Jockey Club Water Caretakers of Tomorrow Programme

Stressed-out Watershed - Unit 3

Organised by

Ocean Recovery Alliance

Funded by

香港賽馬會慈善信託基金
The Hong Kong Jockey Club Charities Tr
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About The Jockey Club Water Caretakers of Tomorrow Programme:

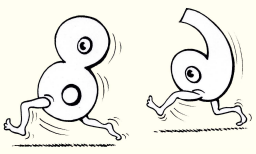
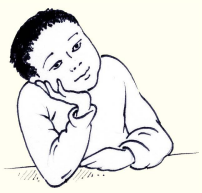
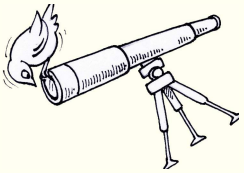
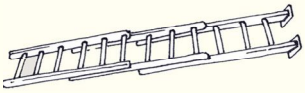
Jockey Club Water Caretakers of Tomorrow Programme is organised by Ocean Recovery Alliance, Ltd and funded by The Hong Kong Jockey Club Charities Trust. There are eight units in this program, and each of them is designed with you, a student in Hong Kong, in mind.

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.

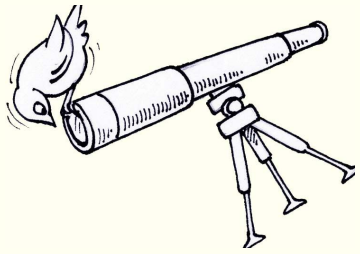
Student introduction

- You will need access to the internet.
- In some activities, using the camera in your smartphone or tablet will be useful.
- Your teacher will tell you if you if your work will be done on your computer, printed paper or notebooks.
- Below is a key to the illustrations found in the student notes.

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	

Student aims:

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



- Sequence change in land use in my watershed.
- Track the sources and effects of pollution in my watershed.
- Suggest ways to balance uses in a watershed and provide reasons for best practices.
- Appreciate the changes in attitude about watershed modifications.
- Create a video that informs the community about the stresses in your watershed.

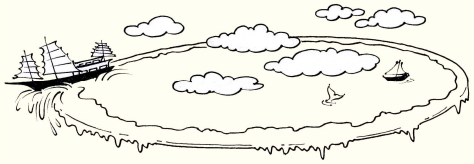
Glossary

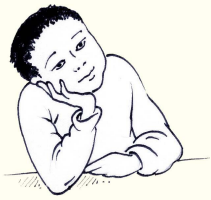
Acid Rain	Created when water in the atmosphere becomes acidified by pollutants in the air.
Agriculture	The cultivation of crops and animals for food, medicine and materials used to enhance and sustain human lives.
BOD	Biological Oxygen Demand is the amount of oxygen needed by organisms to break down organic matter in a water system over a given temperature and time.
Channelisation	Human management of a river channel usually involving modifying and concreting rivers or streams.
Climate Change	Alteration of the Earth's weather patterns.
Colonisation	The process of taking control of an indigenous people's land through invasion and settlement.
Creek	A small waterway, usually sheltered and narrow.
Desalination	The process of removing salt from seawater for use as freshwater.
Diffuse	A pollution input to a water system that comes from surrounding landscape.
Dissolved Oxygen	The amount of oxygen in a water body that is available for plants and animals to use.
E. coli	A type of bacteria that is normally found in the intestines of healthy people and animals. Most varieties are harmless but food or water that is contaminated with some strains of E. coli can cause serious illness.
Environment	The natural world in a given geographical area.
Erosion	Applied to a watershed, it's the weathering of the landscape, the process by which sediment is picked up and moved from one place to another.
Fertiliser	A chemical or natural substance used to encourage and enhance plant growth.
Flooding	The overflow of water from a water body when its limit is exceeded.
Greenhouse Gas	Refers to gaseous emissions largely responsible for the warming effect it creates in the Earth's atmosphere.

Gully	A deep channel in the landscape that has been carved out by flowing water.
Irrigation	The practice of diverting water for use in growing crops and supporting agricultural practices.
Landslide	The collapse of a piece of land usually due to heavy rain.
Migratory Waders	Birds that fly in for part of the year to use wetlands and other water bodies to forage and hunt for food by walking through the water.
Natural/modified	Whether a landscape has remained untouched by people or changed by people to suit us.
Nitrates	Form of the element Nitrogen, utilised by plants for growth.
Phosphates	Form of the element Phosphorous, utilised by plants for growth.
Point Source	A pollution input to a water system that comes from a single place.
Pollution	Contamination from human activities into a natural system.
Salinity	Concentration of dissolved salts and minerals in a water body.
pH	A term used to explain how acidic or basic (alkaline) a solution is. 7 indicates neutral; numbers lower than 7 are more acidic the closer they get to pH 1; numbers higher than 7 are more basic the closer they get to pH 14.
Tanning Industry	Refers to the treatment of animal skins to make them into leather products for us to use.
Turbidity	Measure of the murkiness or clarity of water.
Watershed	The boundary of land that marks where water will drain in a landscape.

What do I know?

Look at each photo. Suggest where rainwater flows in each of the environments. Describe any problems you can see when rainwater flows away.





Lesson 1. Go with the flow

Hong Kong is dominated by very steep hills and mountains. Wise landuse planning has allowed most of the steep areas to keep their vegetation.

The gullies down this steep hillside retain their vegetation. Most of the rocky streams only flow when there is rain. Large volumes of water with immense power can roar down the rocky creeks. The trees, grasses and shrubs hold the soil and the rocks together, reducing erosion and the chance of landslides.	
This hillslope has recently been affected by seasonal forest fire after the long dry winter period. Steep slopes and heavy rain over the summer has caused a lot of topsoil and organic matter to be washed away, making long term natural forest establishment difficult.	
This doesn't look like a creek at the moment. When it rains, however water thunders down this gully. The rocks and plants slow the passage of water and lessen erosion of the topsoil.	
This hill has also lost its soil after the trees were cleared. Fast moving streams during heavy rains have eroded the hillside to form a deep gully. The eroded gully will become deeper and wider unless the area is repaired. To repair the gully, trees could be planted and barriers could be used to stop water from rushing down too fast.	

The banks of a natural stream are protected by plants. The plants have access to permanent water so they can be very dense. The plants also help to clean the water. The plants absorb nutrients such as fertiliser and animal manure. They can also absorb some of the pollutants and catch some of the litter. Vegetated streams also slow down rushing water after heavy rain. This can reduce the impact of floods by making the water pass through more slowly and helping more water soak into the ground.	
Streams that pass through communities are managed by people. Nowadays, many settlements are planned and designed with drainage in mind, in order to more efficiently remove our waste and drain our urban areas. When a natural river gets converted into a concrete channel, this is called channelisation. You can see the amount of litter and pollution in the bottom of this concrete stream.	

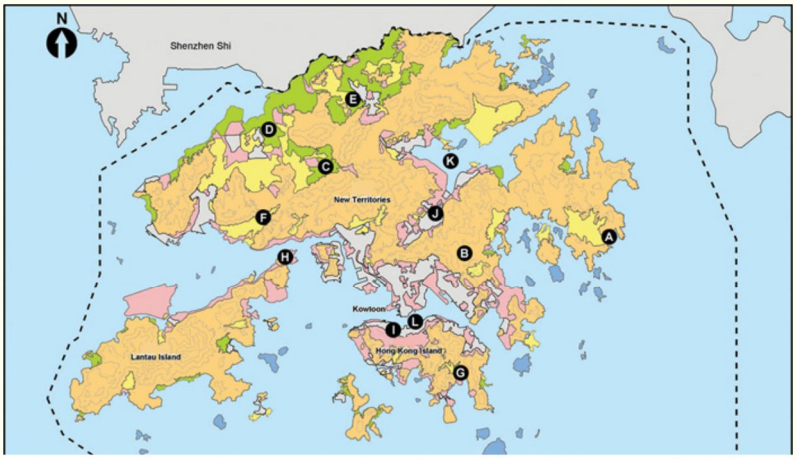
Activity 1. Hong Kong Landscape

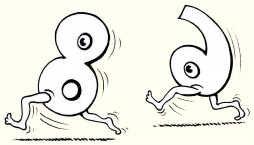
You have your own experiences and ideas about Hong Kong's landscape. Use the information you have just read and the website below to learn more about the landscapes around Hong Kong.
http://www.pland.gov.hk/pland_en/p_study/prog_s/landscape/pamphlet/e_content.htm

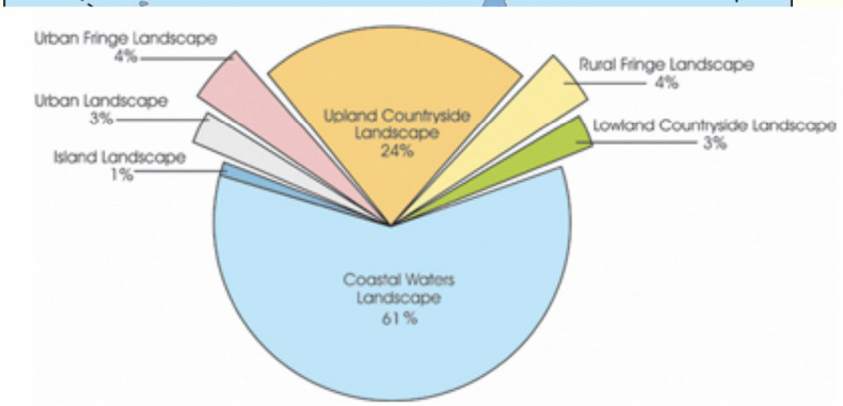
Describe the Hong Kong landscape you know by using these words:

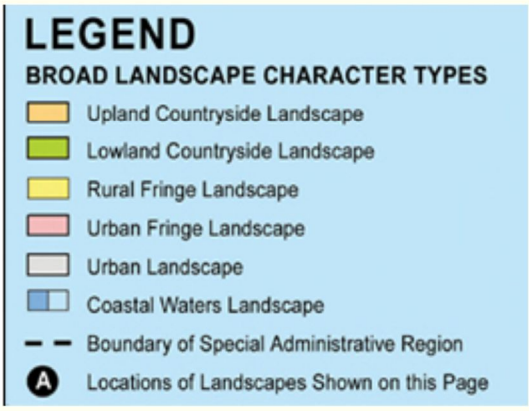
Steep
Forest
Gullies
Gradient
Bay
Wetland
Coastline
Buildings
Roads

Look at the pie chart below. Most of the area is represented by the sea.







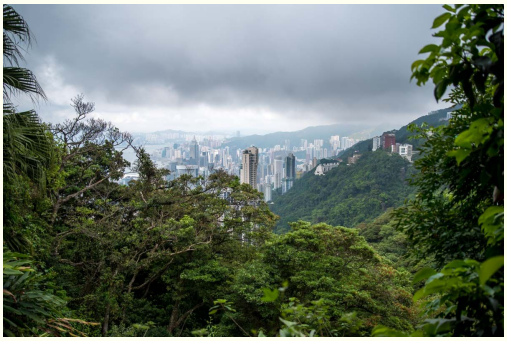


Source http://www.pland.gov.hk/pland_en/p_study/prog_s/landscape/pamphlet/e_content.htm

Compare the area of land used for urban landscape with upland countryside landscape using the pie chart.

Activity 2. Why isn't Hong Kong a disaster?

Hong Kong is a busy high-rise city. Land is at a premium, but much of Hong Kong is too steep for development. You will have seen from the pie chart in Activity 1. that only a small proportion of Hong Kong is built on. In some other cities these areas may have been built on even though there are problems with landslips, drainage, etc. In some countries, areas close to cities are used by the poorer people as shanty towns. Hong Kong has avoided most of these problems.



Watch both videos to summarise the recent history of Hong Kong.
https://www.youtube.com/watch?v=8PI7r892cEk or
https://www.youtube.com/watch?v=p0NZMyMQR5A

Draw and label a timeline of the major land use events for Hong Kong over the past 160 years

Look at the video and the photos on these two links. The buildings are very different. Look carefully at the hills and mountains in the background for any changes you can see.
https://www.youtube.com/watch?v=2b9aLLl0BaQ
http://stock-images.antiqueprints.com/stock/prints/china-prints.html

What has changed most about Hong Kong's landscape?

_____

_____

What has changed least about Hong Kong's landscape?

_____

_____

Were Hong Kong's forested hills protected during colonization?

_____

Are Hong Kong's hills still being protected?

_____

Activity 3. The big transformation

Use this website that explains how the region around Hong Kong has changed: https://www.theguardian.com/cities/2016/may/10/china-pearl-river-delta-then-and-now-photographs

Make up a newspaper headline about the changes in Hong Kong's landscape, with just a few words. Then provide five of the most interesting pieces of information you would include if you wrote an article on the topic.

Headline:

_____

1. _____

2. _____

3. _____

4. _____

5. _____

Activity 4. Water detour

Hong Kong has a very high population for its total land area. To meet its water needs, Hong Kong needs to have many ways to provide enough water to go around. Below are some examples:

Dams are constructed to store rainwater.
https://en.wikipedia.org/wiki/List_of_reservoirs_of_Hong_Kong
Many buildings are supplied with seawater to flush toilets.
www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/seawater-for-flushing/index.html
Water is piped in from mainland China.
http://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/dongjiang-water/index.html
There are future plans to use desalination to turn seawater into freshwater.
http://www.wsd.gov.hk/en/core-businesses/total-water-management-strategy/desalination/index.html
Water conservation is encouraged.
http://www.wsd.gov.hk/en/education/water_conservation/

Activity 5. Agriculture

Agriculture supplies us with our food. The advent of agriculture allowed us to shift from small nomadic hunter-gatherer groups into larger societies that built permanent settlements. Our impact on the watershed changed dramatically when this happened. Today traditional agricultural techniques have been replaced with more modern and industrialised versions of these techniques. All forms of agriculture have some kind of impact on the watershed because water is a key resource for growing food. As time passed, however our methods of agriculture became more efficient and large-scale.

Traditional Vs. Modern Agricultural Practices

Traditional agricultural practices required many hands to manage the heavy workload of feeding a large population. Over time, planting and farming techniques were invented to make these practices more efficient. After the industrial revolution, people were able to design and build large machinery to take over the often laborious and difficult tasks we had to perform each year. We could farm larger and larger areas of land using fewer people to do the same amount of work. Despite the many advantages that technology, machinery and chemicals bring, there are still negative environmental impacts associated with these newer methods. Larger quantities of groundwater are used and pollutants are released into the waterways.

Agricultural impact polluting the watershed

Some forms of agriculture have the potential of causing pollution, including water pollution. The common forms of watershed pollution from agriculture are:

1. Manure from farm animals. This can be a source of fertiliser for crops, but when mismanaged, can end up contaminating our groundwater, rivers and lakes.
2. Insecticides, herbicides, fungicides and chemical fertiliser applied to crops are washed into waterways and groundwater.
3. Soil disturbed by ploughing, heavy machinery and animal hooves can wash into rivers and waterways. This can potentially release contaminants from the soil into the water.

Fertiliser, insecticide and herbicide pollution of watersheds can be reduced by only using the amount needed and spraying on days with no wind and little rain.

Agricultural Impact: Irrigation and Desertification

All forms of agriculture require some amount of water to grow crops and supply water to animals. Poor irrigation practices have been linked to negative environmental consequences like desertification. Desertification is the process of once productive land drying up, becoming a desert. This can occur when more water is being drawn out than is being replenished, or recharged, in the watershed. There are some well documented cases in history where once prosperous ancient civilisations have collapsed because of, among other factors, bad irrigation and agricultural practices.

Extension: Desertification

Research an ancient civilisation whose agricultural practices led to desertification and ultimately the collapse of that civilisation, e.g. Easter Island, Mesopotamia, Mayans, Minoans etc. What were the chief causes of the demise of the civilisation? What strategies could you suggest that would have helped avoid their collapse?

Activity 6. What's happening with water supplies?

To keep a constant supply of water for all our needs we must have a good supply of water. This will depend on the water resources that are available including the reliability of rain and ways we can extract or store water. Not only does agriculture need water. We also need water for domestic and industrial and uses. Some of the water, after it has been used, becomes a waste product that can pollute the environment.

Use the diagram on the next page. Label it to show how water is diverted for our needs. Also show what happens to the water when we have finished using it.

When we have finished using water, what kind of pollutants do you think it might contain?

_____

Can you imagine using wastewater on a farm for any of it for other purposes before it is cleaned? Give an example:

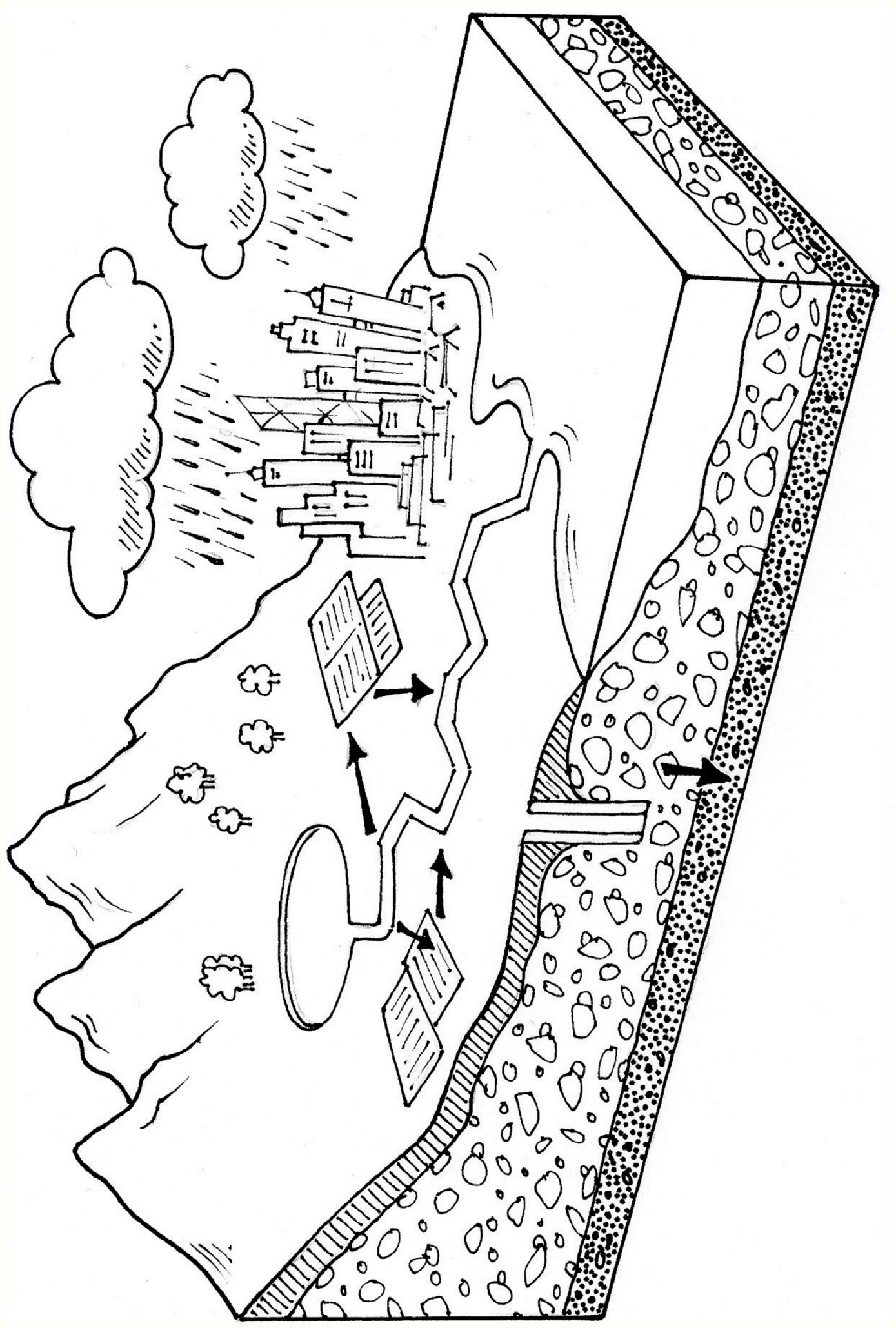
_____

Look up the term "greywater" on the internet. Can you suggest three safe uses for greywater?

1. _____

2. _____

3. _____



Lesson 2. Changing Waterways - Water Pollution and Channelisation

Pollution of watersheds is not new. Some of the historical problems have been fixed. For example, Hong Kong once had a tanning industry. For much of the previous two centuries there were no pollution controls when tanning animal skins. Toxic waste polluted the rivers and sea. The tanning process is toxic for its workers as well as the environment. This is what a tanning operation with no pollution control looks like: https://www.wired.com/2017/01/adib-chowdhury-a-thousand-polluted-gardens-inside-bangladeshs-polluted-billion-dollar-leather-industry/

Many of Hong Kong's major polluting industries have either had to clean up their processes or close down entirely.

Activity 1. What is HKEPD?

It is the job of the Hong Kong Environmental Protection Department to monitor and protect the Hong Kong environment from pollution. http://www.epd.gov.hk/epd/english/top.html

Use the website above to find out what the Environmental Protection Department protects. List the areas that this Department is concerned with:

_____

_____

What are some of the things you can see in the photo that are polluting the water?

_____

_____

What you can't see includes, bacteria and other germs, poisonous substances, chemicals, animal droppings, grease from food, etc.

Conducting experiments

1. Read through the setup for the experiment.
2. Record your prediction for the outcome of the experiment.
3. Gather the materials that are needed.
4. Find a suitable location to conduct the experiment.
5. Review all safety requirements including handling glassware safely and using heat and heated substances. Ask your teacher if you are not sure. Report any accidents.
6. Record your observations as you complete the experiment.
7. Clean and return equipment.

Experiment: Chemical dispersion

Materials	**Method**	
• Food colouring • Clear bowl with water • Smart phone with video	1. Place one drop of food colouring in the middle of a bowl of water. 2. Film the process and time how long it took for the colour to spread throughout the container. 3. Observe how the food colouring disperses and answer the questions below.	

How did the food colouring disperse? _____

Describe the movement of food colouring (straight lines, curves, whirls). Did it first go across the surface, sink, or evenly spread?

_____

How long did it take before the water was evenly coloured?

_____

Based on what you have observed, what can you infer about some kinds of pollution in water compared to pollution on land?

_____

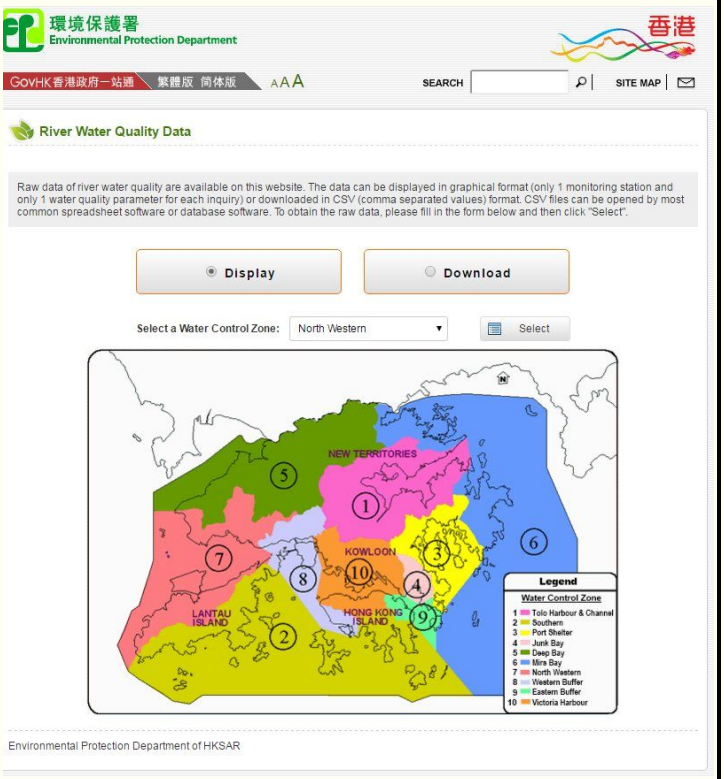
Activity 2. Hong Kong water quality

The Environmental Protection Department provides data about the health of the rivers in Hong Kong.
http://epic.epd.gov.hk/EPICRIVER/river/?lang=en

Use this link to access the data for water quality in Hong Kong.
http://epic.epd.gov.hk/EPICRIVER/river/?lang=en

Hong Kong has been divided into nine zones. Choose one of the nine zones with data.

The next screen will show a map with the river watersheds that are being monitored. To choose a river system, click on it.

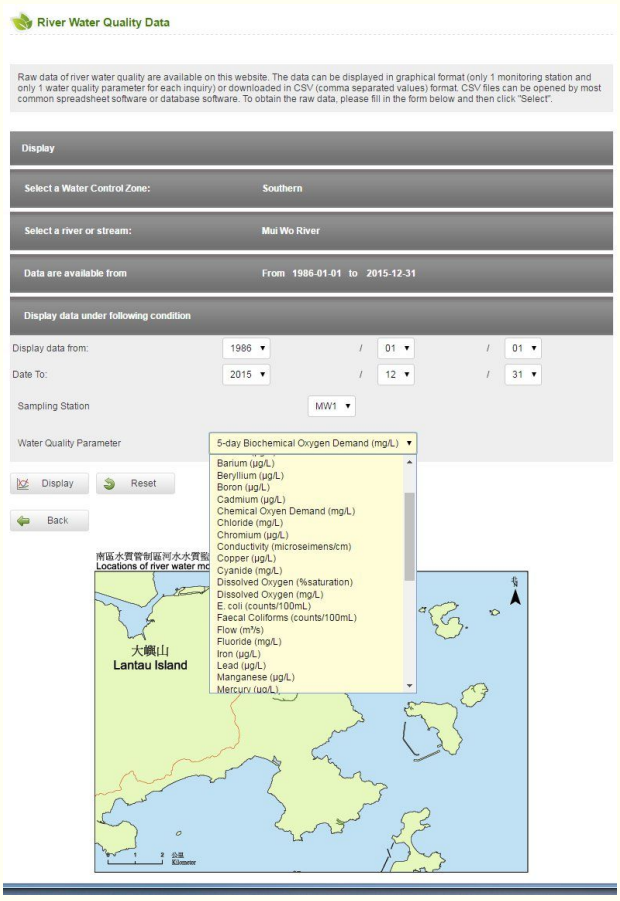


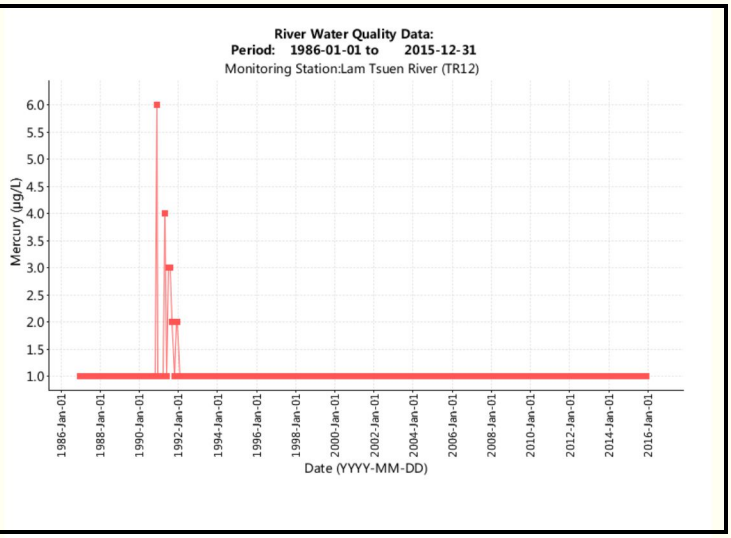
The third screen has the watershed river system map with menu choices.

The bottom menu is labelled Water Quality Parameter. When it is clicked on, a drop down menu provides all the various parameters that have been measured. There are a large number of chemicals being measured along with bacteria, water flow, etc.

To get a graph, click on the parameter and then on the display button. A new window will come up showing a graph.

Scientists can use these parameters to measure the health of a river system and identify some sources of pollution. They can find out if there is a new change or event when one of the parameters spike.



Use the menus to choose a Hong Kong river system. Use the Water Quality Parameters to obtain data about E.coli bacteria, dissolved oxygen levels, salinity, phosphate, nitrates, mercury, flow, turbidity. The data page will bring up a graph like this example on the right. Explain what the graph tells you.	

In the graph above, it would appear that the river was contaminated with mercury in the 1990s. The source of the mercury pollution has stopped and there has been minimal mercury in the water ever since.

Which river have you chosen? _____

Look up the following parameters and explain the graphs that go with each parameter.

Information about the Water Quality Parameter	**1. Explain the graph: 2. Are there great changes in the graph? 3. What might the changes mean?**
E. coli bacteria are the bacteria that live in our gut. When there is a large amount of E.coli in a river, it means that the river is being polluted by sewage or animal waste. Higher levels of E.coli increases the chance of disease-causing bacteria also being in the river water.	
Dissolved oxygen levels measure the amount of oxygen available to animals like fish and tadpoles. Cold water can hold more oxygen than warmer water. High levels of oxygen indicate a healthier river. Very low levels of dissolved oxygen will have a great effect on all river plants and animals.	
Salinity is a measure of salt in the water. High concentrations of salt will affect many plants and animals in water systems. Salts can come from industry and soil. Tidal areas will get salt from the sea.	
Nitrates also accelerate the growth of living things and reduce oxygen levels. High levels of nitrates in drinking water are harmful to people. These high levels come from fertiliser, industry and human waste.	

Phosphates accelerate the growth of many living things in a river. This in turn can use up all the oxygen in the water. When this happens, most of the life in a river can die. Excess phosphorous usually comes from fertilisers applied to crops or lawns.	
Mercury is a dangerous heavy metal that can affect our nervous system. It builds up in the food chain so that larger fish can have dangerous amounts when they live in mercury- polluted waters.	
Flow is the amount of water passing along a river. Flow is affected by rain, the amount of water being released from aquifers, water being stored in dams, clearing of land and human structures like roads and buildings. Human structures and clearings are likely to make floods more devastating.	
Turbidity is the measure of how far light can travel through water. Dirty-looking water has a high turbidity and it is more difficult for aquatic plants to grow. Turbidity will be highest after heavy rain when the dirt and pollution has been washed from our roads and buildings, as well as loose soil and sediment in the landscape.	

Activity 3: Acid Rain

Air pollution also has a harmful effect on the bodies of water in our watersheds. Chemical compounds such as sulphur dioxide and nitric oxide are released from fossil fuel-burning power plants and vehicles. These compounds react with water vapour in the atmosphere to make something we call “acid rain”. This rain has a more acidic pH than water normally has.

Acid rain can travel far from the source of the pollution. Wind can blow the compounds in the air for hundreds of kilometers.

Effects of Acid Rain

Acid rain can kill trees. In the Black Forest in Germany, the loss of thousands of acres of trees due to acid rain spurred the country to increase its use of solar and wind power. Acid rain also makes it difficult for many animals to live in streams, lakes and wetlands. Also, when it enters the soil it can cause larger amounts of aluminium to be released. This too can harm plants and animals.

Experiment:

Different plants and animals have different tolerance for acidic water. Sometimes a species of animal can tolerate a higher amount of acidity than usual, but the organism that it eats cannot. This will also affect its survival.

In this experiment, you will test the pH of four different samples of water. Then you will determine which organisms would be able to survive in water that has that pH. You will use the table below to determine this.

pH is a measurement of how acidic or basic a water solution is.

1. pH 7 is neutral; it is neither an acid or a base
2. pH between 1 and 6 is acidic. pH of 1 is very strong acid. pH of 5 is a weak acid.
3. pH between 8 and 14 is basic. pH of 14 is a very strong base. pH of 9 is a weak base.

Aquatic animal sensitivity to water pH

	pH 4.0	pH 4.5	pH 5.0	pH 5.5	pH 6.0	pH 6.5
Trout	dead	dead	dead	dead		
Bass	dead	dead	dead			
Perch	dead					
Frogs						
Salamanders	dead	dead	dead	dead		
Clams	dead	dead				
Crayfish	dead	dead	dead			
Snails	dead	dead				
Mayfly	dead	dead	dead			

Source of table: http://www.lakescientist.com/acid-rain/

Mayfly

Look at the table on page 20. It shows that the mayfly is very sensitive to acidity. If there are mayfly in a river or stream, what does this indicate about the acidity of the water?

_____

_____

You will need a pH indicator for this experiment. A pH indicator has a chemical that changes colour when it is exposed to acids or bases. For example, Litmus Paper turns red in strong acids and blue in strong bases. Colour pH indicators only give us a general, approximate measurement of the pH, or the strength of the acid or base but this is suitable for our purposes.

Experiment Test pH:

Materials:	**Method**	
• Litmus paper or other pH paper with its colour chart or • pH indicator solution with its colour chart • Lemon juice • Vinegar • 4 small beakers	1. Fill up one of the four beakers with 150 ml of tap water. 2. Add 1 ml of lemon juice to second beaker and fill up to a total of 150 ml with tap water. 3. Add 2 ml of lemon juice to third beaker and fill up to a total of 150 ml with tap water. 4. Add 1 ml of vinegar to third beaker and fill up to a total of 150 ml with tap water. 5. Test the pH of each of these beakers and record. 6. Determine which of the organisms in the table on page 20 would be able to survive in the pH of each of your beakers of water.	

Which if any of the animals on the table on page 20 could survive in your lemon juice of vinegar solution?

Lemon _____

_____

Vinegar _____

_____

Activity 4. Case Study: A Hong Kong River

Locate where the Lam Tsuen River is in Hong Kong by typing these words into Google Maps search engine. You may need to expand the map and look for the blue of the river on the map.

_____

Use this website to find out which parts of the Lam Tsuen River appear more natural and which parts no longer look like a river.
http://www.greenpower.org.hk/river/eng/lamtsuens.asp

Where do the natural parts of the river occur?

_____

Where do the concreted parts of the river occur?

_____

How is the land being used along Lam Tsuen River?
http://www.greenpower.org.hk/river/eng/landuse.asp

_____

_____

_____

_____

What are some of the sources of pollution along the course of this river?
http://www.greenpower.org.hk/river/eng/human.asp

_____

_____

Activity 5. Channelisation - is it the death of a river?

This video takes us on an aerial journey of the Shan Pui River from high up at the Wong Nai Tun reservoir in Tai Lam to the sea:
https://www.youtube.com/watch?v=QLPPfsxDQf0

How does the river system change on its way to the sea?

_____

_____

What is channelisation?

_____

_____

Look at this online powerpoint:
http://www.legco.gov.hk/yr03-04/english/panels/ea/papers/eaplw0223cb1-1035-3-e.pdf

Which solutions do you agree with and why?

_____

_____

What would you do that is different from the recommendations?

_____

_____

Activity 6. Visiting one of the world's major rivers

What would it be like to visit one of these major rivers?

- Ganges watershed
- Pearl River Delta
- Tisza River
- Mississippi River
- Doce River in Brazil
- Citarun River in Indonesia
- Sarno River in Italy

Use Google Images to look at each of these rivers. Ignore the maps of these rivers displayed in Google Images. Categorize the first 50 photos into the headings in the chart below. Tally the number of photos for each category.

River	Natural	City, housing, industry	Farming and fishing	Recreation	Polluted
Ganges watershed					
Pearl River Delta					
Tisza River					
Mississippi River					
Doce River in Brazil					
Citarun River in Indonesia					
Sarno River in Italy					

Which two rivers looked like they would be enjoyable to visit?

_____

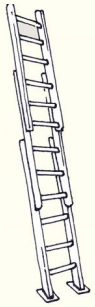
Which two rivers do you think would have the greatest health risk for their communities?

_____

Divide the rivers among your classmates.
In groups of two produce a short guide for tourists visiting one of the rivers. Do some more internet research. Include in the guide:

1. Attractions of the river
2. Attractions of the local culture
3. Health precautions for visitors

Extension: Compare different places in the world in terms of water pollution/modification. What factors are involved in making these pollution hotspots?

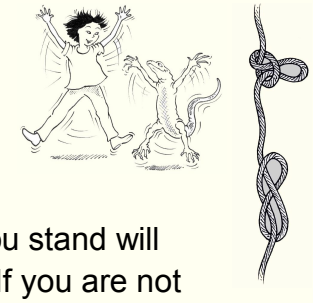


- Choose one of the rivers on the website below.
- Why have they been classified as one of the top 10 polluted rivers in the world?
- What has contributed to their pollution?
- You may need to do some more research using other websites.

https://soapboxie.com/social-issues/What-Are-the-10-Most-Polluted-Rivers-in-the-World

Lesson 3. Is there a perfect solution?

Solutions to watershed problems must be solved by people. Your community may not have much knowledge about pollution in watersheds but will understand how flooding will impact on them. Your community may want more done to prevent flooding.



Activity1. Values activity - Control flooding

In this "values activity" you will compare your values with those in your class. If there is room in your classroom, you will move across the room and stand in the area that you think expresses best how you feel. Where you stand will depend on how strongly you agree or disagree with a particular statement. If you are not sure or don't have enough information, you will stand in the middle. As you move to your position, ask those around you what they are thinking. When the teacher asks some of the students why they are standing in a certain position you may feel you want to change where you stand. You have the chance to do so. You are encouraged to clarify your views as you learn more from other students' point of view.

Our urban environment must be protected ftom all flooding.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

Our urban environment must only be protected from flooding if the protection work does not destroy the river's environment.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

We should allow places to flood where streets and buildings have been constructed in inappropriate places.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

The priority is to protect the river environment and not worry about flooding.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

We should work with nature to reduce flooding and restore our rivers.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

It's not possible to have natural rivers and no flooding.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

It's not possible to prevent all floods.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

Governments should get blamed when there is a flood of a city or urban area.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

We can find better ways of looking after a river's environment and also reduce the impact of flooding.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

Did you change your opinion about this same statement after thinking about all the other issues?

Our urban environment must be protected from all flooding.

Strongly agree Strongly disagree
|_____|_____|_____|_____|

How did you change your opinion, if you did so?

_____

_____

Source: South China Morning Post http://www.scmp.com/news/hong-kong/health-environment/article/2095537/hong-kong-grinds-halt-amid-rainstorm-leaves-social

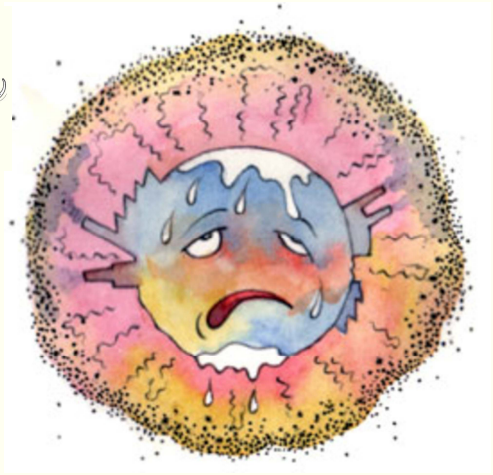
Activity 2. My opinion

Some of our opinions are very personal and have no effect on others. However some activities we might be involved in can have a great impact on others. While smoking will affect personal health, it also has negative effects on those nearby.

In the chart, decide what your opinion is on each of the questions. Can personal opinions about the questions affect other people?

Question	My opinion	Would lots of people with this opinion affect other people?
My favourite music is		
My favourite food is		
Should smoking should be banned in all public places?		
What punishment should violent people be given?		
How should we fix up the environment?		
Students should be given a job for six months when they leave school.		
Should cars be taken away from dangerous drivers?		
No new people should be allowed to live in Hong Kong.		
What is something you would like banned?		
Schools should teach students how to drive cars.		
Meat should be taxed so fewer pigs, cattle and sheep take up the land and cause pollution.		
Heavier punishments are needed for those who pollute.		

Activity 3. Do I need evidence?



Class discussion

There are many crime shows on TV that use forensic science as part of the plot. How much evidence would be required to convict someone of murder? What is the best form of evidence in a murder case? Would the trial require every kind of possible evidence to prove the case?

Not everyone agrees that climate change is caused by greenhouse gases produced by humans.

What do you think can be used as evidence for and against humans causing climate change:

_____

_____

_____

_____

_____

When the class gets together, discuss the evidence available for and against human-induced climate change.

What evidence do you think you would need to show that greenhouse gases can change the climate?

_____

_____

_____

_____

What does the Hong Kong Government think about its responsibility towards climate change? https://www.climateready.gov.hk/

_____

_____

_____

Activity 4. Managing a watershed

You have a map of a watershed. The map is blank except for the streams, rivers and the coast. How would you plan the watershed to provide, housing, work, food for a large population while also protecting the most sensitive parts of the watershed?

- The map is small so you could make a larger copy or have less detail on the small map.
- Decide if you will illustrate the map or use shading.
- Decide if you will label the map, use a legend or rely on your illustrations.

Which criteria would you use in managing a watershed?

Use the drawing below to plan how you would manage a Hong Kong watershed. How could water be obtained while protecting the environment? How will wastewater be treated and disposed?

1. Draw where you would place dams, a city, 2 towns, agriculture and some industry. You may want to include 1 port, 2 to 3 main roads and a train line.
2. The plan for the watershed should be environmentally friendly.
3. You need to include living space for people's homes and places where they work, shop and have recreation.
4. The steep hills are prone to landslip if they are cleared.
5. A major road is needed to link up with other towns and public transport is required.
6. The river and coastal area is environmentally sensitive.
7. Show where the water for the town is coming from and what happens to all waste water.
8. Labels can be used, but are not necessary.

Discuss as a class if it is easier to look after a watershed if people live in high-rise apartments or if they are spread out in smaller buildings.

Activity 5. Is this a good project?

Look at the project that is being done on the Shing Mun River.
http://www.epd.gov.hk/epd/english/news_events/current_issue/shingmunriver.html

After reading about the project, provide your opinion about what the positive and possible negative aspects of the project are.

Positive aspects of the project	Negative aspects of the project

Explain why on balance this is a good project or an inappropriate project:

_____

_____

_____

Extension:
Organize a debate based on the questions above. Have teams divided up and provide the format of: a) opening statement b) argument c) rebuttal d) closing remarks.

Speakers deliver 2 minute, timed speeches in strict order. NO extra time allowed.

Speakers Order (2 minutes each)

Speaker order	Time	Who	What	Details
1	2 min	PRO	Introduction	Main thesis, we are going to show you, define topic
2	2 min	CON	Introduction	Main thesis, we are going to show you, define topic
3	2 min	PRO	List Proof	Supporting facts, statistics, quotes
4	2 min	CON	List Proof	Supporting facts, statistics, quotes
5	2 min	PRO	Rebuttal to other group	Prepared counter arguments, quotes, facts, on your feet response to speakers 2 and 4
6	2 min	CON	Rebuttal to other group	Counter arguments, quotes, facts, on your feet response to speakers 1 and 3
7	2 min	PRO	Final Summary	Last chance at re-rebuttal, summing up. last appeal
8	2 min	CON	Final Summary	Last chance at re-rebuttal, summing up. last appeal

Lesson 4 - We can't do this alone

Activity 1. Our government and their agencies

Use these websites to help understand how the Hong Kong Government takes responsibility for protecting the environment.
https://www.gov.hk/en/residents/onlineservices/
http://www.epd.gov.hk/epd/english/laws_regulations/laws_maincontent.html
http://www.epd.gov.hk/epd/english/laws_regulations/enforcement/laws_eflhk.html

Identify and record five ways the Hong Kong government protects the watershed. Include what is being monitored.

1. _____

2. _____

3. _____

4. _____

5. _____

Who makes sure that the public and businesses obey the regulations?

_____

_____

Activity 2. Working together

There are many Hong Kong organisations run by the community (non-governmental organizations) that also have activities that protect and restore the environment. Choose one organisation from this list or find another on the internet that cares for the Hong Kong environment or environments in other places.

Ocean Recovery Alliance
http://www.oceanrecov.org/
River Net (Greenpower)
http://www.greenpower.org.hk/river/eng/index.asp
Conservancy Society Hong Kong
https://www.cahk.org.hk/
Environment Campaign Committee
http://www.ecc.org.hk/english/index.html
Green Council
http://www.greencouncil.org/eng/index.html

Green Council
http://www.greencouncil.org/eng/index.html
Friends of the Earth Hong Kong
http://www.foe.org.hk/c/default.asp#.WUDdKeuGMuU
Earth Care Hong Kong
http://www.earth.org.hk/
Ocean Recovery Alliance
http://www.oceanrecov.org/
Hong Kong Cleanup
http://hkcleanup.org/

Name of the organisation _____

What activities does the organisation do to prevent environmental damage?

_____

_____

_____

What activities does the organisation do to improve the environment?

_____

_____

_____

Which of their activities helps watersheds?

_____

_____

Report back to the class with your research.

Activity 3 - Now I Know Better

Return to the first activity called **What do I know?**
Add information and make changes to what you initially wrote. Get into small groups of four and discuss how your ideas about watersheds have changed.

Activity 4. Looking forward

Plan a project about your local stressed-out watershed. Get into small teams. Choose one of these three projects or come up with your own project. Project ideas might include:

Oral history of your watershed
Put together your community's ideas about the problems with your watershed and how your watershed has changed. Conduct interviews using a combination of video, photographs and record audio, etc. For example, ask people what they are fishing, how the area looked some years ago, how the area could be improved, etc. These websites will help in recording oral history.
https://museumvictoria.com.au/education/learning-lab/history-skills/creating-a-digital-history/
https://storycorps.org/discover/storycorpsu/effective-interview-questions/

Re-designing your local area
Choose a local area that includes local rivers or other water habitats. Make plans to redevelop the area. What parts of the area would stay as it is? What parts could be changed? How could the rivers and channels be improved? Is there room for more parks? See Hong Kong's landscape planning summary. http://www.hkip.org.hk/En/Content.asp?Bid=7&Sid=25&Id=151

Migratory waders
Find out what is special about migratory waders. Investigate where migratory waders would feed and rest in your local catchment. Are their feeding grounds vulnerable to development, boating or other human activities? How can the area be better protected? Can more wader habitat be created?
http://www.wwf.org.hk/en/news/_m.cfm?2680/A-New-Chapter-Opens-on-Wader-Migration-Research-in-Hong-Kong
http://awsg.org.au/wader-flagging/migration-routes/
http://birdlife.org.au/documents/Shorebirds-FactSheet.pdf
http://news.nationalgeographic.com/2015/09/15092-plastic-seabirds-albatross-australia/

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