DNA

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Acknowledgements

This resource was originally developed by the University of Reading to support outreach work delivered as part of the Chemistry for All project.

To find out more about the project, and get more resources to help widen participation, visit our Outreach resources hub: rsc.li/3CJX7M3.

Guidance notes

This session should take approximately two hours to complete in full. It was initially created for 11–14 year-old learners but can adapted when teaching genetics to other age groups.

Download the PowerPoint presentation, technician notes and student workbook that accompany this resource at rsc.li/3RDNTaW.

Read our health & safety guidance, available from rsc.li/3IAmFA0, and carry out a risk assessment before running any live practical.

The safety equipment suggested is in line with CLEAPSS requirements. For non-hazardous substances, wearing lab coats can help to protect clothes. The safety rules might be different where you live so it is worth checking local and school guidance.

Introduce DNA using **slides 3–5** of the PowerPoint. Ask the learners what they already know about DNA and link this to the inheritance of genes and why we have similarities in our appearance to our parents and siblings.

Career links

Senior director of chip research

Use **slide 6** of the PowerPoint to introduce learners to Jason, a senior director of chip research at Oxford Nanopore Technologies. He works with other scientists to sequence DNA during viral outbreaks or during the discoveries of new species. The video is also available from rsc.li/3ZMJAh1.

Executive editor, scientific publishing

Use **slide 11** of the PowerPoint (video also available at rsc.li/3YNjKZd) to introduce learners to Katie, an executive editor in scientific publishing. She works with scientists around the world to promote and publish their findings in leading scientific journals.

Learning objectives

- Describe the role of DNA in living things.
- Describe the main processes involved in extracting DNA from plant cells.

Demonstration: extracting DNA from strawberries

Demonstrate the method for extracting DNA from strawberries and explain to the learners they will use the same method to extract DNA from kiwi fruit in the activity later. Use **slides 7–10** of the PowerPoint to introduce the demonstration and draw learners' attention to the main steps in the method.

On **slide 8**, during the demonstration, point out to learners that the 'strawberry extraction solution' contains detergent, water and salt. Discuss why they think we use each of these three ingredients. The learners will answer this question in their student workbooks later in the session. The detergent breaks down the fatty cell membrane to release the DNA, and the salt makes the strands of DNA bind together so they become visible.

On **slide 9**, explain that two layers will form – as this is a key part of the experiment, make sure you really highlight this during the demonstration, so learners know how to do it correctly. Explain that the pineapple juice breaks down the cell membrane further to release more DNA. Explain how strands of DNA start rising from the bottom to the top of the upper ethanol layer and can be seen in the colourless upper layer.

Encourage learners to record their observations in the space provided in the student workbook during the demonstration.

The method for this demonstration is also included in the student workbook for reference and to allow learners to be able to use this method themselves depending on time available and teacher preference.

Equipment

- Medium-sized strawberries
- Zip-lock bag
- 10 ml measuring cylinder
- Boiling tube
- Boiling tube rack
- Coffee filter
- Funnel
- 1 spatula/glass rod
- 1 wire hook
- Plastic Pasteur pipette
- Stop clock (or phone)
- Strawberry extraction solution in beaker, labelled (100 ml detergent : 720 ml water : 30 g salt)
- Chilled ethanol
- Pineapple juice
- 250 ml beaker

Safety and hazards

Ethanol is highly flammable and can cause eye irritation so wear eye protection and a lab coat to protect your clothes.

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1. Take a medium-sized strawberry, place it in a zip-lock bag and 'squish' it to form a mush.
2. Using a clean 10 ml measuring cylinder add 10 ml of strawberry extraction solution to the bag.
3. Reseal the bag and continue to 'squish' for three minutes, making the lumps as small as possible.
4. Place a boiling tube in a boiling tube rack, place a funnel containing a coffee filter in the top of the boiling tube and empty the contents of the zip-lock bag into the coffee filter.
5. Once filtered, remove the funnel and using a pipette add five drops of pineapple juice to the boiling tube and gently stir the solution with a spatula or glass rod.
6. Tilt the boiling tube to an angle of 45° (this increases the surface area). Using a clean pipette, slowly run chilled ethanol down the side of the tube onto the surface of the strawberry extract until you have a 3 cm layer of ethanol on top of the strawberry solution.
7. Place the boiling tube back in the boiling tube rack and leave to stand. Visible strands of DNA should start to form and rise from the interface between the two liquids.
8. Once the DNA strands have visibly formed, remove them using a wire hook.

Activity 1: extracting DNA from kiwi fruit

Learners will be using the same method used in the demonstration and can work individually or in pairs depending on the availability of resources.

Depending on time available, learners should follow the methods in the student workbook so they all do the practical twice – once without using pineapple juice and once using pineapple juice.

Use **slide 13** of the PowerPoint to introduce the activity.

While learners are engaged in the practical, look for good examples to highlight at the start of the discussion. Use the hook to demonstrate pulling out stands of DNA from learner samples.

Give learners five minutes to answer the questions in their student workbook (also on **slide 14**) before going through the answers on **slide 15** as a class discussion.

Answers

(a) The process of 'squishing' the fruit separates the cells and allows the DNA to move out of the cell nucleus.

(b) The amount of DNA extracted varies between different plants.

(c) There was a greater amount of visible DNA produced when pineapple juice was used compared with the amount produced when pineapple juice was not used. The pineapple juice helps to break down the cell membrane to release more DNA.

(d) The detergent breaks down the fatty cell membrane to release the DNA. The salt makes the strands of DNA bind together so they become visible. As DNA does not dissolve in ethanol, it forms a jelly-like substance so becomes more visible.