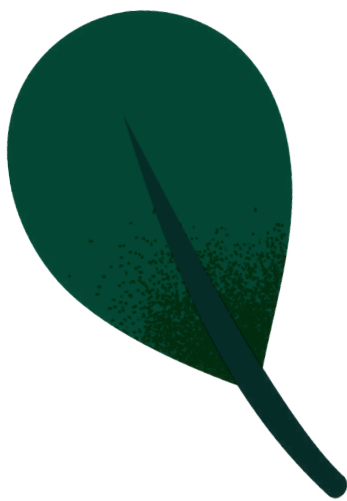


Hot Stuff!

Year 3 – Science

Year 4 – Health and Physical Education



(Science; Yr 3, ACSSU046)

A change of state between solid and liquid can be caused by adding or removing heat

(Science; Yr 3, ACSSU049)

Heat can be produced in many ways and can move from one object to another

(Science; Yr 3, ACSIS053)

With guidance, identify questions in familiar contexts that can be investigated scientifically and make predictions based on prior knowledge

(HPE; Yr 3 & 4, ACPPS036)

Identify and practise strategies to promote health, safety and wellbeing

Hot Stuff!

Let's take a closer look at the different kinds of heat we use to cook food, and what that can mean for nutrition.

Water, steam, and dry heat all react differently with food. Heat can transfer from object to object and cause chemical changes, such as the way the brassica family of vegetables smell different when they're overcooked...

Equipment:

A kettle

A pair of long heat-proof tongs

plenty of sprigs of one soft herb such as basil, mint, Vietnamese mint, coriander, parsley

A source of heat (cooking can be done in advance and brought to class – see notes within lesson)

About a quarter of red cabbage shredded

A heat-proof see-through jug such as a Pyrex jug

A timer

Pieces of pumpkin, and onion, tossed in olive oil and baked at 200°C for 25 minutes (do in advance)

Duration:

45 minutes, with optional cooking session afterwards

Location:

The classroom or the kitchen

Steamy!

👁️ Watch **The One with the Corn Off**



- ❓ Ask the class to tell you what happens to water when it is heated.
- How hot does water need to get in order to turn into water vapour?
- ⚠️ Boil a kettle and observe the steam coming out. (SAFETY: keep the kettle well away from students.)
- Discuss the temperature of steam (100°C) and why it's produced. (Water turns to vapour at 100°C – up until this point it exists as a liquid, not a gas).



Herbal steam bath

- Boil the kettle again (keeping the steam well away from students) and use the heatproof tongs to hold a fresh herb sprig in the steam for 20–30 seconds.
- Basil and mint work well (they should go floppy and a bit brown).
- Hand around a fresh (un-steamed) piece of the herb and, when it's cooled down, the one that you just treated to a steam bath.

What are the observable differences? Make a chart listing observations from each of the five senses:

- ❓ **Smell** – does the steamed herb smell different?
- ❓ **Touch** – what is the texture? Is it floppy or perky?
- ❓ **Sight** – can we see any visual difference in colour or surface shine?
- ❓ **Sound** – what sound does it make if we snap a stem or squash a leaf?
- ❓ **Taste** – does anyone want to taste test both and provide words to describe the differences? (E.g. is the steamed herb stronger tasting? In what way?)
- Bring students' attention back to temperatures – if steam is around 100°C, then what temperature must the steamed herbs have reached?
- Speaking in terms of energy, what has the steam given to the herb? (The steam has transferred energy to the herb in the form of heat, and the energy has changed the herb.)
- Ask the class to tell you of any instances when steam is used to cook food (Have they eaten anything steamed before?)

Super Steam

Steam's temperature is 100°C, or very close to, at normal air pressure. When pressurised, steam can be super-heated. This is how a pressure cooker works, and why pressure cookers cook food faster than steam or boiling water (it's also why we need to be extra careful when releasing the pressure!)

In hot water

- Boil the kettle again. Place the red cabbage in the Pyrex jug (exact amounts aren't crucial here) saving one or two pieces to remain uncooked. Get the timer ready.
- Ask students to observe as you pour the boiling water over the cabbage.
- Start the timer and have students check 'progress' at 1, 3 and 5 minutes.
- Discuss what students see happening. Very soon, purple dye from the cabbage is leaching (running out) into the water. The water should go a bright pinky-purple colour over the course of a few minutes.
- The hot water is conveying energy into the cells of the plant (the cabbage). The cells are breaking up and the purple dye, which is normally held inside, is dissolving into the water.
- Explain that this is how all vegetables respond to heat, but the cabbage's purple dye makes the effect particularly visible. Their cells break and the natural substances including in this case purple dye, leach out into the water. The nutrients we want to eat for good health run out into hot water the longer they sit in it.
- Discuss that this is why we try not to overcook vegetables. It causes them to lose their nutritional value as well as their flavour (and they get mushy). It's also why we grab a grownup to help us lift vegetables out of hot water as soon as they're cooked.

Cold cabbage bath

- Do students think the same leaching would occur to purple cabbage in cold water?
- Take a vote! If students think 'yes', pause the lesson and have them design a cold-water cabbage experiment. Run the experiment with them, take observations and compare the results of the new experiment with those from the hot-water cabbage bath experiment.

Sulphate sniff test

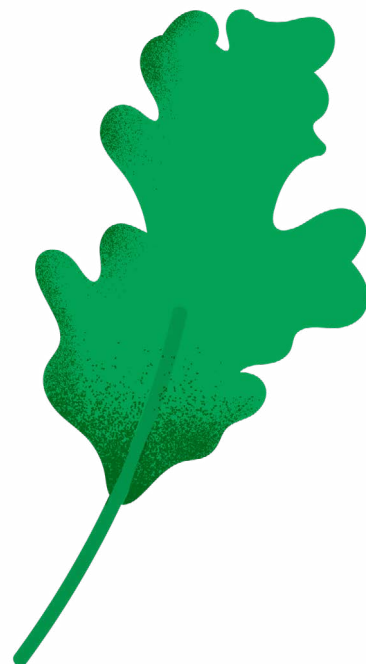
👁 Watch **The One where we Smell Pee for Science**



Hot tip

If your students liked the purple cabbage water, try the lesson called 'Colour Change' where you use the purple cabbage water for some exciting kitchen chemistry.

- Ask a volunteer to sniff some of the (cooled) cooked cabbage and comparatively sniff an uncooked piece of the cabbage. What do they observe?
- The cooked cabbage will probably smell a bit 'whiffy'. Whatever words students use to describe it, what they're perceiving is a mild sulphate which occurs when heat breaks down several natural substances in cabbage (including mustard oil, which is there to repel insects, but that's another story).
- Sulphates are volatile – they turn to vapour – and that means we definitely pick them up with our noses! The longer you boil cabbage, the more sulphates it produces.



Lexicon

leaching	The action of a water-soluble substance as it drains away from a solid. In nature, leaching occurs where rainwater soaks soil, ash, compost, rubbish. In cooking, it occurs when food nutrients drain into the cooking liquid.
sulphide	A naturally occurring volatile compound that smells a bit like rotten eggs.
vapour	A gas.
volatile	A volatile substance boils at a low temperature, changing easily from a liquid to a gas.

Sugar bake

- Ask students to think carefully and then tell you if they think there are sugars (plural) in vegetables.
- Explain that you said 'sugars' as a clue – there are more kinds of sugar than the white refined stuff. Lots of vegetables produce their own sweet compounds that are natural vegetable sugars (think of sweet corn, juicy carrots and capsicum sticks – sweet!)
- There's another way to get plenty of natural sugars out of vegetables and it involves heat. Explain that the reaction from browning, or caramelising veggies (there's a clue in the word caramel) also has a fancy French name, the Maillard ('may-yard') reaction. It occurs when foods are exposed to high heat, over 150°C.
- The key is this:
 - ◇ Water boils at up to 100°C – so browning can't occur in water.
 - ◇ Steam stays at or just above 100°C – so browning can't occur in steam.
 - ◇ Oil and hot ovens can bake at high heats – e.g. 200°C – so they are perfect dry heat to enable browning to occur.
- Share the pumpkin slices cooked earlier – they should be brown on their surface. Explore, sniff and students are welcome to eat them.
- Discuss how this kind of heat, browning (and the Maillard reaction) brings out the natural sugars in bitter flavours, such as Brussels sprouts, onions and broccoli.

Resources

- ◇ Harold McGee – Simple keys to boiling vegetables (video: duration 1:38): <https://youtu.be/DSJciG9tOng>
- ◇ Science Nordic – Why you should steam your vegetables: <http://sciencenordic.com/why-you-should-steam-your-veggies>