

EXTRACTING DNA FROM FRUIT

Activity overview

Age: 7 – 14 years old

Time: 30 min

Topics: DNA, living things

Learning objectives:

- DNA is found in the cells of all living things.
 - DNA can be extracted from cells.
-

BACKGROUND

A bit like a recipe 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.

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 participants to extract DNA from fruit using basic household ingredients. They will be using essentially the same chemicals and processes that are used when DNA is extracted in the lab!

Find out more

Read this fact page about DNA:

www.yourgenome.org/facts/what-is-dna

Read this fact page about cells:

www.yourgenome.org/facts/what-is-a-cell

Watch this video to see how to extract DNA from strawberries:

www.yourgenome.org/activities/extracting-dna-from-fruit

EXTRACTING DNA FROM FRUIT

Activity overview

ACTIVITY PREPARATION

Materials

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

Set up

1. Put the vodka in the freezer overnight. It works best if it is 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 (ideally the day before) to make sure you are clear on how the process works.
4. Set up each group (or table) with:
 - Fruit
 - 10 ml of vodka (if possible, put it in a different container and label as alcohol)
 - 5 g of salt (about one heaped teaspoon) in a small cup
 - 5 ml of washing-up liquid in a cup
 - 50 ml of water in a cup
 - Measuring cylinder or jug
 - Jug
 - Sieve
 - A bowl of toothpicks
 - Sealable plastic bags
 - Cups for mixing water, salt and washing-up liquid
 - Small cups
 - Instruction sheet

EXTRACTING DNA FROM FRUIT

Activity overview

ACTIVITY GUIDANCE

Warm up

1. Ask the participants if they know what DNA is. Ask them what they know and to describe its shape. Use PowerPoint slide 1 to help with this.
2. Explain 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. Use the image from (www.yourgenome.org/facts/what-is-dna) or PowerPoint slides 2 and 3 to help illustrate this if needed.
3. Explain that DNA is found in all living things from the very tiny to the very large. Ask if they can name a living thing that has DNA? Explain that 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 can use PowerPoint slides 4-8 to help illustrate this.

Run the activity

1. Now the group is familiar with DNA, explain that they are going to extract DNA from some fruit. You can use the final slide of the PowerPoint to show the steps involved.
2. Show them the instruction sheet that they will follow.
3. Explain to the groups that there are three main processes in this activity. A short summary of these processes is given below:

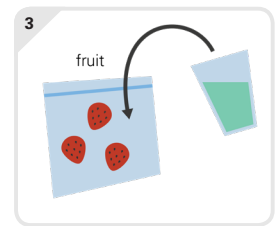
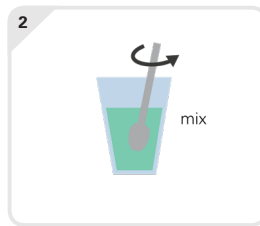
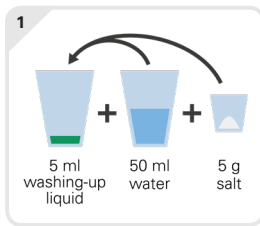


- During **preparation**, mixing the ingredients makes a solution that will break down the fruit cells and release the DNA.
- During **lysis**, the cells that make up the fruit are being burst open by the prepared solution leading to the DNA being released into the liquid.
- During **precipitation**,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

EXTRACTING DNA FROM FRUIT

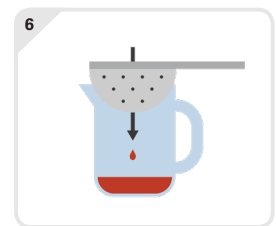
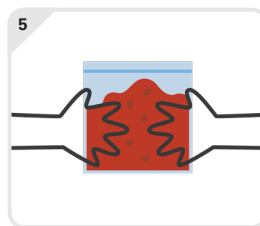
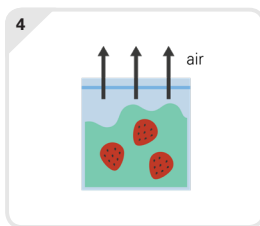
Activity overview

4. Demonstrate the **preparation process** (steps 1-3):



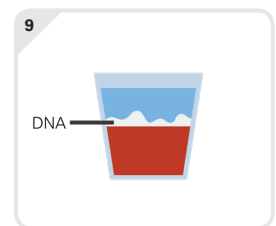
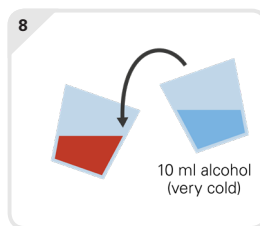
- The solution of washing-up liquid, water and salt, is great at breaking up the fruit cells.
- Washing-up liquid bursts the cells that make up the fruit (much like detergent cuts through grease when cleaning).
- Salt helps in this process of releasing DNA from the cell. Later on in the protocol the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

5. Demonstrate the **lysis stage** (steps 4-6):



- 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):



- 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.

EXTRACTING DNA FROM FRUIT

Activity overview

Reflect on it

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 400 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!

Take it further

Did you get DNA from the strawberry? Why don't you take it further and see if you get as much DNA from another fruit? What about another type of berry? Or how about a banana or apple? What other fruit could you try?

Do you want to explore the topic of DNA further? Why not try making an edible DNA model from sweets or make a DNA sequence bracelet?

Yummy gummy DNA: www.yourgenome.org/activities/yummy-gummy-dna

Sequence bracelets: www.yourgenome.org/activities/sequence-bracelets