

# Fabulous Food Waste: Citrus

Years 7 & 8 Science  
Years 7 & 8 Technologies



**(Science, Year 7, AC9S7U06)**

Use a particle model to describe differences between pure substances and mixtures and apply understanding of properties of substances to separate mixtures

**(Science, Year 8, AC9S8U06)**

Classify matter as elements, compounds or mixtures and compare different representations of these, including 2-dimensional and 3-dimensional models, symbols for elements and formulas for molecules and compounds

**(Science, Years 7 and 8, AC9S7I02 and AC9S8I02)**

Plan and conduct reproducible investigations to answer questions and test hypotheses, including identifying variables and assumptions and, as appropriate, recognising and managing risks, considering ethical issues and recognising key considerations regarding heritage sites and artefacts on Country/Place

**(Science, Years 7 and 8, AC9S7I05 and AC9S8I05)**

Analyse data and information to describe patterns, trends and relationships and identify anomalies

**(Technologies, Years 7 and 8, AC9TDE8K06)**

Analyse how characteristics and properties of materials, systems, components, tools and equipment can be combined to create designed solutions

**(Technologies, Years 7 and 8, AC9TDE8K05)**

Analyse how properties of foods determine preparation and presentation techniques when designing solutions for healthy eating

# Citrus Chemistry & Food Waste

## Sunny citrus oil is special stuff

Green or orange, yellow or pink, the peel that wraps your fave citrus is too good to throw away. Citrus peel is full of essential oils and nutrients, and we can use it in so many ways. We explore some of the uses of this fabulous natural resource, and delve into the chemistry to see *why* citrus oil is so valuable.



### Before you start :

Read the activities and decide which ones you would like to do with students.

Gather the ingredients and equipment.

### Equipment:

Fresh lemons, limes, oranges, grapefruit and/or mandarins

Kitchen equipment as listed in the kitchen activities you decide to do.

Chemistry lab equipment if you decide to do the basic steam distillation of essential oils.

### Duration:

45 minutes, more if you do all the optional activities

### Location:

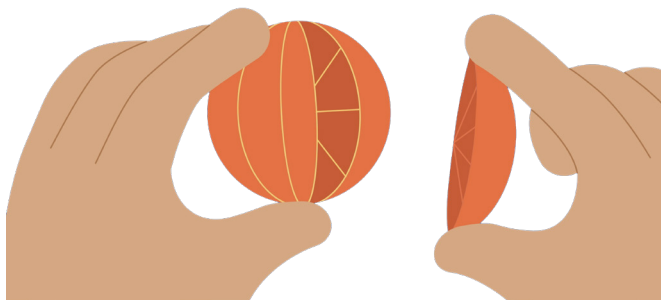
The kitchen or science lab

### Notes:

## Getting Started



- Discuss student experiences of citrus fruit.
- Identify foods students know or have tried that include grapefruit, oranges, lemons, limes, mandarin oranges and possibly finger limes!
- Has anyone picked lemons, mandarins or other citrus? They're most prolific in winter when there is plenty of water in the soil for their juicy flesh to develop full flavour. But you can buy fresh citrus most of the year round.
- Ask the class if they can tell you some of the uses of citrus peel named in the Nomcast episode. Uses of citrus peel range from insulation material to perfumes, bioplastics and biofuels, animal feed, fertiliser, medicines, air freshener, cleaning fluid and cosmetics.



## Taste test

- You could bring in some examples and slice them for students to explore the taste, texture, aroma, colours and forms of the fruit – or do the simple kitchen activities below.

## The grizzly facts on food waste:

- Ask the class to write a definition of food waste.
- There are many definitions of food waste in use, but for our purposes we define food waste as all food that was intended for human consumption that is thrown away after harvest. (It also includes leftover cooked, processed and part-cooked food.)
- (If you need it, a clear definition and many more facts on food waste can be found on the Food Bank Australia website: [www.foodbank.org.au/food-waste-facts-in-australia](http://www.foodbank.org.au/food-waste-facts-in-australia))
- Tell the class: every year, about 310 kg of food waste is thrown out for every person in Australia.
- That's about the same weight as your average adult grizzly bear. (Thankfully, bears aren't usually found in Australia or in your fruit bowl.)
- Technically the peels of citrus, for example after you have made orange juice, are a grizzly-free zone because they we don't tend to eat the peels. This kind of waste is termed 'organic waste'.
- Working out ways to harness the benefits of organic waste and food waste are both big growth areas for design and technical specialists, and entrepreneurs.
- Across Australia, big projects are underway to stop food waste and organic waste from going into landfill.
- This is because when organic matter rots in anaerobic (zero oxygen) environments, such as inside garbage bags, it produces greenhouse gasses and other emissions that contribute to global warming and climate change.

## If you have a kitchen

These easy ideas are sustainable uses of citrus peel that make use of the natural volatile organic compounds found in all citrus fruit. Use the chemistry content below to discuss how and why the properties of citrus make them perfect for these culinary uses (and others, such as orange essential oil for aroma in perfumes).

### Delicious citrus oil

This citrus oil can be used in baking and vegetable dishes to add a fresh citrus flavour.

- You will need a vegetable peeler, a heat proof jug such as a Pyrex measuring jug, a microwave, a sieve, a funnel and a bottle.
- You will use 250mL olive oil, 1 orange and 1 lemon

### What to do:

- Wash the orange and lemon. Dry them on a teatowel or paper towel.
- Measure 250mL olive oil into the heat-proof jug.
- Using the vegetable peeler, peel the waxy outer skin from the lemon and the orange. Try to avoid including the bitter white pith from below the coloured skin layer. Place the peels in the olive oil in the jug.
- Place the jug in a microwave and on LOW POWER gently heat the liquid for 30 seconds, then stir it. Continue heating until it is slightly warmer than your body temperature. Do not do this on high power and always watch it as it warms!
- Leave the jug, covered, at room temperature to steep for 3 hours.
- When the oil is completely cool and has steeped, set up the funnel in the top of a clean bottle, sieve the mixture and put the peels in the compost.
- Seal the bottle and keep it in the fridge. Makes 1 cup, and can be used for up to 3 weeks.

- Find a simple recipe for an olive oil cake – replace the olive oil with this oil to add a citrus flavour. Use it as a base to salad dressings and dips or as a drizzle on steamed or roasted vegetables (like roasted carrots, with a bit of honey too, mmmm...)

### Orange oil skin scrub

This gentle skin scrub removed oil and dry skin, and makes a great gift.

- You will need a microwave, a heat-proof bowl, metric measuring cups and spoons and a small glass jar with a lid in which to keep your scrub.
- You will use 90mL coconut oil, 2 tablespoons avocado oil, 250mL plain white sugar, a few drops of orange essential oil.

### What to do:

- Melt the coconut oil in a bowl in the microwave. Stir in the avocado oil, the plain white sugar and the orange essential oil.
- When the mixture is thoroughly combined, spoon the scrub into a small jar with a lid. Fasten the lid and add a nice label. Keeps for 6 months at room temperature.



## The ap-peel (appeal, get it?) of citrus peel

- Demonstrate why citrus peel has so many uses.
- Take a fresh citrus fruit (any kind) and scratch the skin with a vegetable peeler or any rough implement (even your fingernail will do it).
- Ask students to sniff the skin and try scratching it themselves (it's the original 'Scratch and Sniff!')
- Explain that there are several naturally occurring volatile organic compounds in citrus peel that give it its distinct properties.
- Explore the definition of volatile organic compounds in chemistry.
- Organic compounds are chemicals that occur naturally. They contain carbon and are found in all living things.
- Volatile organic chemical compounds evaporate easily at room temperature and are generally not soluble in water.
- Volatile organic compounds in plants contribute to the aromas and flavours we perceive. Refer to strongly scented foods such as vanilla, citrus fruit, onions, rosemary, mint and basil.
- Discuss how the fact that these compounds are not soluble in water determines the way the essential oil can be extracted. Explore and explain what a cool steam distillation process is. (An [image can be found here](#) that may help.)

Discuss the chemistry of the key ingredients distillation extracts from citrus peel.

- **limonene** – despite its name, there is more limonene in orange peel than in lemon. It has grease-removing and antibacterial properties and is used as a solvent in degreasing metals prior to industrial painting, as well as in electronics manufacturing and in printing. Despite its name, there is more limonene in orange peel than in lemon peel, which is why orange peel has more grease-removing qualities.

- **monoterpenes** – these volatile oils do not dissolve in water, which enables us to extract them using steam. Monoterpenes are hydrocarbons that contribute greatly to the flavour and aroma of many plants. They have anti-fungal and anti-bacterial properties. There are more monoterpenes in lemon peel than in orange peel.
- **pinene** – a common liquid hydrocarbon in plants, pinene contributes the sharp, piney, woody scent associated with plants like pine trees and rosemary. It is also in citrus. Pinene is of particular interest to the biofuels industry for its volatile properties and potential uses.

## Citrus chemistry in the lab

If you have the equipment for a simple steam distillation, head to the science lab to make distilled citrus oil.

These two videos show how essential oil and hydrosol for home uses are made.

- [Le Time – Citrus Oil Distillation](#) (YouTube video: duration 09:19)
- [Albrigi Luigi – Mandarin oil by distillation](#) (YouTube video: duration 03:46):

