: Research Assistant Sandra Bustamante | PBS LearningMedia

Bibliography:

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- Rosalind Franklin's Life - The Rosalind Franklin Institute [online] Available at: https://www.rfi.ac.uk/about/rosalind-franklin/ [Accessed 15 Mar. 2022].
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- Banana DNA Extraction - Arizona State University [online] Available at: https://askabiologist.asu.edu/activities/banana-dna [Accessed 15 Mar. 2022].