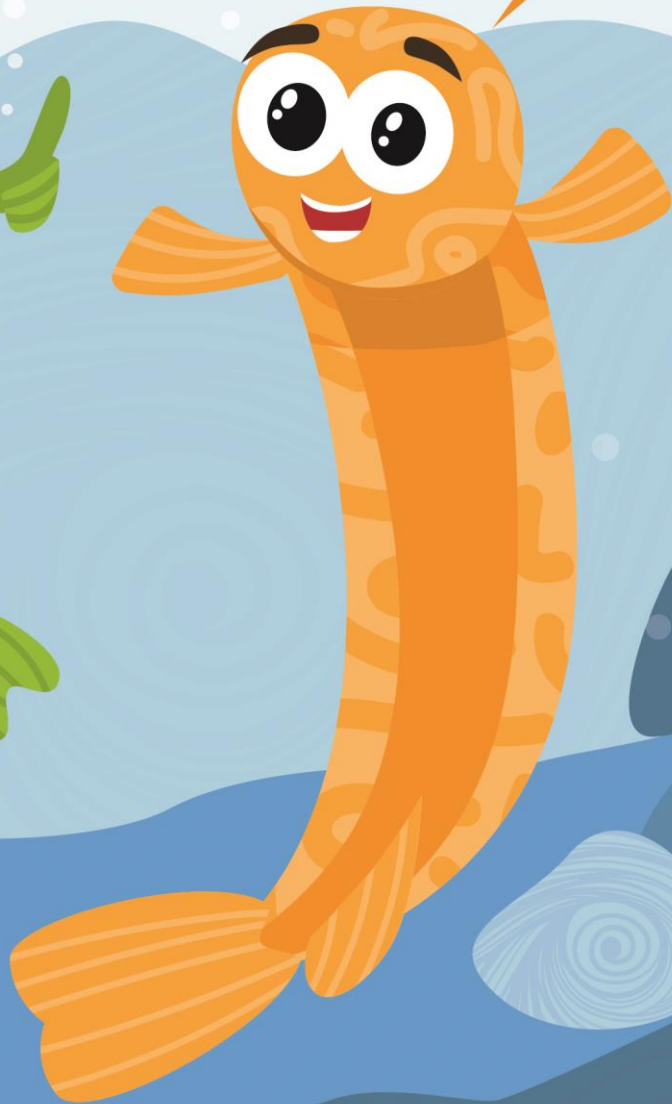


HE PUNA WAI

Hi I'm Ian the
Inanga



I'm Koro the
Kokopu



Wastewater

Let's learn about wastewater!



Wastewater

Activity	Subject Areas	Inquiry Stage
7	Science	3. Pūhuru: Splash around

Q Overview

Learn about wastewater and what can happen when different items get into the wastewater system.

Key Concepts

- Wastewater is water that we have used, which goes down drains and sinks.
- Wastewater flows from the piped network to the wastewater treatment plant.
- The wastewater treatment process
- Items such as wet wipes, sanitary products and rags shouldn't go into the wastewater system; these can cause problems and blockages.

🔗 Curriculum links

New Zealand Curriculum

Learning Areas	Levels	Years
Science Nature of Science: Investigating in Science	3-4	5-8
Material World: Chemistry and society		

🧠 Learning intentions

Students are learning to:

- Understand what wastewater is and where it goes.
- Investigate the effects of water and shaking on a range of items.

📖 Success criteria

Students can:

- Describe what wastewater is and where it goes.
- Observe and record the effects of immersing items in water and shaking.

Background information: Wastewater

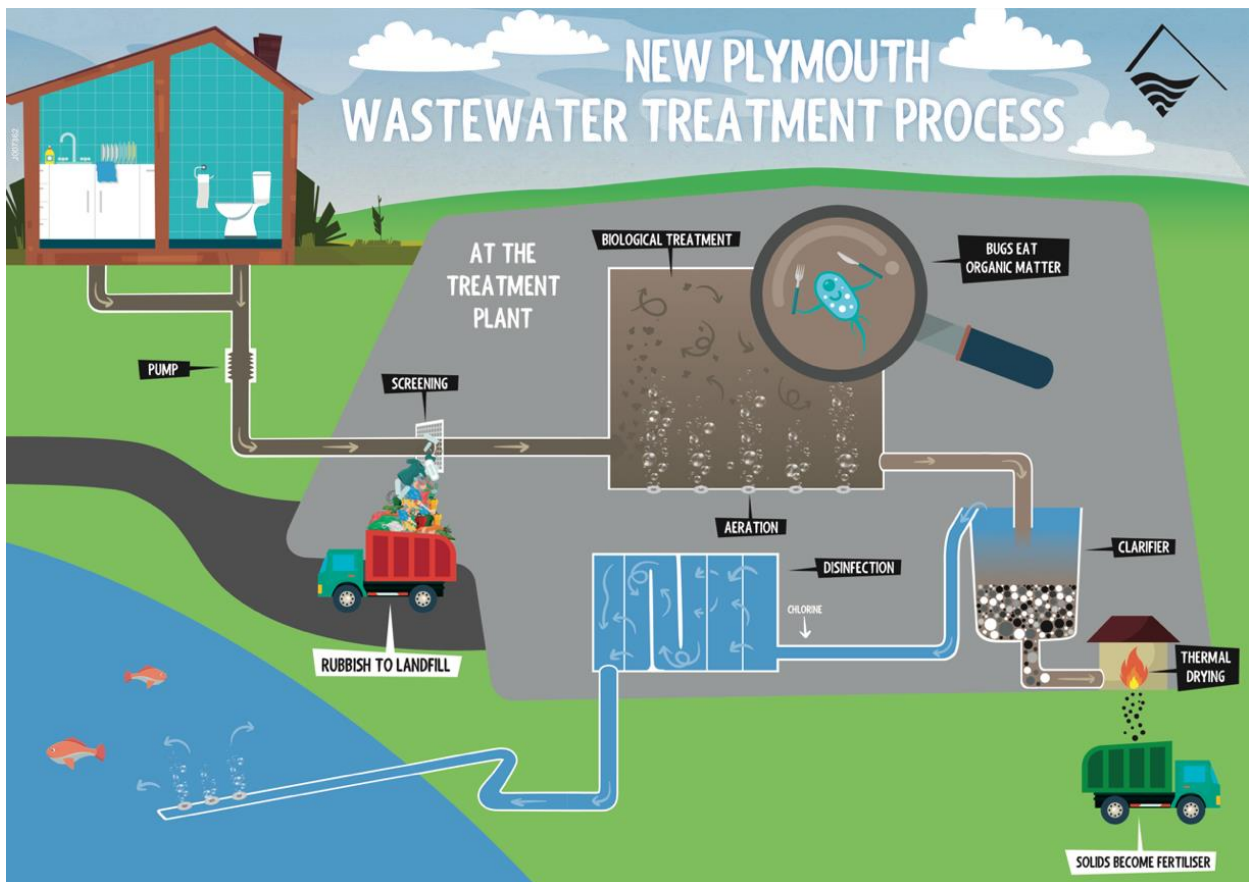
What is wastewater?

Wastewater is the used water that goes down sinks, washing machines, showers, baths and toilets. Wastewater is made up of about 99 per cent water and one per cent other waste such as plastic, rags and rubbish.

Where does wastewater go?

Wastewater from Oakura, New Plymouth, Bell Block, Inglewood and Waitara is all pumped to the New Plymouth Wastewater Treatment Plant in the Waiwhakaiho Valley. Once the water has been treated it is tested to ensure it is safe and clean, then it is piped out into the sea.

Rural properties and those in Okato, Egmont Village, Lepperton, Tikorangi, Onaero and Urenui have private septic tank systems where wastewater is treated on their own property. Private septic tanks need to be cleaned out every few years this wastewater comes to the New Plymouth Wastewater Treatment Plant.



Did you know?

22 million litres of wastewater is treated each day at the New Plymouth Wastewater Treatment Plant

Pumping wastewater

Wastewater leaves your property via underground pipes. All of the wastewater from Inglewood, Waitara, Bell Block, Oakura and New Plymouth is pumped to the New Plymouth Wastewater Treatment Plant. Because wastewater is going against gravity, pumps are needed to send the water to the wastewater treatment plant. There are 37 smaller pump stations which send wastewater to the five larger pump stations. Sometimes rags and wet wipes get tangled in these pumps and the pumps stop working.

Screening

When wastewater arrives at the wastewater treatment plant it first passes through screens to filter out items that shouldn't be in there. These items are removed from the wastewater. Some commonly found items include rags, wet wipes, sanitary products, cotton buds and plastic. Between five and six tonnes of rubbish are removed each week from wastewater in New Plymouth! This rubbish is disposed of at the landfill.

Biological treatment

Biological treatment is the second stage, where naturally occurring microscopic bugs feed on the organic matter in the wastewater. These helpful bugs are encouraged to grow and breed with the addition of oxygen. These tiny bugs can be seen under the microscope; one drop of water can have hundreds of bugs in it.

Clarifying

The third stage of treatment is clarification. This is where the bugs are separated from the water in the clarifiers. The bugs are heavy so they settle to the bottom of the clarifier. These excess bugs are dried and sold as fertiliser, while the clear water on top of the clarifiers is taken to be disinfected.

Disinfection

The water is disinfected with a chemical called sodium hypochlorite this is a type of chlorine similar to what goes into swimming pools. The water then flows through a maze for 15 minutes to make sure the chlorine has had time to kill every last bug. Now that the water has been completely cleaned it is piped 450m out into the ocean.

Thermal Drying

Excess microscopic bugs are mechanically squeezed to remove water before they are cooked in a huge rotating drum oven fuelled by natural gas. In the thermal dryer the temperatures reach 600-700 degrees Celsius with a minimum temperature of 85 degrees when the product leaves the oven. These temperatures ensure all the pathogens and bugs are killed creating a safe to use fertiliser.

Soluble and insoluble

Soluble materials will dissolve in water: they will essentially disappear into the water and become part of it. Insoluble materials do not dissolve in water.

What can I put into the wastewater system?

The wastewater system can only handle water and a very small amount of insoluble material (e.g. toilet paper). It is best to put insoluble items into the red landfill bin rather than flush them down the loo.

Toilets are designed to flush only the 3 Ps (Pee, Poo and toilet Paper).

If rubbish such as wet wipes, rags, cotton buds, nappies and sanitary items go down the toilet they can cause serious blockages and are costly to dispose of. This can result in blocked pipes and blocked pumps. If these items enter the system, they need to be removed from the water and are taken to the landfill.

This activity aims to show students what can happen when insoluble items are introduced into the wastewater system.

Papatū ā nuku and Tangaroa

We care for Papatūānuku (the Earth Mother) and Tangaroa (atua of the sea) when we treat wastewater. Care is taken to ensure the treated water returning to Tangaroa is clean. The water leaving the wastewater treatment plant meets the safe guidelines for swimming.

The wastewater treatment plant produces a high-quality fertiliser from the excess microscopic bugs used in the treatment process. This fertiliser is safe to use on all types of gardens, allowing nutrients to be returned to Papatūānuku. Papatūānuku has nurtured, protected and cared for all her children and grandchildren for her whole life and she continues to do so today. It is so important that we nurture, protect and care for Papatūānuku in return, so that she can remain strong and healthy for us in the future.

Learning experience: Wastewater

These are suggestions only and are intended to be altered to suit your students and their needs.

Resources

Presentation:	Wastewater treatment
Posters:	New Plymouth Wastewater Treatment Plant Water New Zealand 2019 Māori language week poster- https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=3855
Student activity sheet 7:	Wastewater treatment process Page 6
Student activity sheet 8:	Observing changes in a wastewater system Page 9

Reflecting on previous learning

- Revisit ideas/concepts from previous activities. Reflect on prior knowledge, inquiry and experiences of students, altering the learning sequence according to these.

Introducing the wastewater system

- Introduce the wastewater system with the Wastewater treatment presentation
- Identify where students could find wastewater at school or at home. Discuss which inside sinks and water appliances drain into the wastewater system, for example: toilets, urinals, sinks, dishwasher, washing machine, showers and baths.
- Clarify the difference between the stormwater system (untreated) and wastewater system (treated). Water used on the driveway and gutters along the road will go into the stormwater system, which ends up in streams and then the sea.
- View the New Plymouth wastewater treatment plant poster and complete student activity sheet 7: Wastewater treatment

The water cycle

- Explore the water cycle and te reo Māori wastewater vocabulary using the *Water New Zealand 2019 Māori language week poster*: https://www.waternz.org.nz/Attachment?Action=Download&Attachment_id=3855. Discuss how wastewater relates to the water cycle. Treated wastewater is discharged and re-joins the water cycle.

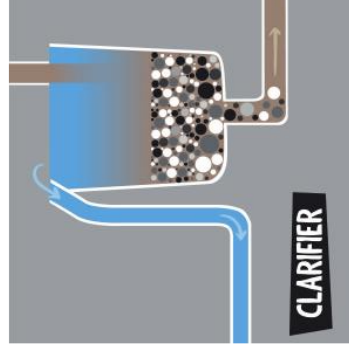
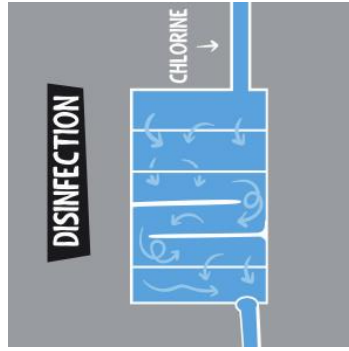
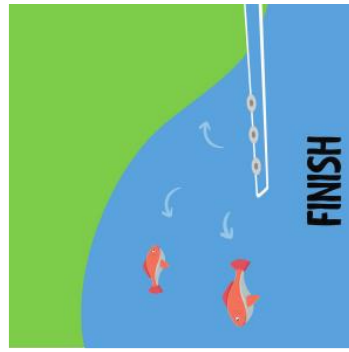
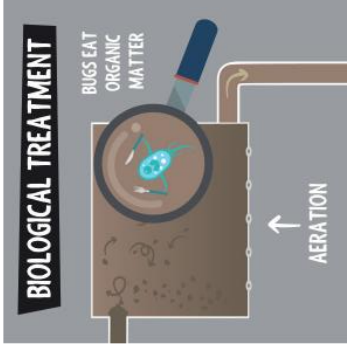
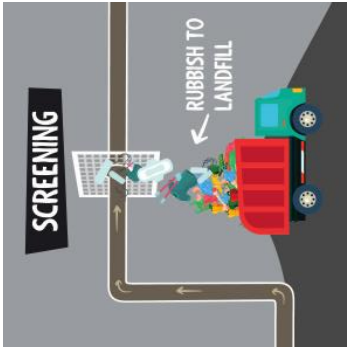
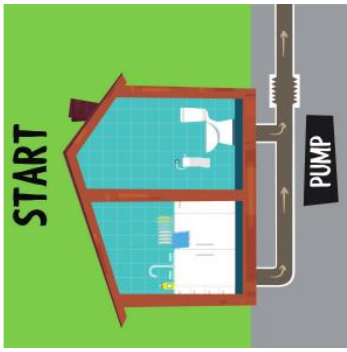
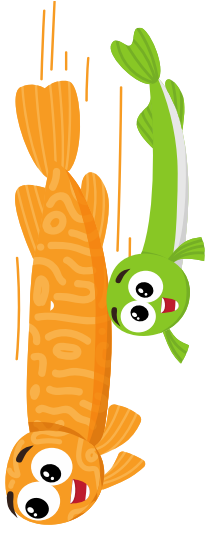
Problems for the wastewater system

- View the Wellington Water wastewater video: <https://www.youtube.com/watch?v=zwoaAP5OmfU>
After viewing, discuss: how did the owners of 'Louie the Toilet' not look after him very well? How can we all look after the wastewater system?
- Investigate what happens when things enter the wastewater system, using the 'Shaking up wastewater experiment' on page 7

Student Activity Sheet 7

Wastewater Treatment

Explain the wastewater treatment process in your own word.



Experiment: Shaking up wastewater

Aim of experiment: Investigate the impact of different items on the wastewater system.

Learning Objectives

After this activity, students should be able to:

- Describe what happens to items in the wastewater system.
- Outline why certain items should not go into the wastewater system.

Items you will need



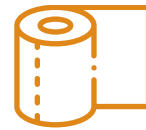
3 clear plastic bottles of the same size.



Fresh water.



A kitchen colander or large-holed sieve.



Three different items that might enter a wastewater system, such as toilet paper, flushable wipes, nappy liners, pieces of nappy, paper towels, tissues, and fats and oils (add one item per bottle of water).

Method

1. Set up clear plastic bottles and add water. Imagine that these bottles are the wastewater pipes in your home and under the road.
2. Place a different item in each of the three plastic bottles. These items could be toilet paper, paper towels, wet wipes, oil or fat, or a piece of nappy. Ensure lids are on tight and label each bottle.
3. Shake each bottle for five seconds at a time, and then leave to settle to see what impact the shaking has made. This movement is similar to what happens in the pipes underground.
4. After 10 minutes make the next observation and record on the template on page 9. Use describing words and phrases such as: disintegrate, break up, come apart, stay together, insoluble, etc. to explain what has happened to the items.
5. Wait until the next day and look at the bottles to see what has happened overnight to your items. Observe what has happened in each bottle and make notes about your observations.
6. Pour the contents of each bottle into a colander or large-holed sieve to mimic the screening stage of wastewater treatment. What happens to the material in the bottles? What will go through the holes and what does not? (The screens at the wastewater treatment plant are 5mm wide, therefore anything larger than that will be removed from the water. Toilet paper dissolves and fits through the screens.)



Left: wet wipe after shaking for one minute. Right: toilet paper.

Discussion

Discuss why some groups may have different results than others.

Why did some items disintegrate/break up, while others didn't?

Students should find through their experimentation that only toilet paper has broken down with the shaking, whereas other items such as wet wipes and oils have not broken down. This is because toilet paper is more fragile, thinner and is made from only a few layers of paper fibres. If you used three-ply toilet paper the results can vary; one-ply works most dramatically. Items such as nappies and cotton buds may include materials such as plastic and therefore will take many years to break down, even in water.

Student Activity Sheet 8

Observing changes in a 'wastewater system'



Observations

Item added to bottle

After 5 seconds of shaking

After 10 minutes

The next day

Conclusions

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Reflecting on Learning

Do the results of the experiment make you think differently about what you put into the wastewater system? (Only the three 'P's: poo, pee and toilet paper, will break down/disintegrate in the wastewater system.)

Conclusion: Other than water, only pee, poo or toilet paper should go into the wastewater system.

Extending learning

- Discuss the bigger implications of blockages on the wastewater system. Investigate recent and past blockages in your area. What caused these? How can we prevent this happening in future?
- Which behaviour changes and changes in purchasing decisions could have a positive effect on wastewater?
- Visit the think before you flush page on the NPDC website for more information
<https://www.newplymouthnz.com/Residents/Your-Property/Wastewater/Preventing-Sewer-Blockages>