Extracting DNA from fruit

Activity Guide

This hands-on activity allows you to extract the DNA from fruit using household items.

Suitable for: age 7+
Estimated duration: 30 minutes

You will need:

- Fruit such as strawberries, bananas, blueberries, etc
- Table salt
- Washing-up liquid
- Water
- Vodka (chilled)
- Toothpicks
- Cups for mixing
- Small cups for DNA solution
- Sealable plastic bag
- Large jug
- Sieve
- Spoon
- Measuring cylinder or jug (up to 100 ml)
- Toilet roll or paper towels (in case there are spillages)
- Instruction sheet

Introduction

A bit like a recipie book, all the biological instructions for making an organism are contained in a long molecule called DNA (deoxyribonucleic acid). All living things, from humans and mice to plants and bacteria, have a unique set of instructions written in the four chemical letters of DNA: A, C, G, and T. Although it's not visible to the naked eye, we know that DNA has a unique shape. It is a double helix that looks a bit like a twisted ladder.

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DNA is found inside the cells of all living things. In animals, plants and fungi most of the DNA is found inside the nucleus – the information centre of the cell. As it is such a long molecule (the DNA in one human cell is 2 metres long!) it is packaged into bundles, known as chromosomes. This makes sure it all fits inside the nucleus.

This activity will enable learners to extract DNA from fruit using household ingredients. Although common, these ingredients and the way learners will use them is very similar to how scientists extract DNA in the lab.

Running the activity

Set up

1. Put the vodka in the freezer overnight. It works best if really cold.
2. To speed things up you can premeasure the salt, water and washing-up liquid into cups or other containers (this is optional)
3. Follow the instructions and do a practice run of the activity to make sure you are clear on how the process works.
4. Set up equipment. Amounts given are for each participant / group.

- Instruction sheet
- Handful of fruit, e.g. 3 strawberries or half a banana
- Sealable plastic bags
- Measuring cylinder or jug (if group are measuring out themselves)
- Cups for mixing water, salt and washing-up liquid together
- 5g of salt (about one heaped teaspon)
- 5 ml of washing-up liquid
- 50 ml of water
- Large jug
- Sieve
- Small cups for DNA mixture
- 10 ml of vodka
- Bowl of toothpicks

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Warm up discussion

- Begin the activity by discussing with the group what they know about DNA and its shape.
- Discuss that DNA has a unique shape – a double helix that looks a bit like a twisted ladder. The rungs of the ladder are made up of 4 letters, A, C, G, T, and the letters pair up in a particular way: A with T, and C with G.
- Discuss that DNA is found in all living things from the very tiny to the very large. DNA is found in cells (animal, plants, fungi, bacteria etc.). All the DNA in a cell is known as a genome and provides the instructions to make that living thing function.
- You might want to show the group this page to support this activity: https://www.yourgenome.org/theme/what-is-dna/

How to complete the activity

1. Explain to the group that they are going to extract DNA from some fruit.

2. Show the group the instruction sheet that they will follow. You can also show this video that has all the steps: https://youtu.be/ojGRBQ2FjP8

3. Share with the group that there are three main processes in this activity, preparation, lysis and precipitation. A short summary of these processes is given below:

- During **preparation**, mixing the ingredients makes a solution that will break down the fruit cells and release the DNA.
- During **lysis**, the cells that make up the fruit are being burst open by the prepared solution leading to the DNA being released into the liquid.
- During **precipitation**, alcohol is used to bring the DNA out of solution and appears as a gloopy solid which can then be collected.

4. Demonstrate the **preparation process** (steps 1-3 on instruction sheet), then get the group to follow:

- The solution of washing-up liquid, water and salt, is great at breaking up the fruit cells.
- Washing-up liquid bursts the cells that make up the fruit (much like detergent cuts through grease when cleaning).
- Salt helps in this process of releasing DNA from the cell. Later on in the protocol the salt will help to draw the DNA out of the solution

5. Demonstrate the **lysis stage** (steps 4-6), then get the group to follow:

- The prepared solution is often called a lysis buffer ('lysis' being the act of breaking open cells).
- Squashing the fruit into smaller pieces speeds up the lysis process by physically breaking up the tissue or flesh of the fruit. This then exposes more of the cells to the solution, enabling them to be burst open by the lysis buffer.
- Sieving the mixture into a jug separates the left over fruit chunks from the DNA-containing liquid.

6. Demonstrate the **precipitation stage** (steps 7-9), then get the group to follow:

- Slowly pouring cold alcohol down the side of the cup, will lead to it forming a clear layer sitting on top of the fruit solution. This is because the alcohol has a different density to the fruit solution.
- The DNA in the fruit solution comes into contact with the alcohol where the two layers meet.
- DNA is not soluble in alcohol (and is even less so because of the salt in the solution) so it precipitates out of the solution.
- The DNA now appears as a white, gloopy solid that you can fish out of the cups with a toothpick.

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Discussion guide

Ask the group, whether they were able to extract any DNA? Did they see the DNA? Was it as they expected? If not, why not?

The DNA you have extracted from the fruit probably looks like mucus or snot. It is such a long molecule that it bunches up into clumps. There could also be some other materials from the cells there as well.

To help visualise this, let's think about human DNA. If you were to stretch the DNA out from just one human cell it would stretch about 2 metres! Try that with a piece of string. Humans are made of around 37 trillion cells –all the DNA in a human would stretch roughly to the sun and back almost 250 times!!!

Finally, let's think about strawberry DNA. Ask the group if they think a strawberry has more or less DNA than a human?

Strawberries have a lot of DNA in their cells. The genome size is smaller than a human but it has lots of copies of it packed into its cell, in fact four times as much as a human cell does. That's because humans have two copies of their genome per cell, but a strawberry has eight!

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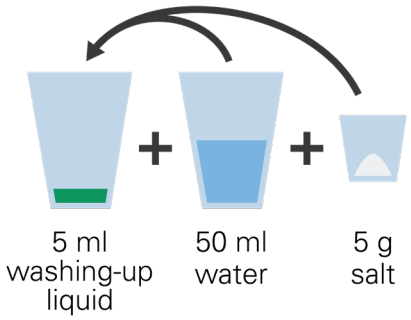
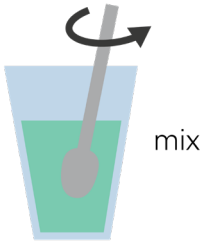
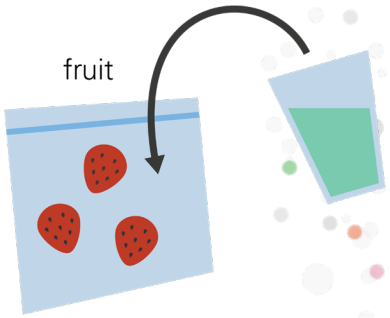
Instruction Sheet



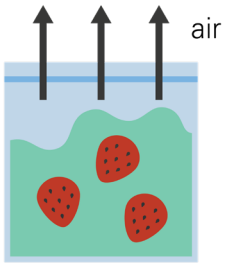
1. Mix the washing-up liquid, the water and salt in one cup.



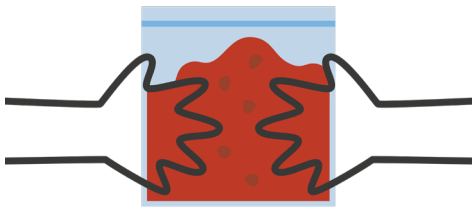
2. Stir gently to mix it all together.



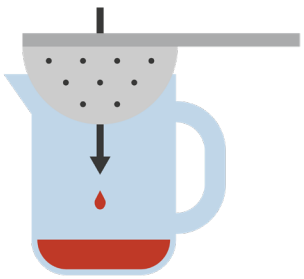
3. Put the fruit in a bag and add the mixture.



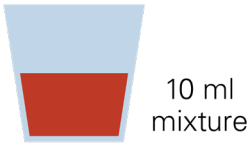
4. Squeeze the air out and seal the bag.



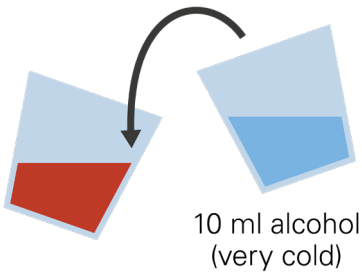
5. Squash to break up cells and release the DNA.



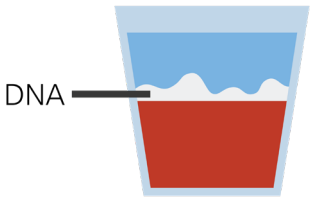
6. Pour the fruit mixture through the sieve and into the jug.



7. Half fill a small cup with the liquid from the jug.



8. Slowly pour very cold alcohol down the side of the small cup.



9. You should see white clumps forming in the clear layer... that's DNA!