

Jockey Club Water Caretakers of Tomorrow Programme Down the Drain - Unit 6

Organised by

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延生牌位 往生牌位
(收益撥充社會服務)
歡迎參觀

The 6th Hong Kong Games
23/4-28/5
2020
第六屆
全港運動會

Ladder Street
樓梯街

Organised by



Funded by



About The Jockey Club Water Caretakers of Tomorrow Programme:






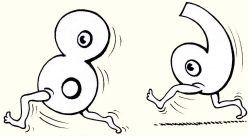
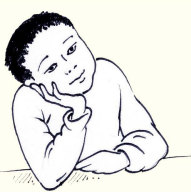
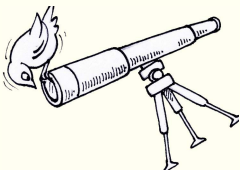
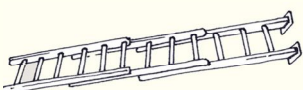

Jockey Club Water Caretakers of Tomorrow Programme is organised by Ocean Recovery Alliance, Ltd and funded by The Hong Kong Jockey Club Charities Trust. There are eight units in this program, and each of them is designed with you, a student in Hong Kong, in mind.

These are the goals for your lessons, to:

- Understand and appreciate how our water systems function on a local and global scale.
- Understand how watersheds function, and the interconnections of life within and between these watersheds.
- Be able to assess threats, such as pollution and habitat destruction, and learn how to lessen these effects.
- Be empowered to take an active role as caretakers of our water resources by sharing your commitment with your communities.

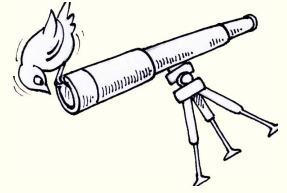
Student introduction

- You will need access to the internet.
- In some activities using the camera in your smart phone or tablet will be useful.
- Your teacher will tell you if your work will be done on your computer, printed paper or notebooks.

Start of a new activity.		A new amazing fact .	
Get ready to do an experiment .		Fast forward to make your contribution to improving our world.	
Identify your misconceptions before your move on.		Data will be used to solve problems.	
Identify your prior learning .		These are the goals for this unit.	
An extension activity.		A cross-curricular activity	

At the end of this unit I will be able to:

- Understand how to find and identify the location of sewage and drainage systems in my neighbourhood.
- Explain the purpose of drainage and sewage systems
- Design a fieldwork activity to gather data that answers questions about stormwater pollution.
- Identify issues related to drainage and sewage.
- Identify ways to reduce water pollution related to drainage.
- Develop a communication project that educates a section of my community about reducing the community's impact on water pollution.



Glossary

Data	Systematic recording of observations.
Drain	Enclosed (pipe) structure that channels running water.
Climate	The average weather for a region over many years.
Climate change	Refers to changes in the average weather as a result of natural variations such as changes in the sun's radiation or human influences such as the release of greenhouse gases.
Groundwater	Permanent water stored in the ground.
Gutter	Open structure that channels running water on buildings, streets etc.
Inorganic	Material that does not come from living matter.
Litter	Waste that has been allowed to escape into the environment where it can cause pollution or injure wildlife, etc.
Organic	Material and products that are living matter or have been produced from living matter.
Permeable and Impermeable	Gas or liquid can pass into or through material Gas or liquid can't pass into or through material
Pollution	Contamination of the air, water or soil from human activity.
Sewage	Wastewater from communities and businesses toilets, bathrooms, kitchens and often industry.
Sewer or sewerage system	Pipes that channel wastewater from toilets, bathrooms, kitchens and laundries to a sewage treatment plant.
Stormwater	Water that collects during and after rain.
Waste	Any material no longer needed for its original purpose.
Watershed	The boundary of land that marks where the passage of water will drain in a landscape.
Weather	Daily, weekly and seasonal changes in temperature, humidity, wind, precipitation, etc.

What do I know?



Where does rainwater flow after it rains?

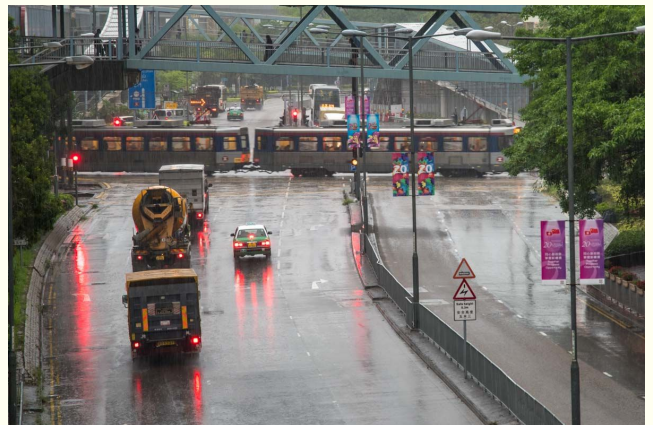
What stories have you heard about floods in cities and towns?

Why is litter on land a problem for waterways?

What other things can cause water pollution besides litter?

Where does the water used at home and school come from?

What is the difference between stormwater and sewage?



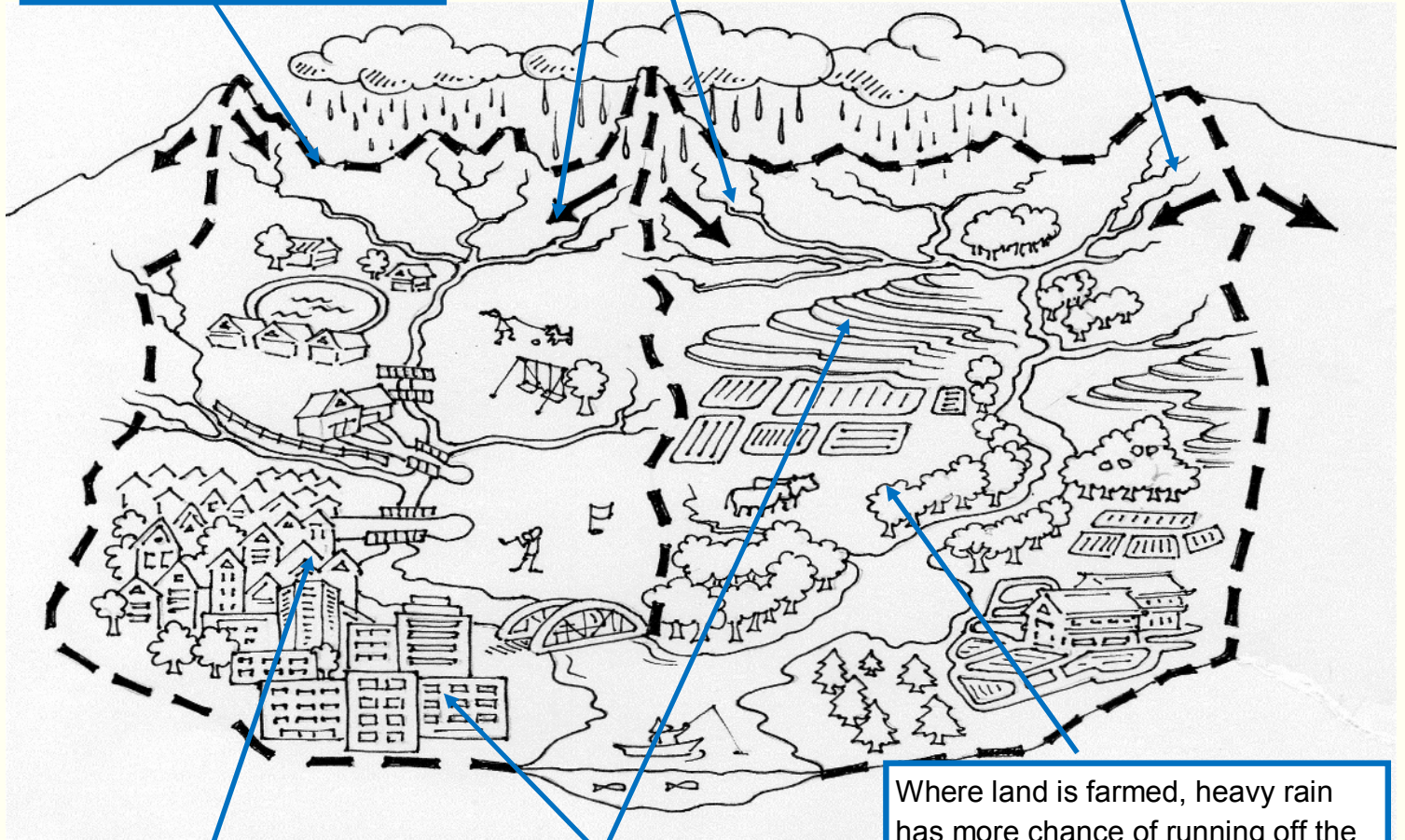
Lesson 1 - All washed out

We live in a watershed

A watershed is the boundary of land that marks where the passage of water will drain in a landscape. A valley is an example of a watershed. The water ends up in a stream, river, lake or sea.

Rainwater that doesn't soak into the ground runs downhill.

Hong Kong has very steep slopes allowing heavy rainfall after it hits the ground to rush downhill. To reduce the chance of floods, concrete barriers over gullies hold back the water, allowing the water to drain out slowly.



Any polluting materials on the ground, including on streets and farms will be collected by rainwater and washed into the streams, rivers, lakes and the sea.

Where land is farmed, heavy rain has more chance of running off the land because land with crops does not absorb water as well as forested or uncultivated land.

Some of the rainwater that soaks into the ground will collect as groundwater. This underground water is also part of the watershed. This water moves very slowly downhill. Where the water table reaches the surface, we have a spring.

Where there are towns, cities and many streets, rainwater hits many hard surfaces. There is less chance of water soaking into the ground and much of the water needs to go somewhere. People have constructed stormwater drains so rainwater can harmlessly travel to the closest stream, river, lake or into the sea. If there is more rainwater than can be carried in the stormwater pipes, then the streets will flood. Rising water can then flood buildings. Traffic will come to a standstill and people caught in the flood can drown.

Activity 1. Where does the rain go?

Explain what will happen when it rains on these surfaces in the photos.

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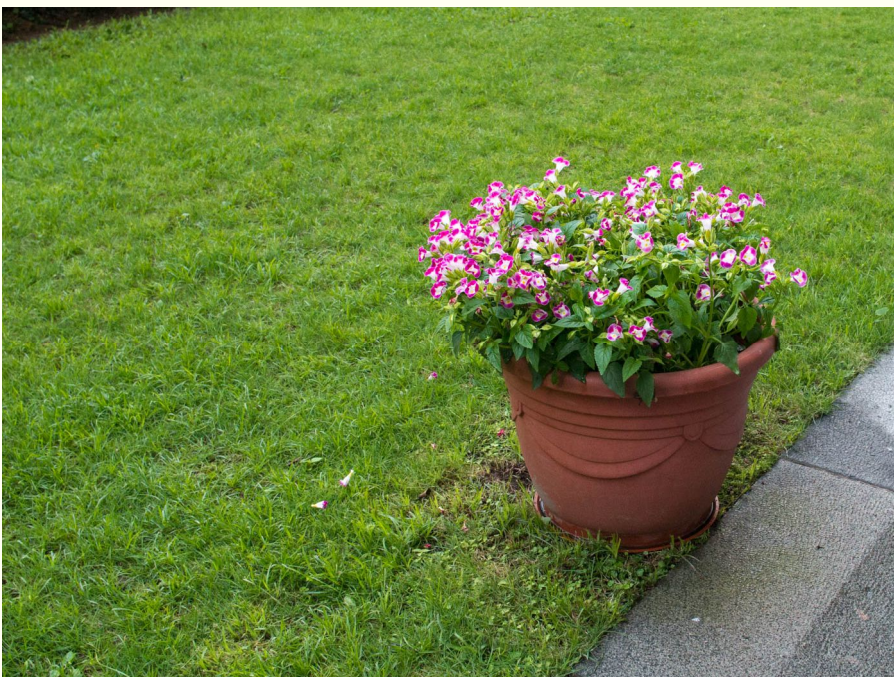


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How would you describe these two surfaces?

1. _____

2. _____

Explain which surface is more permeable to water.

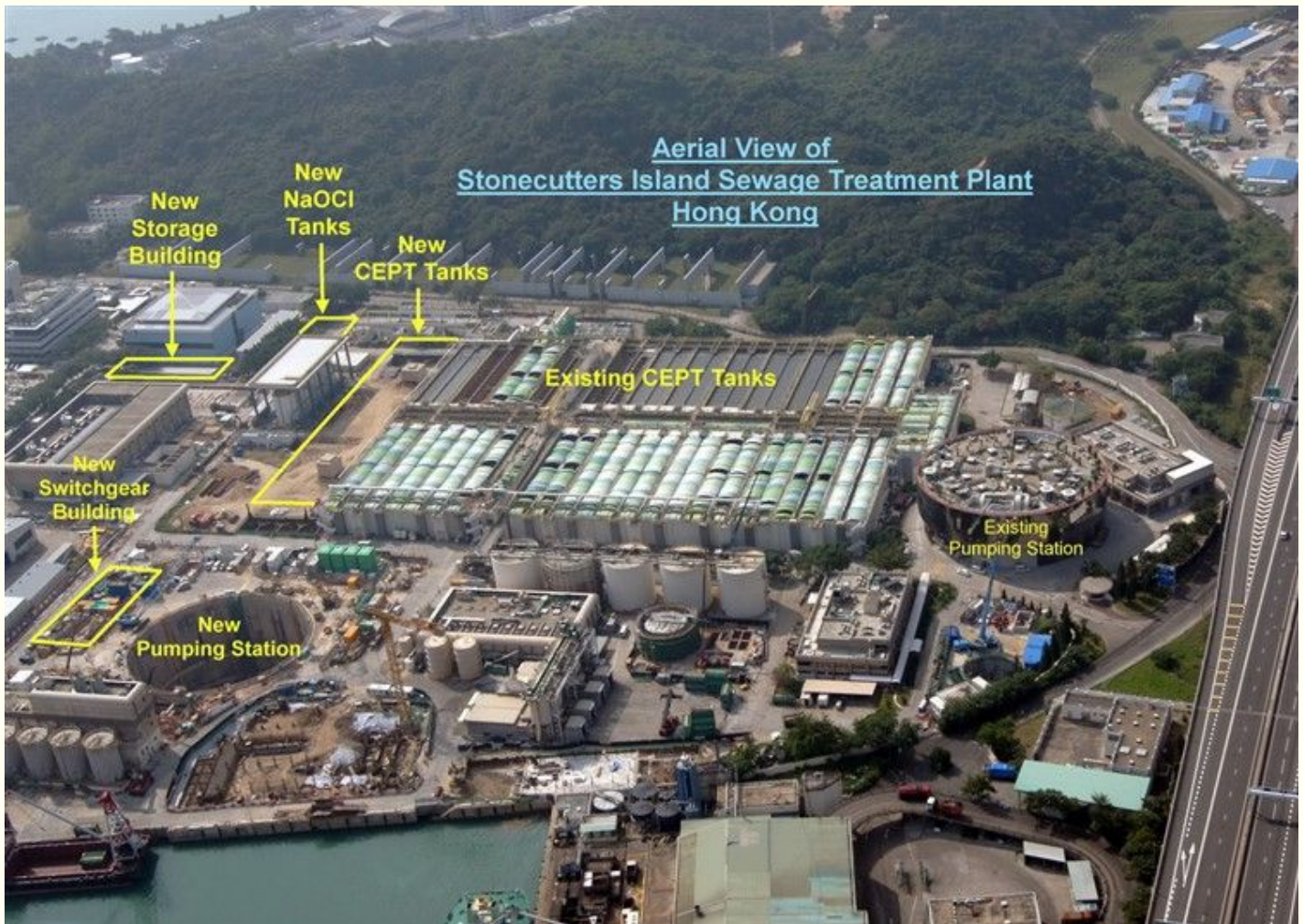
Disposing of water

Once people start living in cities, they need to access clean water and to get rid of waste in order for the population to remain healthy. Waste can include dirty water, sewage, unwanted food, packaging, garden waste, etc.

Buildings and roads don't absorb rain so cities need a system to remove rainwater quickly. The heavier the rain, the more important the removal of the water is, to prevent flooding.

In modern cities, water is piped to the buildings. Often the water is treated before it is piped so it is safe to drink. Safe drinking tap water is referred to as "potable water".

Wastewater from dwellings and workplaces needs to be safely disposed of. "Blackwater" is the name given to wastewater from toilets. "Greywater" is the water from showers, baths, sinks and washing machines, among other domestic sources. To protect our own health and the environment, both black and grey wastewater must be treated so it is safe to release back into the environment. This wastewater is called sewage and the pipes it travels through is part of the sewer system. Below is an example of a sewage plant where sewage is treated.



Source: http://www.biwater.com/Articles/325198/Biwater/BW_Home/waste_water/waste_water_projects/Stonecutters_Island_STW.aspx

Activity 2. Stormwater and sewage system



When our towns and cities are constructed, stormwater pipes are laid under our roads and pavements. They are organised so that gravity will take the water to the nearest stream, river, lake, dam or the sea.

Along the roads are stormwater entrances to collect water from the road. Buildings have pipes that directly connect to the underground stormwater pipes.

Any untreated wastewater being released from homes, industry or farms can also pollute the streams, rivers, lakes and the sea. If it soaks into the ground, it will pollute the groundwater as well.

Greywater and blackwater are carried in separate pipes to a sewage treatment plant. Where necessary, pumps will help to transport the sewage.

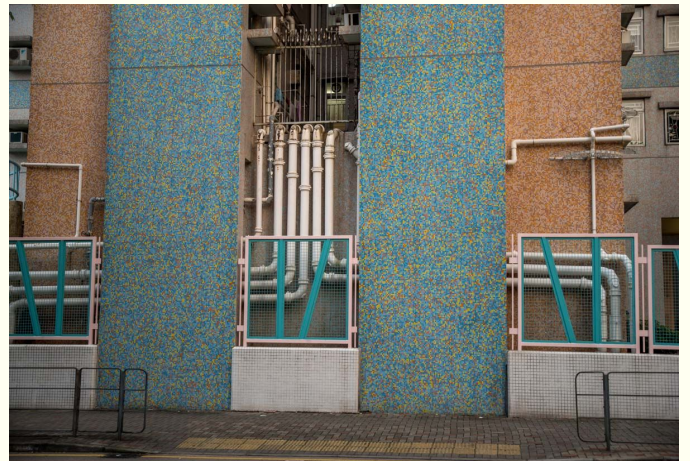
This waste water is treated as sewage.



Operating a sewer from a computer.



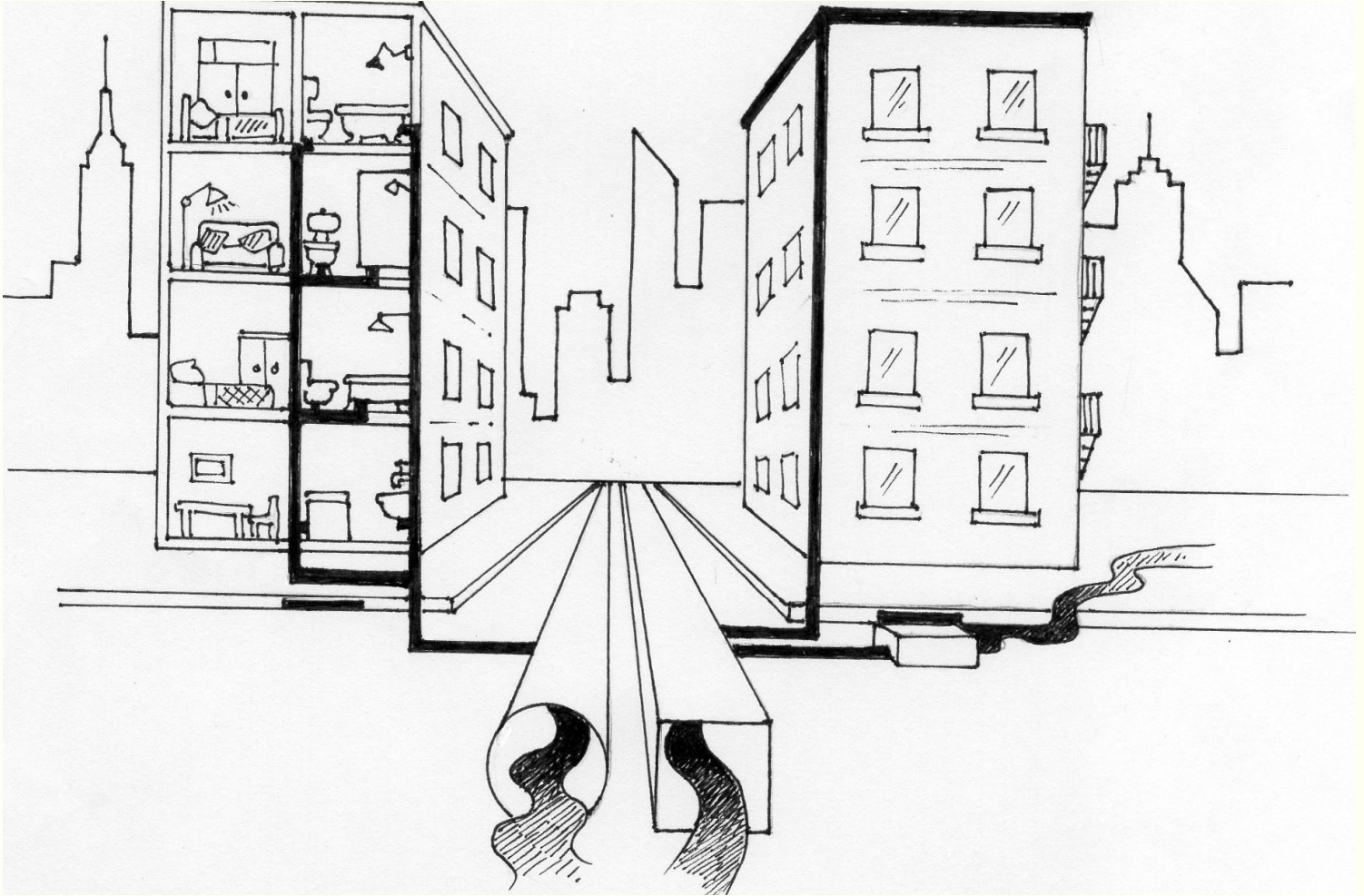
There are stormwater, sewage and water pipes.



Litter in the stormwater will go into the sea.



Complete the drawing and label how the pipes in a home are linked to the separate sewerage and stormwater systems.



Activity 3. Where are the drains?

Using online maps, you will guess where your school's stormwater drains go. Revise fieldwork preparation and personal safety before venturing outdoors.



Equipment:

Camera in mobile phone or tablet

Method:

- Get into groups of three.
- Use Google street maps to see your school and neighbouring streets.
- Go outdoors to view the school, local buildings and the streets. Take a mobile phone or tablet to take photos.
- Find gutters and evidence of rainwater coming off roofs and the road.
- Find grills on the ground that enter into the stormwater pipes below.
- Look for large stormwater pipes on the sides of buildings.
- Take photos of gutters, drains, grills and exposed pipes on buildings. Identify what direction slopes downhill.
- Back in class, use an online map (e.g. Google Maps). Suggest in what direction stormwater pipes will direct stormwater from your school and local streets.



Activity 4. What happens to water when it hits the ground?



In small groups you will find out which surfaces around the school are permeable and impermeable to water.

Equipment: Buckets of water, phone or tablet with camera, data sheet and pencil

Method:

1. Get into small groups
2. Identify what kind of ground surfaces are around the school.
3. Each group, fill a bucket or another container with water.
4. Go outdoors and tip the water onto different surfaces. Surfaces can include soil, footpaths, sand, etc as well as flat and sloped surfaces.
5. Record and photograph your observations of water on different surfaces.
6. Record which surfaces are permeable and impermeable to water.

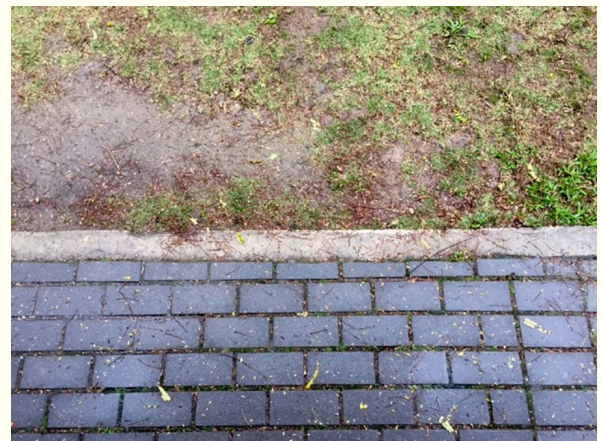


Type of surface	Flat surface or sloped	Observation Describe what happened to the water, e.g. soaks into ground, stays on surface, flows away

Which surfaces soak up rain?

Which surfaces allow rain to run away?

Which types of surfaces increase the amount of water that can sink into the ground?



Why is it important to soak up water rather than letting it run off the land's surface?



Extension:

1. Use a phone or tablet to take photographs of different surfaces and put in order of least to most permeable.
2. Research and describe at least three strategies to increase permeability of surfaces in a city.



Activity 5. Where do the stormwater and sewage end up?

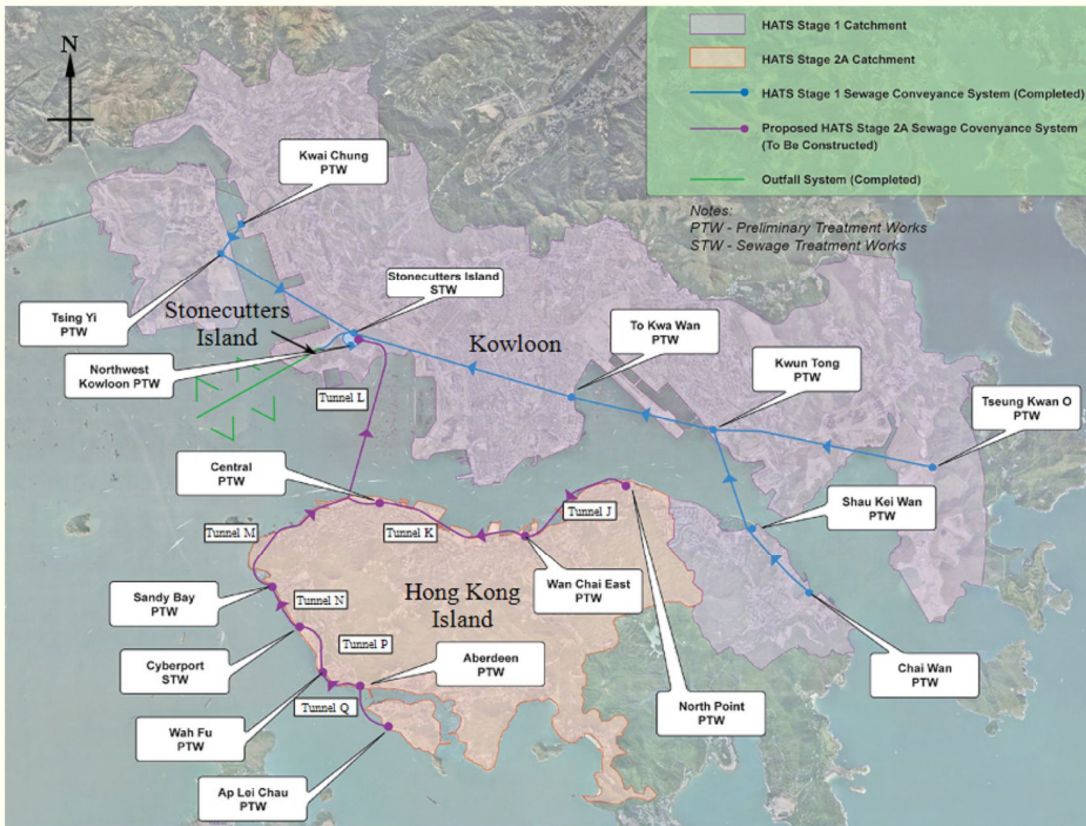
Equipment: writing material, access to computers or tablets to get access to online maps

Make a list of the different sources of wastewater from the home and the community:

These sources of waste are all bound for a sewage treatment plant.

All the smaller sewer pipes are connected to major pipe lines. Use the map below to find which of the major sewer pipe lines your area is connected to. Locate your sewage treatment plant using this link and Google Maps .

[http://www.dsd.gov.hk/EN/Sewerage/Sewage Treatment Facilities/index.html](http://www.dsd.gov.hk/EN/Sewerage/Sewage_Treatment_Facilities/index.html)



Source: <http://www.tunneltalk.com/HongKong-HATS-Programme.php>

Activity 6. Potential impact of climate change - can our stormwater system cope?



We will always have variable weather. We will continue to have storms and typhoons causing a lot of destruction. Can we claim that climate change makes some of these events worse?

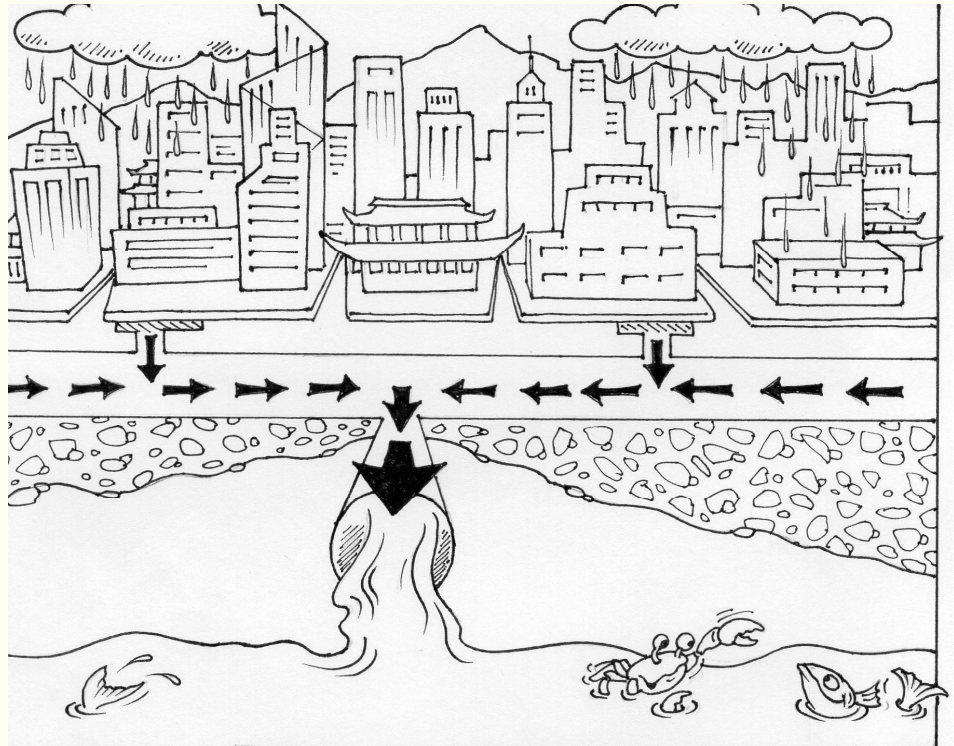


Source: South China Morning Post

<http://www.scmp.com/news/hong-kong/health-environment/article/2000460/little-damage-typhoon-nida-due-extensive-disaster>

When our streets flood, it is because our stormwater systems can't cope with the volume of water. There are many causes for our stormwater being unable to carry the water away during heavy downpours:

- Sometimes the drains are blocked with litter.
- Often the stormwater pipes just aren't large enough to remove water that quickly.
- During a storm, the outlets of the stormwater pipes might be below the water level due to high rivers and the sea. Water pressure from the rivers and sea can prevent stormwater escaping quickly.



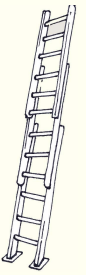
What is your opinion? If we have storms that produce even more rain, what might we expect in our drainage of cities, towns and countryside?

What kind of evidence would you need to support your opinion?

How could we reduce the impact of bigger storms?

Extension - Local floods

Do some research about past floods that have occurred in Hong Kong and China. Find examples that were caused mostly by heavy rain. Find examples where high tides and big waves also contributed to a flood. What is the difference between a flood caused by storms and a tsunami?



Lesson 2. It stinks



Activity 1 - It stinks

Recall the weather when it's been hot and dry in Hong Kong for weeks. There has just been a heavy downpour of rain in Hong Kong.

1. Describe how Hong Kong feels, smells and looks after many hot days.



2. How does Hong Kong feel, smell and look after heavy rain?

3. Describe what happens to the rivers and the sea after the land has been washed clean.

4. Suggest how life in the rivers and seas are affected by polluted stormwater.



Main sources of stormwater pollution

Chemicals including oil, detergent, etc

Chemicals change the water quality. A small amount of some of these chemicals such as oil can kill most of the small creatures downstream. Some chemicals get into the streams when cars leak oil, but sometimes people dispose of oil down stormwater drains. No chemicals should ever be disposed of down drains.



Litter

Plastic, paper, metal and food are just some of the litter that is dropped in the environment. When they reach the water the items that rot contaminate the water. Items that don't rot can hang around for many years, injuring and killing wildlife.



Main sources of storm water pollution continued.

Soil and erosion

Soil washed into streams, rivers and the sea, reduces the depth sunlight can penetrate into the water. Aquatic plants beneath the surface have less light to grow.



Fertiliser and insecticide

Fertilizers and insecticides used on farms, parks and gardens cause problems once they have been washed into streams, rivers and the sea. Fertilizer and some insecticides increase the growth of some aquatic plants and bacteria, upsetting the ecological balance and even reducing the oxygen level. Insecticides and herbicides can destroy some of the aquatic wildlife.



Hormones, antibiotics

Much of the medication we consume is excreted in our urine. Even though it is treated in a sewage treatment plant, some of the active chemicals can make its way into the rivers and sea. The tiniest concentration of some medications can have a big impact of the lifecycle of some animals. Antibiotics released into the environment increase the rate at which bacteria become resistant, leading to more resistant diseases infecting humans.



Specific plastic issues

Plastics in the rivers and sea have become a silent killer. Larger items of plastic can choke aquatic and marine animals. 50% of dead birds washed up on the beach have plastic in their stomach. Animals can also get entangled in plastic. As plastic breaks down into smaller pieces, polluting chemicals stick to them. When eaten, the animals ingest higher and higher levels of pollution.



Main sources of storm water pollution continued.

Domestic animal and human excrement

In some cities pet droppings along the footpath and drains are a major source of water pollution. Rain will dissolve the animal dropping and wash the material down stormwater drains.



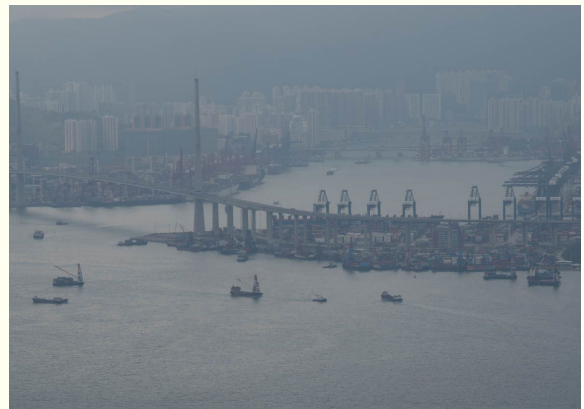
Building sites

Unless all materials including the waste are carefully looked after on a building site, some of the polluting waste will be washed down the drains or blown away.



Air Pollution

Many of the more complex chemicals that pollute the air will come down with the rain. Different chemicals will have different impacts. Some chemicals come down as acid rain, others are poisonous and some of the most poisonous chemicals can build up in the streams, rivers and the sea.



Factory or sewage outfall

When factories or transport have accidents, polluting liquid chemicals can quickly flow into the stormwater system causing major pollution. Laws require everyone, including industry, to dispose of polluting chemicals responsibly. Sewage will overflow when heavy rain flows into the sewage pipes and the treatment plant can no longer hold all the fluid.



Main sources of storm water pollution continued.

Sewage from feedlots

Pigs are usually raised in pens. Cattle and sheep can also be raised in small enclosures. Food and water are supplied to the animals. Their enclosures need to be regularly cleaned, removing their droppings and urine. If this sewage is not properly treated, it will get into the water table or the local streams and rivers. In the manure are hormones and antibiotics fed to the animals to make them put on weight. The hormones can affect many water creatures and antibiotics in the environment decrease the effectiveness of these drugs.



Disgusting fact. The amount of visible litter in an urban river or a beach indicates the amount of dissolved pollution you can't see.



Activity 2: Litter and pollution survey

Litter is one form of pollution.

Before you investigate litter outdoors:

Which three kinds of litter do you think are most common around Hong Kong?

1. _____
2. _____
3. _____



What do you think is the most dangerous litter for people?

Why is this plastic litter, pictured below, deadly for some wildlife?

If you do a litter cleanup outside your school grounds, you must always discuss with responsible adults how you will remain safe.



Its stinks: Litter and pollution survey sheet

Location _____ Date _____ Time _____

Equipment: Clip board, pencil and record sheet. A tablet or phone for taking photos

Method:

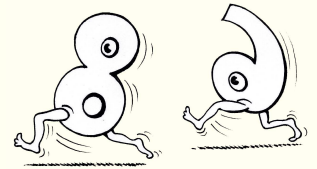
1. Review safety when working outdoors.
2. Choose where the survey will be done.
3. In each location count the number of different items of litter.
4. Record what was found.
5. Photograph any locations where there is a lot of litter.



Type of litter or pollution	Footpath	Gutter	School	Park	Total
Metal can					
Plastic bottle					
Plastic wrapping					
Plastic straw					
Other plastic					
Cigarette butts					
Paper packaging					
Other paper					
Glass					
Oil					
Dog droppings					
Other					
Totals					

What is available in your neighborhood to help reduce litter and other forms of pollution getting into storm water? hint: do you see trash cans, grills over stormwater drains, etc.

Analysing the litter and pollution data



Fill in the table below, calculating the percentage of each type of litter, how litter got to be there, and who or what caused the litter.

To calculate % $\frac{\text{Number of litter items for a type}}{\text{Total amount of litter}}$ multiplied by 100

Type of litter or pollution	Total number of items See above chart	Number of items %	How the litter got there	Who or what caused the litter
Metal can				
Plastic bottle				
Plastic wrapping				
Plastic straw				
Other plastic				
Cigarette butts				
Paper packaging				
Other paper				
Glass				
Oil				
Dog droppings				
Other				
Total				



Data analysis

Where is litter most likely to be found?

Use the ranking below to rank the level of litter found around your community:

Extreme

Piles of litter



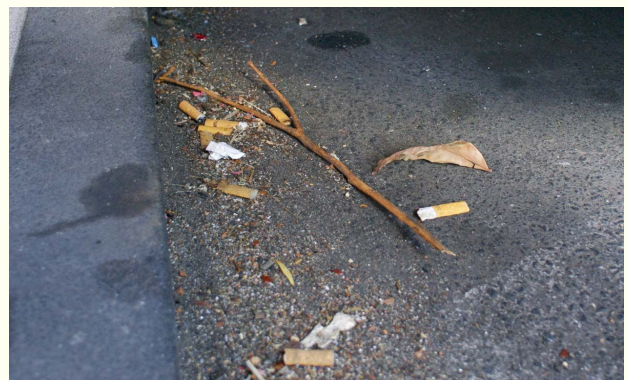
Very high

Large amounts of litter in gutters, streets and footpaths



High

Scattering of litter
More than 2 items of litter every metre



Moderate

Up to two items of litter every metre



Low

Less than one item of litter every 10 metres



Zero



The ranking for my neighbourhood was: _____

What evidence was there for other forms of pollution that could end up down the drain?

The photo of this pollution was taken just as it poured out of a stormwater drain. Besides a lot of litter, there was a lot of dirt and grease. Suggest where the dirt and grease came from.





Activity 3 - How water pollution works

Organic waste

Organic material comes from animals or plants. It can include garden waste, vegetable waste, food scraps such as bread, meat products, vegetable oils and fats.

In a student's lunch, organic waste mostly consists of fruit scraps and uneaten lunch. Some of this waste can be composted or fed to worms.



Inorganic waste

Inorganic material does not come from animals or plants. Much of the inorganic waste we produce comes from packaging which includes glass bottles, cardboard, metal cans and a wide range of plastics.

In a student's lunch, the common items of inorganic waste includes plastic packaging and drink containers. Some of this waste can be recycled.



Equipment:

- Recording material
- Collect some of the class's lunch waste that normally goes into the school's waste system, e.g. fruit peel, paper, plastic wrapper, unwanted food, etc.
- Common items of organic and inorganic waste from student lunches
- Large glass jar with lid or small aquarium

Method

1. Collect samples of waste after students have finished their lunch.
2. As a class review the difference between organic and inorganic material.
3. Place the organic and inorganic waste in separate small aquariums or jars of water in a safe place for a week.
4. Record your observations.



Which materials are organic?

Which items are inorganic?

Predict what will happen to the two types of waste when placed in water. What will happen to the water?

Place the organic and inorganic waste in separate small aquariums or jars of water in a safe place for a week and then record your observations:

Observations	Organic	Inorganic
Changes in the material?		
Changes in the water?		
Change of smell?		

How do you think organic waste affects the water and the things that live in it?

How do you think inorganic waste affects the water and the things that live in it?

By always disposing of your waste correctly you will be helping many parts of your watershed.



Lesson 3: The dark mystery



Activity 1. Staying alive

Examine the graph below published by the Hong Kong Medical Journal.

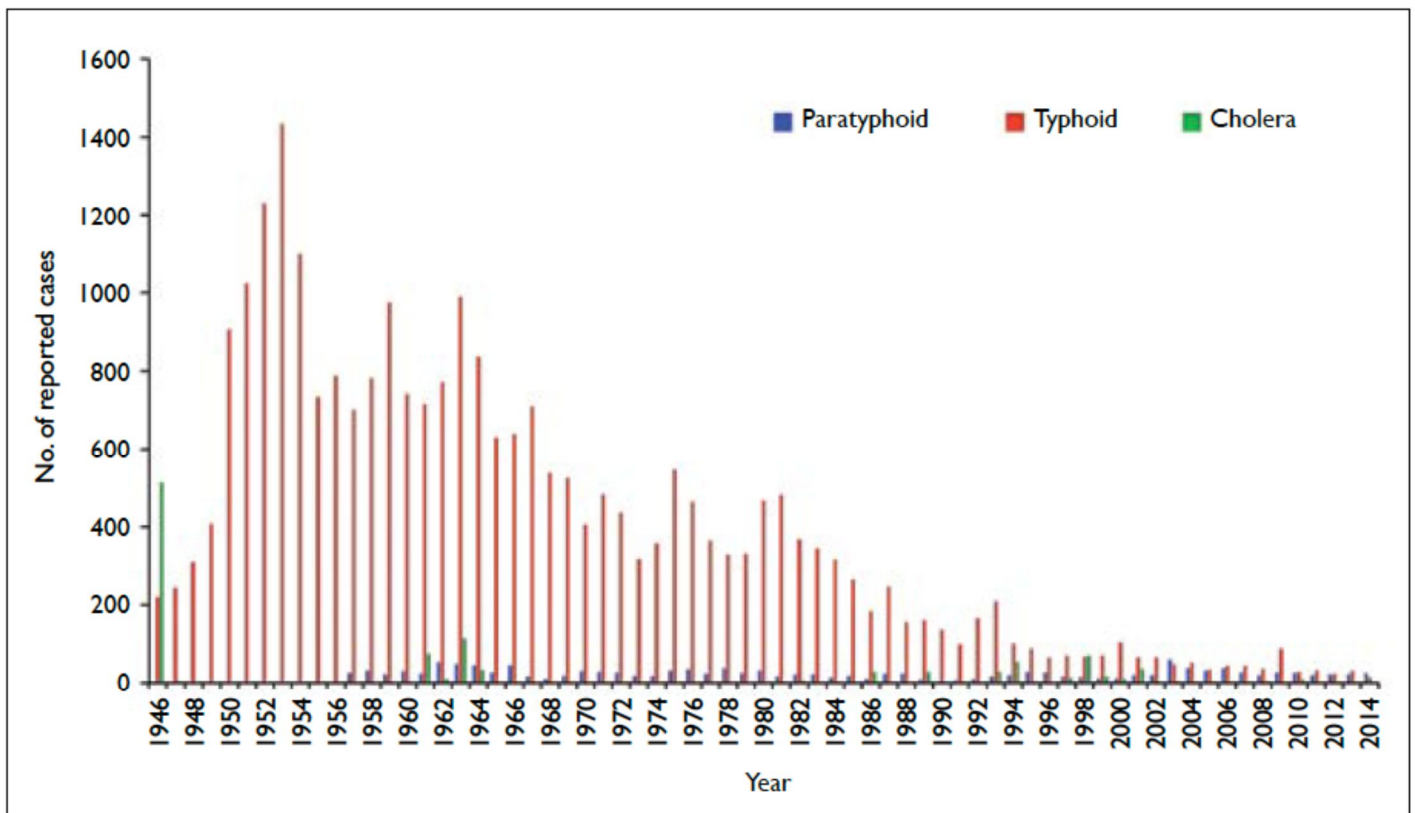


FIG 2. Reported cases of typhoid fever, paratyphoid fever, and cholera in Hong Kong from 1946 to 2014 (cases of typhoid and paratyphoid fever were grouped together before 1957)

Source: Hong Kong Medical Journal

<http://www.hkmj.org/system/files/hkmj-v21n6-hkmms-fig2.jpg>

Use the graph to explain the change in diseases over time.

These diseases are largely waterborne diseases. Suggest what could cause the trend you observed in the graph above.

History of sewage contamination

Use Google Images and use the search words: **History sewage contamination**

What kinds of images do you see that indicates that sewage is harmful?

Staying alive

Read examples of waterborne diseases from this website: "Biomedical Science - The Key to the Diagnosis of Food and Waterborne Diseases" <http://www.hkimls.org/links-20020415.HTM>

If you were in an area that had waterborne diseases, list five ways of preventing and/or reducing the chances of getting a waterborne disease.

1. _____
2. _____
3. _____
4. _____
5. _____

Non-human effects of untreated sewage in waterways

Do a Google search using Google News to search the words: **sewage sick wildlife**. Read some of the articles and share with the class.

From what the class found out, how does sewage affect wildlife?

1. _____
2. _____
3. _____
4. _____
5. _____

Activity 2: How to treat sewage



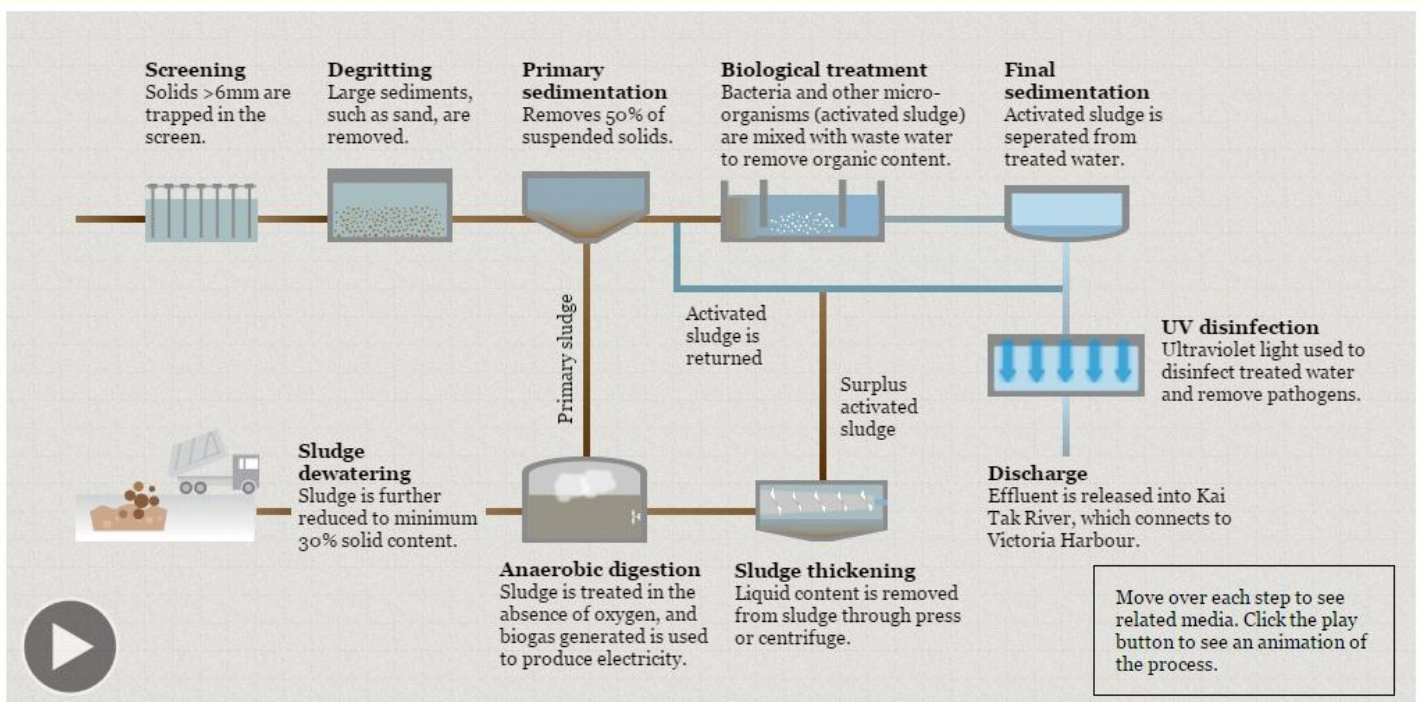
Background information

Good hygiene requires that we have access to clean water, food that isn't contaminated and the safe removal of sewage.

When hygiene can't be maintained, diseases quickly spread through communities. Wastewater must be treated so that when the final liquid is released back into the environment it will not cause the spread of disease or pollution of the environment.

In this lesson you will research the requirements for dealing with sewage so people and their environment remain safe from contamination.

Finding out more: Steps taken to make sewage safe



Source 21HK multimedia <http://multimedia.scmp.com/21hk/>

Go to the website <http://multimedia.scmp.com/21hk/>

- Scroll down until you see the image above.
- Click the play button on the bottom left for the text to appear.
- Place the cursor over each image to play the video.

Further research links

Sewage treatment hits new milestone (24.9.2014)

https://www.youtube.com/watch?v=xj5q_TNxZ6Q

A waste-to-energy journey in Hong Kong

<https://www.youtube.com/watch?v=i8KRnQYEpRA>

Hong Kong Walk Tour】 The Shatin Sewage Treatment Works

<https://www.youtube.com/watch?v=72PpN2ryLmQ>

Settlement pond



Aeration



Removing sludge



Controls for UV disinfection



What is sludge?

How do we get rid of sludge?

How does bacteria help in the process of cleaning up sewage?

Why is UV light used in the final treatment stage?

Activity 3: Only the right kind of crap

Equipment:

- 4 jars with water
- toilet paper
- tissue paper
- a wet-wipe
- a cotton bud.



Method

1. Half fill each of the four jars with water.
2. In each jar place separate materials, toilet paper, tissue paper, a wet-wipe and a cotton bud.
3. Use the chart to predict if the materials will change and how they might change.
4. Leave the experiment for a day.
5. After a day or more observe and record on the chart any changes.
6. Suggest which materials could block sewage pipes and could be a problem in sewage treatment plants.

Material	Predict if or how the material will change	Did the material change? How did it change?	Could the material block sewage pipes?
Toilet paper			
Tissue			
Hand/baby wipe			
Cotton bud			

Explain the consequences of flushing the wrong materials down the toilet:

What might happen if large volumes of old cooking oil or poisonous liquids are poured down the sink?

<https://www.iconwater.com.au/My-Home/Caring-for-your-drain.aspx>

<https://www.itsdone.com/what-you-can-and-cannot-flush-down-the-toilet/>

Activity 4: Looking forward



List at least three things you think would help to decrease water pollution due to stormwater runoff in your city:

1. _____
2. _____
3. _____

Develop a public information campaign to address one of the things that lead to contamination of our waterways through drainage systems in Hong Kong.

Suggestions might include:

- Replacing harsh chemical cleaning products with more environmentally friendly products.
- Bringing awareness to what we put down stormwater drains.
- Identifying ways to reduce, reuse and recycle in order to limit the waste entering the waterways.

Identifying appropriate media that link the message and the interest of their audience.

Communication products can include:

- a. Posters
- b. Billboards
- c. Radio commercials
- d. TV commercials
- e. Newspaper advertisements
- f. Press releases
- g. Musical jingles
- h. PowerPoint presentations
- i. Web page
- j. Newsletter
- k. Email letter
- l. Competition
- m. Postcard



This Little Grebe is entangled in a discarded net used for packaging plastic

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