

Key inquiry questions

How can we use **filtration** to separate out a mixture (wastewater) to help protect public health and the environment?

Time: 2 x 45-60 min

Syllabus outcomes

SC4-1VA, appreciates the importance of science in their lives and the role of scientific inquiry in **increasing understanding of the world around them.**

SC4-13ES-explains how advances in scientific understanding of processes that occur within and on the Earth, influence the choices people make about **resource use and management**

SC4-17CW-explains how scientific understanding of, and discoveries about the properties of elements, compounds and **mixtures relate to their uses in everyday life.**

Syllabus Content

CW3 Mixtures, including solutions, contain a combination of pure substances that can be separated using a range of techniques.

- investigate the application of a physical separation technique used in everyday situations or industrial processes - **water filtering.**
- research how people in different occupations use understanding and skills from across the disciplines of Science in carrying out separation techniques.
- identify different ways of **separating mixtures.**
- explore reasons for separating mixtures - **water purification (treatment).**
- separate the components of some common mixtures through techniques including **filtration.**

ES4 Science understanding influences the development of practices in areas of human activity such as industry and resource management.

- demonstrate how scientific knowledge of the **water cycle** has influenced the development of household, industrial and agricultural water management practices

Working scientifically skills

SC4-5WS - collaboratively and individually produces a plan to investigate questions and problems.

SC4-6WS - follows a sequence of instructions to safely undertake a range of investigation types, collaboratively and individually.

SC4-7WS - processes and analyses data from a first-hand investigation and secondary sources to identify trends, patterns, and relationships, and draw conclusions.

Sydney Water aim for activity

- Our core objectives are to protect the environment and protect public health. Every day we provide clean safe drinking water and treat your wastewater.
- In this lesson, we'll investigate what's in our wastewater and how we use filtration as one of the steps in water treatment.
- This practical investigation will show how we use working scientifically skills in water management.
- We'll explore the importance in carrying out separation techniques in a real-life application. To treat wastewater to a high quality to re-use as recycled water and to protect the environment.

Teaching and learning

Lesson 1: Introduction – What is filtration? How can we use it?

Q. Have you ever wondered what happens to water after you've used it inside the house?

A. Probably not! Water is an excellent solvent that dissolves and picks up things. Once you've used this amazing drinking water – it becomes a mixture we now call wastewater and goes down the drain. Wastewater is 99% water and the remaining one per cent is made up of things you've added. It goes through the pipes to our wastewater treatment plants where we clean the water.

Did you know? We treat the wastewater for re-use as recycled water and to protect the environment, keeping rivers and creeks healthy. See our Wastewater treatment and Water recycling webpages for more information.

Resources

[Wastewater treatment
sydneywater.com.au/education/Wastewater-recycling/Wastewater-treatment](http://sydneywater.com.au/education/Wastewater-recycling/Wastewater-treatment)

[Water recycling
sydneywater.com.au/education/Wastewater-recycling/Water-recycling](http://sydneywater.com.au/education/Wastewater-recycling/Water-recycling)
[Solids recycling
sydneywater.com.au/education/Wastewater-recycling/Solids-recycling](http://sydneywater.com.au/education/Wastewater-recycling/Solids-recycling)

Activity: Hands up if you use water? Care about the environment? Care about science? We all care about water. To look after it, we need to understand science. You will be a water scientist today and look at how we can use scientific knowledge of separation techniques to manage water.

Q. How do we treat mixtures of water and solids? How can we turn wastewater into recycled water and make sure it's clean enough to re-use and safe for the environment?

A. One thing that scientists have learned from nature is how to separate a mixture using filtration. We have been separating water and solids through filtration for thousands of years. Filtration is just one of the many separation techniques we use to clean water that you'll learn about in your science class.

Did you know? We got our ideas about filtering water from the natural water cycle. Filtration or infiltration is the process in the water cycle where water seeps through rocks. Turns out the water gets cleaner when this happens! Humans have filtered water to make it clean to drink for thousands of years. Australia's First Nations people treated water by using grasses and other vegetation to filter out sediments. The ancient Egyptian uses sand to filter water for drinking too. See our Natural water cycle and Water quality and filtration pages webpages for more information.

Q. What is filtration?

A. Filtration is a process used to remove solid particles from a mixture by passing it through a filter. Filters are devices that remove solids from a mixture passing through them. See our Glossary webpage for more definitions.

Activity: Compare infiltration in nature and filtration at Sydney Water plant. What similarities and differences are there? Watch and compare *Sydney Water Cycle animation* on our Natural water cycle webpage and *Sydney Water Filtration animation* on our Water quality and filtration webpage.

Here are some questions to get you thinking.

Q. How does water quality change, in nature compared to an urban environment?

A. There are many influences of water quality in an urban environment.

- In nature, water runs off through the landscape. It picks up things like dirt and leaves as it runs into a catchment or the sea.
- In urban environments, we call run off, stormwater. Stormwater hits hard surfaces and pavements and flows to natural waterways. It picks up everything on those surfaces such as litter, oil, sediment, animal droppings and anything else left behind by people.
- We can help by reducing our littering and use water sensitive urban design to help filter this water. We also have water that flows through pipes like wastewater. This is filtered at wastewater treatment and water recycling plants.

See our Urban water management, Stormwater and Wastewater treatment webpages for more information.

Q. Which flow do you think is faster? Infiltration in nature or filtration at a plant?

A. Cleaning water through infiltration in nature is variable depending on the soil, rocks and water. It can also take years and years to seep through. At a filtration plant, we use science to speed up the processes. We do this meet demand for water supply by our customers.

Q. What makes a good filter? Is it natural?

A. We often use natural materials because they're great at trapping the suspended solids and are easy to clean.

[Natural water cycle
sydneywater.com.au/education/drinkin-g-water/Natural-water-cycle](https://sydneywater.com.au/education/drinkin-g-water/Natural-water-cycle)

[Urban water management
sydneywater.com.au/education/water-management/Urbanwatermanagement](https://sydneywater.com.au/education/water-management/Urbanwatermanagement)

[Stormwater
sydneywater.com.au/education/water-management/Stormwater](https://sydneywater.com.au/education/water-management/Stormwater)

[Glossary
sydneywater.com.au/education/programs-resources/Highschool/glossary](https://sydneywater.com.au/education/programs-resources/Highschool/glossary)

[Water quality and filtration
sydneywater.com.au/education/drinkin-g-water/Water-quality-filtration](https://sydneywater.com.au/education/drinkin-g-water/Water-quality-filtration)

[High school
sydneywater.com.au/education/programs-resources/Highschool/](https://sydneywater.com.au/education/programs-resources/Highschool/)

Did you know? Scientist and engineers at Sydney Water spend a lot of time thinking about making the best filters. We've taken observations of natural processes and improved them so we can filter water on an industrial level. We must make filters that:

- clean the water effectively making the water meet standards to protect health and the environment
- clean the water efficiently to meet the demand for water use by our customers. We treat over 1 billion litres per day! It also must be affordable, so our process must aim to be the lowest cost too
- are easy to clean for ongoing re-use.



Q. Do you think you can make a filter that will clean water?

A. Yes, we can! Go to our High school webpage to find the *Make a simple water filter* sheet and watch the *Water filter experiment* for more details.

Activity: Lay everyday items in front of your students. A sieve, tea strainer or sink strainer, a hair net or shower cap, a toy, clothing, a bottle, a potted plant, whatever is laying around. Get the students to:

- discuss if each of these materials can be used as a filter? Are they a “device” that separates water from solids?
- think about if they could turn these materials into a better filter.
- make a design plan for your experiment next lesson.

Lesson 2: Practical investigation – Make a simple water filter

Activity: Look at all the equipment and method on the *Make a simple water filter* sheet – make a quick risk assessment as a class. Then test and build the best filter within the time limit.

Risk	Rating	Control
Cut/Abrasion	M	Elimination – use plastic containers Administration – be careful with sharp scissors
Poison	L	Administration – follow instructions on packages, don't consume the substances

There are several ways you could deliver this activity:

1. Easy - give all students the same sample of water and make it a competition to see whose water is the cleanest by the end of the lesson.
2. For the thinking class - give each group a different sample of water or different materials and ask them to present their findings as a comparison. See the *Make a mock water sample* factsheet on our High school webpage for some ideas. We suggest you use the wastewater sample for best results.
3. Extension – resource recovery as well as clean water. Can you recover all the items and make use of them such as organics, non-organics and water?

Did you know? Our old filter material can also be recycled for purposes like construction. We also recycle as much of the solid waste as possible. Most of the organic solids are turned into a safe fertiliser called biosolids. See our Wastewater treatment and Solids recycling webpage for more information.



Q. Who do you think has the best filter? Why? Did you manage to think like a Sydney Water scientist or engineer?

A. Students to think about whether their filter:

Sydney Water resources

[Wastewater treatment](https://www.sydneywater.com.au/education/Wastewater-treatment)
[sydneywater.com.au/education/Wastewater-treatment](https://www.sydneywater.com.au/education/Wastewater-treatment)

[High school](https://www.sydneywater.com.au/education/programs-resources/Highschool/)
[sydneywater.com.au/education/programs-resources/Highschool/](https://www.sydneywater.com.au/education/programs-resources/Highschool/)

<ul style="list-style-type: none"> cleans the water effectively cleans the water efficiently is easy to clean out and materials can be recycled. <p>Q. Why is filtration important in everyday life?</p> <p>A. It helps us clean water that was otherwise in a messy mixture. Filtration helps clean our wastewater so we can use it again and protect the environment. Imagine if we didn't filter wastewater, what could your local waterway look like!</p> <p>Q. Think about the water you just filtered. What would be the impact if there were less pollutants in the sample?</p> <p>A. The less solids there are to filter, the more efficiently the filter will work. It won't become clogged as often, so it won't need to be cleaned as frequently.</p> <p>Q. Can you make your wastewater have less pollutants? What can you do at home to make wastewater easier to filter?</p> <p>A. Some things aren't meant to go into wastewater or in water at all! Rubbish like wipes, plastics should go in the bin, food scraps, oil and grease should either go into the bin or compost. These items can block pipes leading to overflows - where wastewater comes back up and out of pipes ewwww! These items make it more difficult to recycle water. See our Wastewater treatment and Clean up not down webpages for more information.</p>	
<p>Extension – we have a range of experiments and lesson ideas you can use to demonstrate separation techniques used at our wastewater and water recycling plants. See our High school webpages for more information. You can also see some of these techniques by:</p> <ul style="list-style-type: none"> downloading our other lesson plans and experiments to investigate separation techniques and the application of scientific knowledge used in managing water. Go to our High school webpage for more information reading about treatment processes on our Penrith Water Recycling Plant webpage. 	<p>Penrith Water Recycling Plant sydneywater.com.au/education/Wastewater-recycling/Water-recycling/penrith-water-recycling-plant</p>
<p>Conclusion</p> <p>Evaluation questions</p> <ul style="list-style-type: none"> How did you use your scientific skills to make the best filter to separate water? Did you think about your water and filtration before today? What pollutants can you remove from water to help us and the environment? <p>Reflection activity - Students finish these statements</p> <ol style="list-style-type: none"> I used to think(at the start of these lessons) But now I think(at the end of these lessons) 	<p>Sydney Water resources</p> <p>Find out more</p> <ul style="list-style-type: none"> sydneywater.com.au/education facebook.com/SydneyWater  instagram.com/sydneywater  twitter.com/SydneyWaterNews 