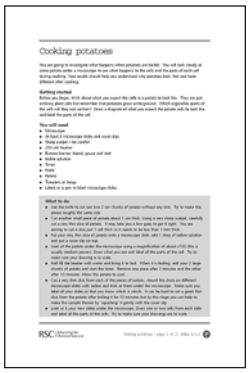
RSC | Advancing the Chemical Sciences

Cooking potatoes


Cooking potatoes

Index 4.1.1
2 sheets

The aim of this practical activity is for students to observe and appreciate the changes that take place when a potato is cooked. The vast majority will be aware that the potato changes – this activity will help show what those changes are.

The activity takes at least 30–40 minutes.

Prior knowledge required

Students will need to know the structure of a plant cell, or should be reminded of it at the start of the lesson. A diagram of a plant cell is shown below:

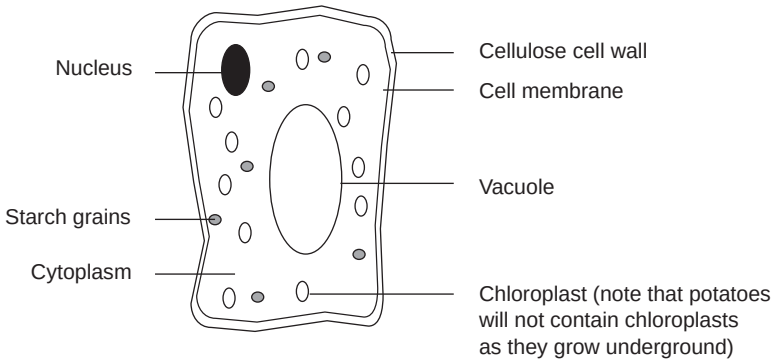


Figure 1 A plant cell

Equipment required

For each student or group of students:

- Microscope
- At least 3 microscope slides and cover slips
- Sharp scalpel – warn students to take care with this
- 250 cm^3 beaker
- Bunsen burner, tripod, gauze and mat
- 0.01 mol dm^{-3} iodine solution – either in a dropping bottle or with a plastic dropper pipette
- Timer

- Knife
- Potato (one average sized potato will be enough for 4 or 5 groups)
- Tweezers or tongs
- Labels or pens to label microscope slides.

Notes

For students who struggle with practical work (or if you wish to avoid handing out sharp scalpels) you could have the potato already cut into pieces and very thin slices. These slices will not keep and will dry out very quickly so this cannot be done much in advance of the lesson. You may wish to amend the worksheet.

Using a kettle to boil water will help cut down the time required.

Students can look at one sample under the microscope while another is boiling if they are able to do this and keep track of the time.

It may help students if you set up a digital microscope and link it to a television or computer screen (particularly if you can project the images). Students with particularly good slides could show these to the class. You can then discuss what changes take place during cooking. This is better done alongside a class practical rather than instead of it.

Answers to questions

1 and 2. The main changes that take place in the cells of a potato when it is cooked are:

- The cell membrane ruptures
- The membrane around the vacuole breaks
- The membrane around the starch grain breaks and the starch grain swells up, although it initially remains intact
- The cell wall breaks down and the contents, including the starch, begin to disperse.

The first two can be difficult to see under the microscope. The cell membrane is very thin and is usually in close contact with the cell wall. The latter two points show up very well. The starch grains swell noticably and iodine staining makes them clearly visible. You can also see that the starch initially remains in the cells. As time progresses, the iodine-stained starch begins to spread into the gaps between cells and the grains no longer have a distinct spherical shape. You can see some breakage of the cell walls.

3. As the potato is cooked its texture becomes softer and ‘squishier’.

4. The reason for the change in texture is the rupturing of the cell walls. When they are intact they hold the potato in a rigid shape. They are strong and hard to break just by gently pressing on the potato. As the walls break down they no longer have a strong rigid structure. Breaks in the structure mean that the potato begins to collapse, which gives the softer, ‘squishier’ texture.

Cooking potatoes

You are going to investigate what happens when potatoes are boiled. You will look closely at some potato under a microscope to see what happens to the cells and the parts of each cell during cooking. Your results should help you understand why potatoes look, feel and taste different after cooking.

Getting started

Before you begin, think about what you expect the cells in a potato to look like. They are just ordinary plant cells but remember that potatoes grow underground. Which organelles (parts of the cell) will they not contain? Draw a diagram of what you expect the potato cells to look like and label the parts of the cell.

You will need

- Microscope
- At least 3 microscope slides and cover slips
- Sharp scalpel – be careful
- 250 cm^3 beaker
- Bunsen burner, tripod, gauze and mat
- Iodine solution
- Timer
- Knife
- Potato
- Tweezers or tongs
- Labels or a pen to label microscope slides.

What to do

- Use the knife to cut out two 2 cm chunks of potato without any skin. Try to make the pieces roughly the same size.
- Cut another small piece of potato about 1 cm thick. Using a very sharp scalpel, carefully cut a very thin slice of potato. It may take you a few goes to get it right. You are aiming to cut a slice just 1 cell thick so it needs to be less than 1 mm thick.
- Put your very thin slice of potato onto a microscope slide, add 1 drop of iodine solution and put a cover slip on top.
- Look at the potato under the microscope using a magnification of about x100 (this is usually medium power). Draw what you see and label all the parts of the cell. Try to make sure your drawing is to scale.
- Half fill the beaker with water and bring it to boil. When it is boiling, add your 2 large chunks of potato and start the timer. Remove one piece after 2 minutes and the other after 10 minutes. Allow the potato to cool.
- Cut a very thin slice from each of the pieces of potato, mount the slices on different microscope slides with iodine and look at them under the microscope. Make sure you label all your slides so that you know which is which. It can be hard to cut a good thin slice from the potato after boiling it for 10 minutes but by this stage you can help to make the sample thinner by 'squishing' it gently with the cover slip.
- Look at it your new slides under the microscope. Draw one or two cells from each slide and label all the parts of the cells. Try to make sure your drawings are to scale.

Questions

1. What differences could you see between the samples of potato?

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Which parts of the cell change when the potato is cooked?

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Use diagrams to show what the cells are like before cooking, after two minutes and after ten minutes of boiling.

2. Describe in words what happens as the potato is cooked.

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3. What happens to the texture of the potato as it is cooked?

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4. Explain from your results why these changes happen.

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