Jockey Club Water Caretakers of Tomorrow Programme

It's all Downhill - Unit 2

Organised by

Ocean Recovery Alliance

Funded by

香港賽馬會慈善信託基金
The Hong Kong Jockey Club Charities Trust
同心同步同進 RIDING HIGH TOGETHER

About The Jockey Club Water Caretakers of Tomorrow Programme:

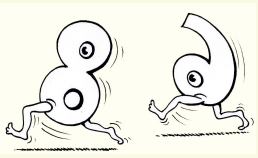
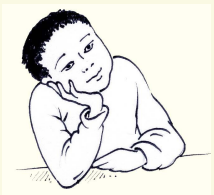
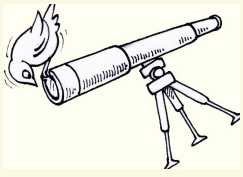
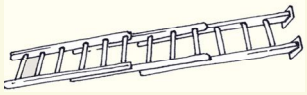
Jockey Club Water Caretakers of Tomorrow Programme is organised by Ocean Recovery Alliance, Ltd and funded by The Hong Kong Jockey Club Charities Trust. There are eight units in this program, and each of them is designed with you, a student in Hong Kong, in mind.

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

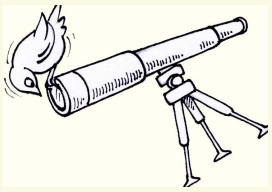
- Understand and appreciate how our water systems function on a local and global scale.
- Understand how watersheds function, and the interconnections of life within and between these watersheds.
- Be able to assess threats, such as pollution and habitat destruction, and learn how to lessen these effects.
- 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 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		**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:

- describe the physical features of the watershed and its relationship to the water cycle
- show the links and interactions in a watershed
- identify and describe the watershed I live in, using maps
- connect land use with impact on the watershed
- design a product or develop an outdoor activity that communicates an understanding of watersheds.

Glossary

Agriculture	The cultivation of crops and animals for food, medicine and materials used to enhance and sustain human lives.
Aquifer	Underground layer that stores water and lets water flow through it.
Climate vs. weather	Climate is the average weather over a year. Weather refers to the day-to-day climatic conditions such as wind, rain cloud, humidity and temperature.
Commercial	Referring to trading business or making money.
Condensation	Water from the air that collects as droplets and changes from gas into liquid.
Creek	A small waterway, usually sheltered and narrow.
Drainage basin	The area of land that water drains from.
Ephemeral	Is only present for part of the year.
Estuary	Where a river mouth meets the sea.
Evapotranspiration	The process of water going from liquid to gas by the sun's heat and by plants.
Geoengineering	Large-scale modification of a landscape's natural processes to better suit people's living conditions and counteract climate change.
Groundwater	Permanent water stored in the ground.
Impermeable	A material that does not allow water to pass through it.
Industrial	Economic activities that turn raw materials into goods in factories.
Infiltration	The downward movement of water from the surface to below ground.
Landslip/mudslide	The collapse of earth or rock down a slope.
Meteorological	The science of studying the atmosphere and its processes.
Parks/conservation	Areas of land that are protected for the purpose of maintaining their natural state.
Percolate	Movement of water through a porous surface or material.
Perennial	Present all year round.
Permeable	A material that allows water to pass through it.
Precipitation	When water falls from the sky as a liquid or a solid.
Recharge	The rate something is filled back up.
Recreational	Used for the purpose of fun, entertainment, or leisure.

Reservoir	A natural or artificial body of water on the surface that is used as a supply of freshwater.
Residential	Refers to the size of the buildings where people live. (high vs low rise)
River	A flowing body of water in a channel.
Saltwater Intrusion	The contamination of a freshwater source by seawater.
Solar radiation	Various rays from the sun entering the atmosphere.
Spring	Where freshwater wells up from the ground to the surface.
Stream	A flowing body of water in a channel that is smaller than a river.
Sublimation	Solid turning into gas without becoming a liquid.
Surface runoff	The movement of water above ground after a rain event.
Topography	The study of the surface shape of the land.
Transport	Movement of a substance or object.
Typhoon	A big storm in the Western Pacific region of the world.
Velocity	The speed and direction at which something moves.
Water cycle	The circular movement of water around our planet.
Water table	The level of water under the surface of the earth.
Watershed	The boundary of land that marks where the passage of water will drain in a landscape.
Weather	Changes in the physical atmospheric conditions over the hours of the day.
Wetland	A piece of land that is always or periodically submerged in water.

Lesson 1 - Flowing water carves out a watershed

What do I know?

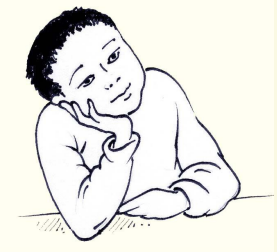


Photo match - Draw a line between the word and the best matching photo.

Agriculture

Estuary

Drain

Stream

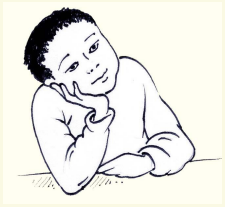
River

Reservoir

Pollution

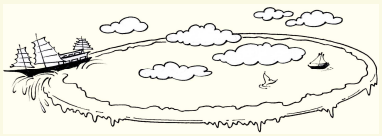
Ornamental pond

What do you know?



Interview the person next to you and record their answers:

1. Why is the Earth called the water planet?
2. What is so unusual and special about water compared to other substances on Earth?
3. Where is most of the Earth's freshwater supply stored?
4. What is the water cycle?
5. Why do we say that the Earth's water is recycled?
6. What is evaporation? What causes it on Earth?
7. If oceans are always losing water through evaporation, why aren't they becoming more and more salty and shallow?
8. What happens to precipitation after it falls to the Earth?
9. What is groundwater and why is it important?
10. Why does some water run over the ground, seep into the ground or stand on the ground?
11. Why is the pollution of groundwater so serious?
12. How is water purified during the water cycle?
13. What are some examples of different types of land use around where you live?
14. Name three ways to preserve Earth's water supplies from pollution.



Activity 1 - I'm on a roll

If this activity were to be done with water, the classroom would quickly become messy. In this experiment round objects rolling down a slope will be used to simulate water. Gravity is a force that will make any material get as close as it can to the centre of the Earth unless there is a force (such as something getting in the way) preventing it from going any further. You will make observations of how the angle of the ground affects the speed of an object and what force it can apply to other objects that get in its way.

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: Rolling downhill

Materials:	**Method**	
• Jars cylinders, balls • Long flat surface that can be angled e.g. moveable tabletop, tray, large book, long wide ruler	1. Use a surface that can have its angle changed 2. Roll a round object down the sloping surface. 3. Change the angle of the slope and observe any difference in speed. 4. Place an upright object at the bottom of the slope to stop the rolling object.	

Prediction:

_____

Observation: How does the increased angle of the slope affect the force the rolling object has when hitting the stationary object?

_____

_____

Explain how increased slope affects the speed and force of water moving downhill.

_____

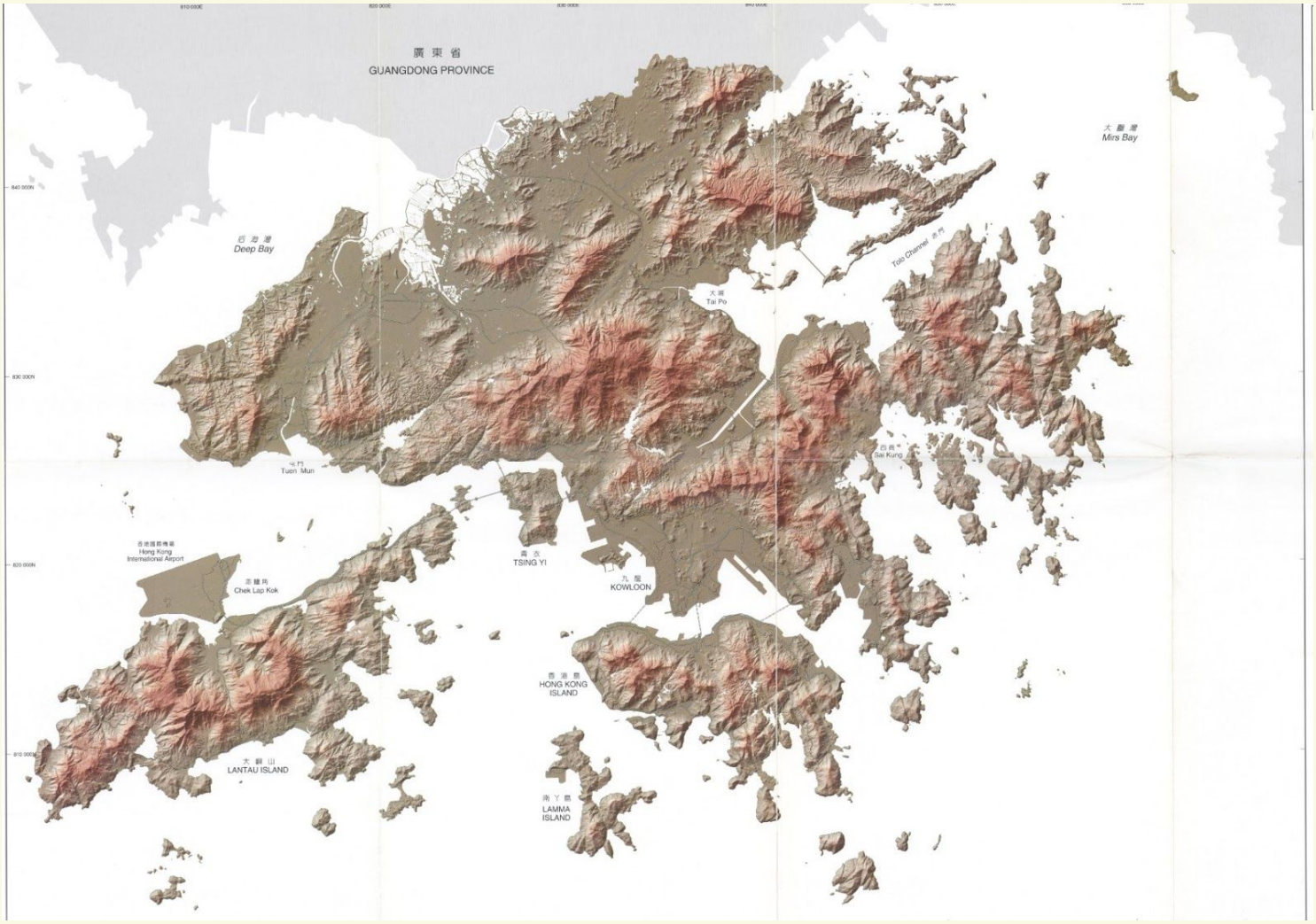
_____

Activity 2 - Connect the dots

A watershed is an area of land in which all the water collects together. Its starts from the top of the ridgeline of hills or mountains. The water starts flowing in small streams or collects underground. Often the surface water flows into rivers and moves to lakes, estuaries or the sea.

In this activity try to make the outline of one or two watersheds by drawing the ridge line that encloses a watershed.

1. Download the map from the website. The digital map is very detailed. You can crop and print a small section of the catchment you want to work om.
2. Find the ridge lines that enclose the catchment.
3. Use a fine pencil to draw dashes or place dots on the ridgeline. If you can't see all of the ridgeline guess how ridge lines connect.
4. Draw an arrow where you think the water will flow into the sea.
5. Compare the watershed you drew with the watersheds other students made.



Use this link for more information about determining the boundaries of a watershed:
http://www.geo.brown.edu/research/Hydrology/FTP_site_5099-05/maine_appD_watershed-delineate.pdf

Activity 3 - That is a whopping big watershed

Choose one of the world's largest rivers and find out how big its watershed is.
Examples of the world's largest rivers are:

- Amazon
- Yangtze
- Nile
- Mississippi
- Congo
- Volga
- Murray Darling

https://en.wikipedia.org/wiki/List_of_rivers_by_length

Name of watershed _____

Area of watershed _____

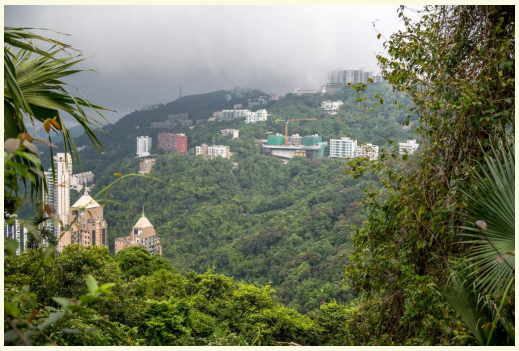
Where the river flows out _____

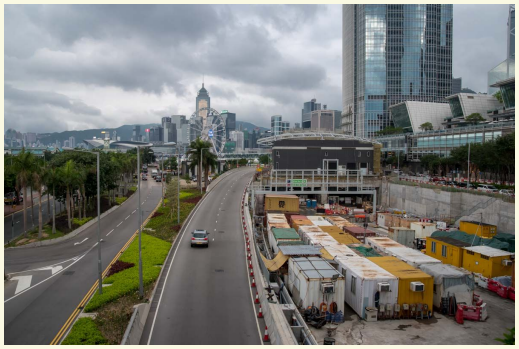
Some countries that are part of the watershed _____

Or use the activity on the National Geographic website
https://www.nationalgeographic.org/activity/mapping-watersheds/

Activity 4. What's inside my watershed?

Use Google Maps or Google Earth to find out what is inside your watershed. You will need to use your Activity 2 catchment to locate the boundaries of the watershed you live in.





- ☐ Forests
- ☐ Lakes
- ☐ Estuaries
- ☐ Rivers
- ☐ Agriculture
- ☐ Reservoirs
- ☐ Urban parks
- ☐ Roads
- ☐ Freeways
- ☐ Trains
- ☐ Shipping ports
- ☐ High rise housing
- ☐ Low rise housing
- ☐ High rise offices
- ☐ Open car parks
- ☐ Light industry
- ☐ Heavy industry
- ☐ Shopping areas
- ☐ _____
- ☐ _____
- ☐ _____

Describe your watershed using some of the terms above:

_____

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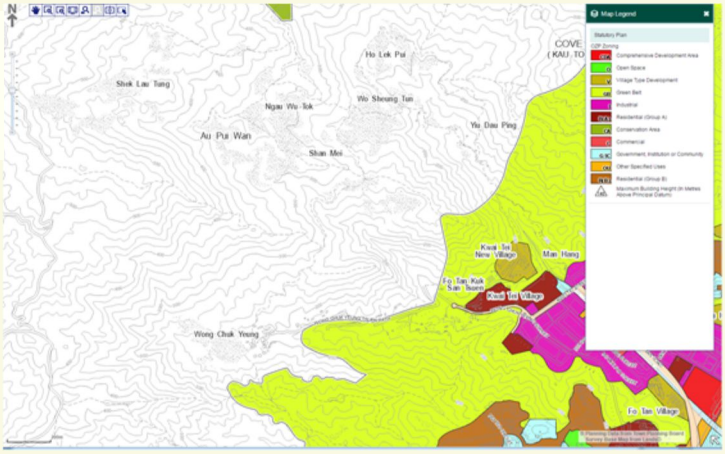
Activity 5. Hong Kong contours

The Statutory Planning Portal has maps with detailed contours. Did you know that the closer the contours are, the steeper the slope?



Town Planning Board 城市規劃委員會
Statutory Planning Portal 2
法定規劃綜合網站 2

http://www1.ozp.tpb.gov.hk/gos/default.aspx

Using the contour map, identify some steep places around Hong Kong.

_____

_____

Activity 6. Slip sliding away

Very steep land and high density populations around Hong Kong could be a serious risk. What kind of work is involved to keep people in Hong Kong and their buildings safe from landslips, mudslides and falling rocks?

The image on the right is from a website called Hong Kong Slope Safety:
http://hkss.cedd.gov.hk/hkss/eng/student_page.aspx
It has twelve items in the menu. The first link doesn't have much information. In your group, find three or more interesting facts to share with the class.

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Activity 7. The good news and bad news

Watch the first minute or two of some of these videos and make some notes:

Youtube: Monster flood in China (June 2016) - How did the flooding change? Were people at risk? What was at risk?
https://www.youtube.com/watch?v=ADnk1WXR9cs

_____

_____

_____

BBC News: China flooding: Wuhan on red alert for further rain - How did the flooding affect people? How many people were affected? How did people respond?
http://www.bbc.com/news/world-asia-china-36721514

_____

_____

The Guardian: Thousands of birds flock to Australia's inland lakes after record rain - How were people affected by this flood? How did the flood help wildlife?
https://www.theguardian.com/environment/2017/apr/03/thousands-of-birds-flock-to-australias-inland-lakes-after-record-rain

_____

_____

Youtube: From floodplain to wetland wonderland (8.5.2016) - How has the area been changed? Would it be a big problem for people if the area got flooded?
https://www.youtube.com/watch?v=v_EG8JyskF8

_____

_____

Choose one of the quotes below. Then make a drawing or sketch to explain the quote. On the Gallery Walk, be prepared to explain how your drawing represents the main ideas behind the quote you chose.

- Moving water can have a great impact on the way we live – both positive and negative.
- Humans can have great impacts on the quality and quantity of moving water.
- Moving water does not stay the same. It is itself always changing.
- Moving water can help communities and it can also hurt them.
- Moving water has great impacts on both the natural and human world.

Quote

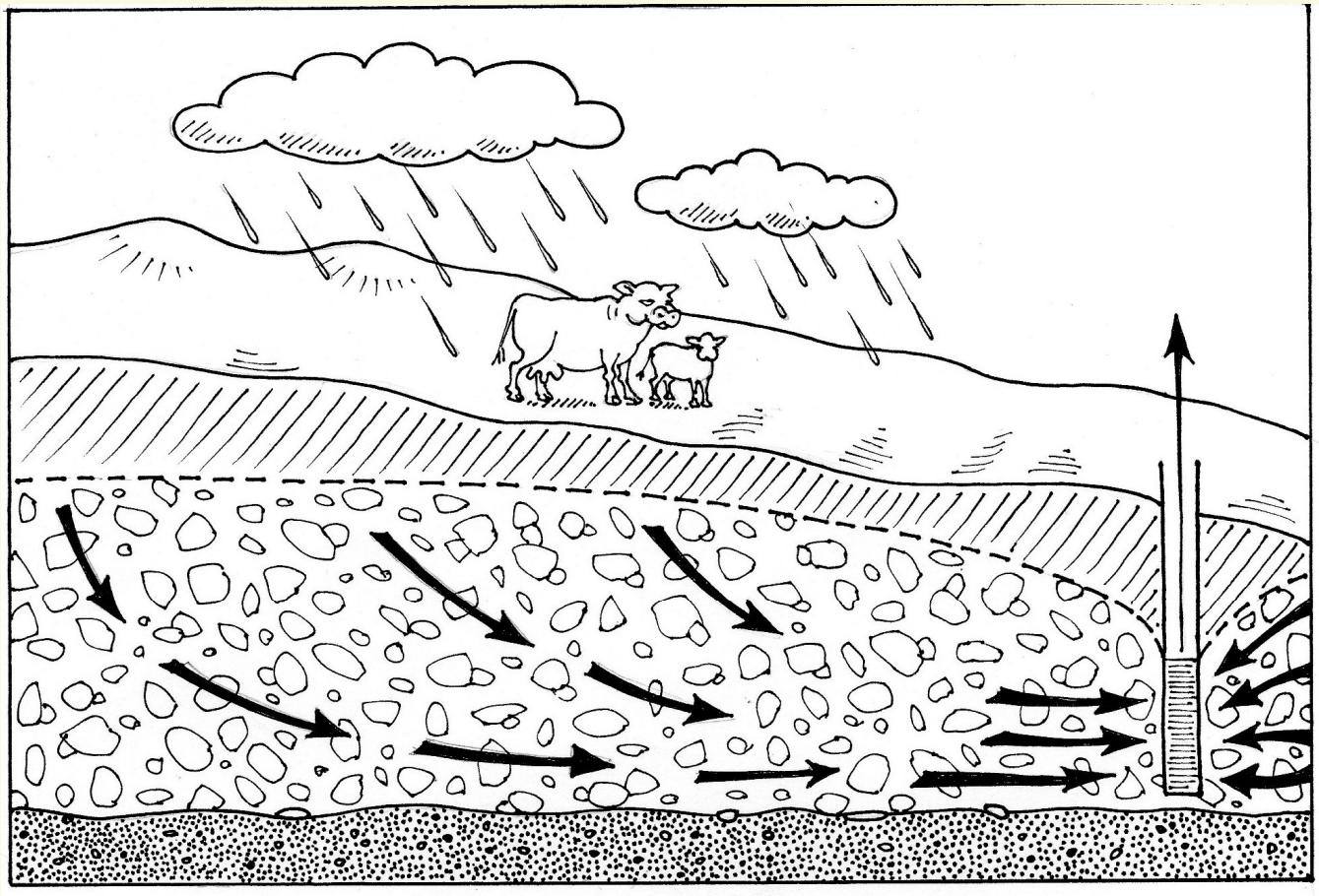
_____

Sketch

Lesson 2. Water travels underground too

Activity 1. Aquifer

Where does all the water go when it soaks into the ground? It travels down into the ground until it reaches rock that is impervious to water. It is stored in the rock and soil above the impervious rock. The top of the underground water is called the water table. When the water table meets the surface of the soil there is a spring with water flowing out.



Watch this video to see how water travels in a hilly aquifer.
https://www.youtube.com/watch?v=RUt43dSOsZQ
And more information about groundwater
https://www.youtube.com/watch?v=NWCj2wlMDsQ

Where does the water contained in an aquifer come from?

_____

What are some ways in which the water table can drop?

_____

_____

How can pollution get into an aquifer?

_____

_____

Activity 2 - Aquifer in a plastic cup experiment

Experiment: Where did the water go?

Materials:	**Method**	
• Clear plastic cups • Small pebbles - 50 ml • Sand - 50 ml • Clay eg modelling clay - 50 ml • Jug of water - 200 ml	1. Layer the clear plastic cup starting at the bottom with some pebbles– 2cm. 2. Press down a layer of clay - 1cm and more pebbles—2cm. 3. Cover with a layer of sand—2cm. 4. Pour water over the sand and observe how far down the water moves. 5. See how much of the water can be poured out of the cup.	

Prediction:

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Observation:

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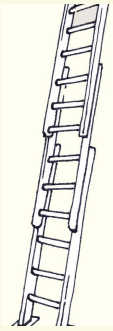
Where was the water held in the cup?

_____



Extension - For a more authentic aquifer make a more sophisticated model using the instructions on this website:
http://www.ngwa.org/Fundamentals/teachers/Pages/Make-Your-Own-Ground-Water-Model.aspx

Experiment: How fast will it drip out

Materials:	**Method**	
• Four clear plastic cups • Small pebbles - 50 ml • Sand - 50 ml • Soil - 50 ml • Clay eg modeling clay - 50 ml • Measuring jug of water - 250 ml or larger • Scissors • Tray that will hold water from experiment ruler	1. Using scissors, cut two 5 mm hole at the bottom side of each plastic cups. 2. In each cup place one of the items - pebbles, sand, soil and clay. 3. Be sure that each cup has the same amount of material. 4. In each cup pour the same volume of water. 5. Compare how quickly the four cups empty. 6. Use your own method or measure the height of the water in the cups as some start to empty.	

Prediction:

_____

Observation:

_____

_____

Explanation?

_____

_____

Experiment: The big squeeze

Materials:	**Method**	
• Water bottle two thirds filled with water • Bottle top with small hole drilled in the top.	1. Go outdoors with the water bottle. 2. Choose a garden area. Make sure the lid of the bottle is screwed on. 3. Point the bottle towards the garden. 4. Squeeze the bottle, applying even pressure around the mid-dle. 5. Observe what happens to the water when it is under pressure.	

Prediction:

_____

Observation:

_____

_____

Explanation?

_____

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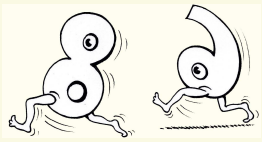
Activity 3 - Who is using aquifers?



The 15 nations with the largest estimated annual groundwater extractions (2010)[7] are:

Country	Population 2010 (in thousands)	Groundwater extraction			
		Estimated groundwater extraction 2010 (km^3/yr)	Breakdown by sector		
			Groundwater extraction for irrigation (%)	Groundwater extraction for domestic use (%)	Groundwater extraction for industry (%)
India	1224614	251.00	89	9	2
China	1341335	111.95	54	20	26
United States	310384	111.70	71	23	6
Pakistan	173593	64.82	94	6	0
Iran	73974	63.40	87	11	2
Bangladesh	148692	30.21	86	13	1
Mexico	113423	29.45	72	22	6
Saudi Arabia	27448	24.24	92	5	3
Indonesia	239871	14.93	2	93	5
Turkey	72752	13.22	60	32	8
Russia	142985	11.62	3	79	18
Syria	20411	11.29	90	5	5
Japan	126536	10.94	23	29	48
Thailand	69122	10.74	14	60	26
Italy	60551	10.40	67	23	10

Source http://www.ngwa.org/Fundamentals/Documents/global-groundwater-use-fact-sheet.pdf

Which countries use their aquifers for supporting their industry?

_____

Which three countries depend on aquifers for domestic use?

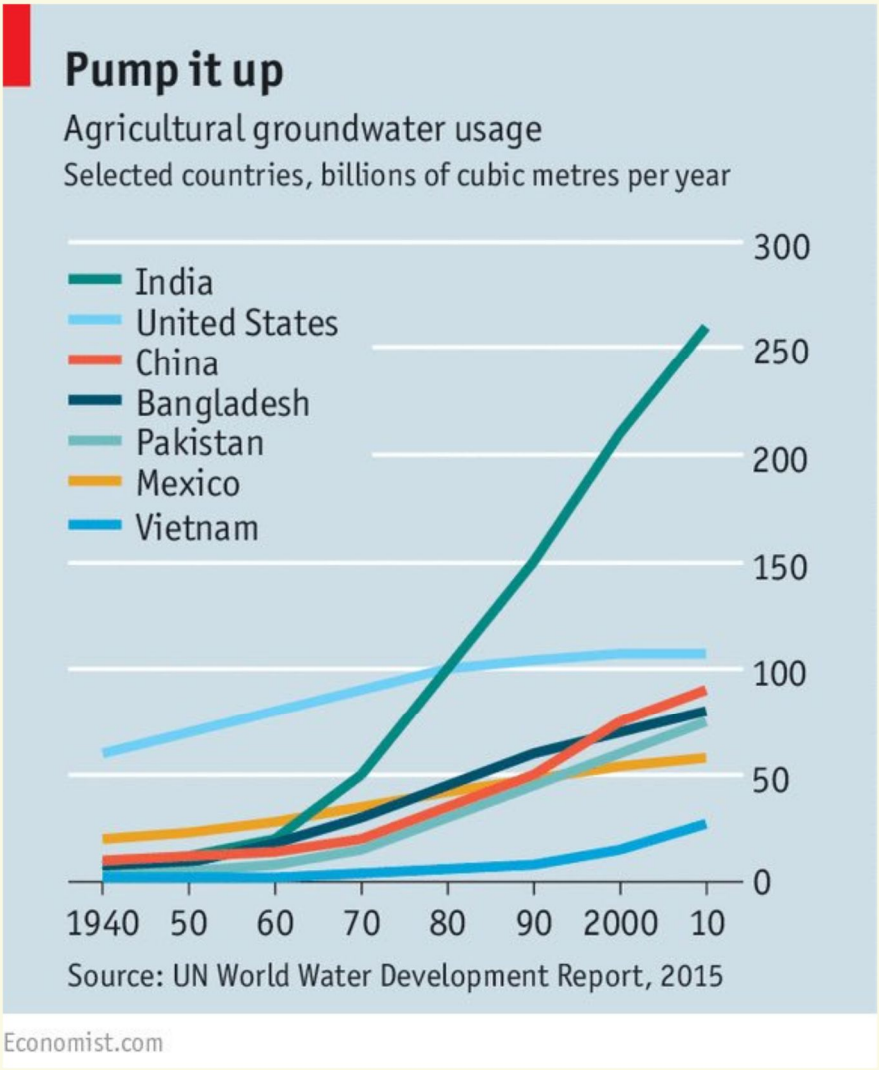
_____

_____

Which country uses the most groundwater per person? Figure out how to calculate this and write the formula:

_____

_____



Source http://www.economist.com/news/briefing/21709530-water-becomes-ever-more-scant-world-needs-conserve-it-use-it-more-efficiently-and

Which country is increasing the quantity of groundwater it uses the most? What do the slope of the lines show about the use of groundwater over time?

_____

In what year did China and India use the same amount of groundwater? _____

How much more groundwater did India use compared with China in 2015? _____

Which other countries are still increasing the amount of groundwater they are using?

_____

Activity 4. Recharging an aquifer

Watch these three videos to find out how water is recharged (replaced) as water is used and drains out of aquifers.
https://www.youtube.com/watch?v=RUt43dSOsZQ
https://www.youtube.com/watch?v=ZimRO31Nobw
https://www.youtube.com/watch?v=guqinVOHTqc

Why are aquifers useful during a drought?

_____

_____

Where does the water in aquifers come from?

_____

_____

How can aquifers get polluted?

_____

_____

What will happen if the amount of water taken from an aquifer is greater than the recharge?

_____

_____

Activity 5. Polluted aquifers

You will be making an aquifer in a cup that you can eat and drink. It will consist of layers that represent soil and rocks. Coloured cordial will show how water is moving through your aquifer. Below are suggestions about how you can make your aquifer. You could choose to use what you have learned about aquifers and make your own version.

Before you start this activity, wash your hands and make sure the surfaces you work on are clean. All the equipment you use must be clean and have never been used in a science laboratory.

The movement of cordial ice cream and crushed biscuits will simulate how water carries dissolved materials through the water table including pollution.

Experiment: Edible aquifer

Equipment:	**Method**	
• A small clear plastic cup for each student • Tub of ice cream • Concentrated juice • Tube of food colouring that can be used by single drips • Some of the following Small gummy bears, • chocolate chips, crushed cookies, breakfast cereal, or crushed ice • Cake sprinkles • Straws • Spoon	1. In a cup, layer the small gummy bears, chocolate chips, crushed cookies, breakfast cereal, or crushed ice (represents gravel and rock). 2. Pour some concentrated juice to just cover the layer above (groundwater). 3. Place a scoop of ice-cream on the top (Confining layer). 4. Place sprinkles on top (grass). 5. Place one drop of food colouring on top of the ice-cream to see how the ice-cream moves through the material below. 6. Observe what happens when you use the straw to slowly drink from the bottom of the cup. 7. What happens when the aquifer is recharged with more cordial? 8. Clean up after the experiment.	

Predict how this experiment simulates pollution.

_____

Observation of liquid and the materials that it carries when it is being drunk.

_____

_____

Explain how aquifers become polluted

Use the internet to find out more about how aquifers become polluted and what chemicals and other materials can pollute aquifers.

Groundwater contamination
http://www.groundwater.org/get-informed/groundwater/contamination.html
How groundwater pollution occurs http://www.mnn.com/earth-matters/translating-uncle-sam/stories/how-does-groundwater-pollution-occur
China Water Risk
http://chinawaterrisk.org/resources/analysis-reviews/the-state-of-chinas-agriculture/

Draw and label a diagram that shows where different sources of pollution enter into and moves through the aquifer:

Activity 6. A drip at a time

Watch some of these videos
https://www.youtube.com/watch?v=j23TqoMNPY8
https://www.youtube.com/watch?v=PpbxFpAZmSQ
https://www.youtube.com/watch?v=HYV6gBssMFs

Tick the correct answer:

What does limestone come from?
- ☐ Volcanoes
- ☐ Rivers
- ☐ Shells of dead sea creatures

Limestone is made from
- ☐ Sand
- ☐ Calcium carbonate
- ☐ Carbon Dioxide

Solid limestone is dissolved by
- ☐ Carbon dioxide in water
- ☐ Calcium carbonate in water
- ☐ By water alone

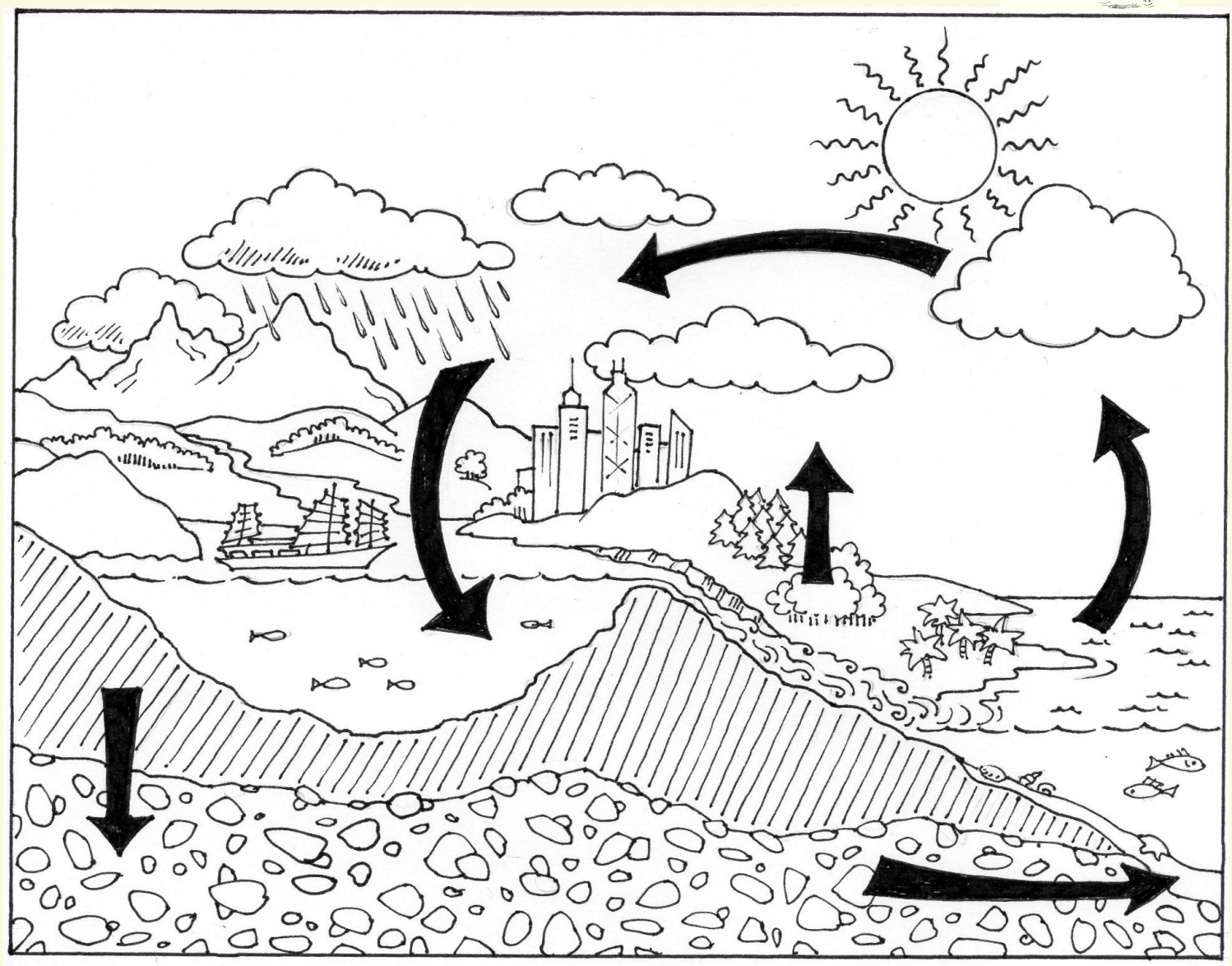
Limestone caves are formed by
- ☐ Earthquakes
- ☐ Groundwater
- ☐ Geological faults

Watch some of these videos:
https://www.youtube.com/watch?v=nGkDouBVoLs
https://www.youtube.com/watch?v=Cp5S6WWZsWc
https://www.youtube.com/watch?v=JII0KLQqVR4

Write a fictional short story about a sinkhole opening up without warning on your school's grounds.

Lesson 3 - Changing environment

Activity 1. Review the water cycle



Label this diagram and add more arrows. Use this list of words . Refer to the glossary and the internet for words you are not familiar with

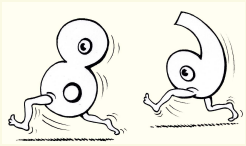
Solar radiation
Evaporation
Condensation
Transpiration
Sublimation
Surface runoff
Groundwater
Precipitation
Infiltration
River

Activity 2. Local and regional weather information

Weather: use this website to see how daily weather is changing in your part of the world.

http://en.sat24.com/en/forecastimages/azie/forecastwind
http://en.sat24.com/en/forecastimages/azie/forecastprecip
http://en.sat24.com/en/forecastimages/azie/forecastlightning
http://en.sat24.com/en/forecastimages/azie/forecasttemp
http://en.sat24.com/en/forecastimages/azie/forecastcloud

What changing weather conditions are being measured?



_____

_____

Over what time period are the weather maps being produced?

_____

How is this information useful?

_____

_____

Find out how much variation there was in temperature and humidity in your area by looking at the graphs on the Hong Kong Observatory website link,
http://www.hko.gov.hk/wxinfo/ts/display_element_tt_e.htm

Maximum temperature _____ Minimum temperature _____

Change in temperature in 24 hours _____

Maximum % humidity _____ % Minimum % humidity _____ % Change in humidity _____ %

Activity 3. Destructive weather events (Just another disaster)

This link to Wikipedia has a menu of 41 typhoons that have moved across Hong Kong. Typhoons affect very large areas. Hong Kong is a small area compared with China so most of the typhoons on this list will have done more damage to the greater China area.
https://en.wikipedia.org/wiki/Category:Typhoons_in_Hong_Kong

Each student picks a separate typhoon to investigate and report back to the class.

When did the typhoon occur? _____ What name was it given? _____

Describe the weather conditions during the typhoon: _____

_____

What damage did the typhoon do? _____

_____

Report about your typhoon to the class.

What has the class learned about the dangers of typhoons in general?

_____

This Wikipedia page describes some of Hong Kong's landslips.
https://en.wikipedia.org/wiki/1972_Hong_Kong_rainstorm_disasters

What kind of damage can a mudslide cause?

_____

_____

At the Edge of Your Seat

What disaster movies have you seen? Do you think they are realistic? Can they become exaggerated or are some actually ridiculous?
Look carefully at this video. Only look at the short introduction.
https://www.youtube.com/watch?v=mLuvjTVHfSQ

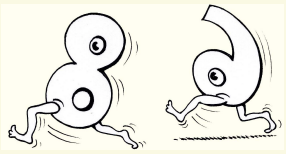
Discuss as a class:
Why was this video made?

_____

Give your reason why you think disaster movies might be a good idea or a bad idea.

_____

Activity 4. What is climate?



Look at the climate images on this Hong Kong weather website.
http://www.weather.gov.hk/cis/climahk_e.htm

How does maximum temperature change over 12 months?

_____

How does humidity change over 12 months?

_____

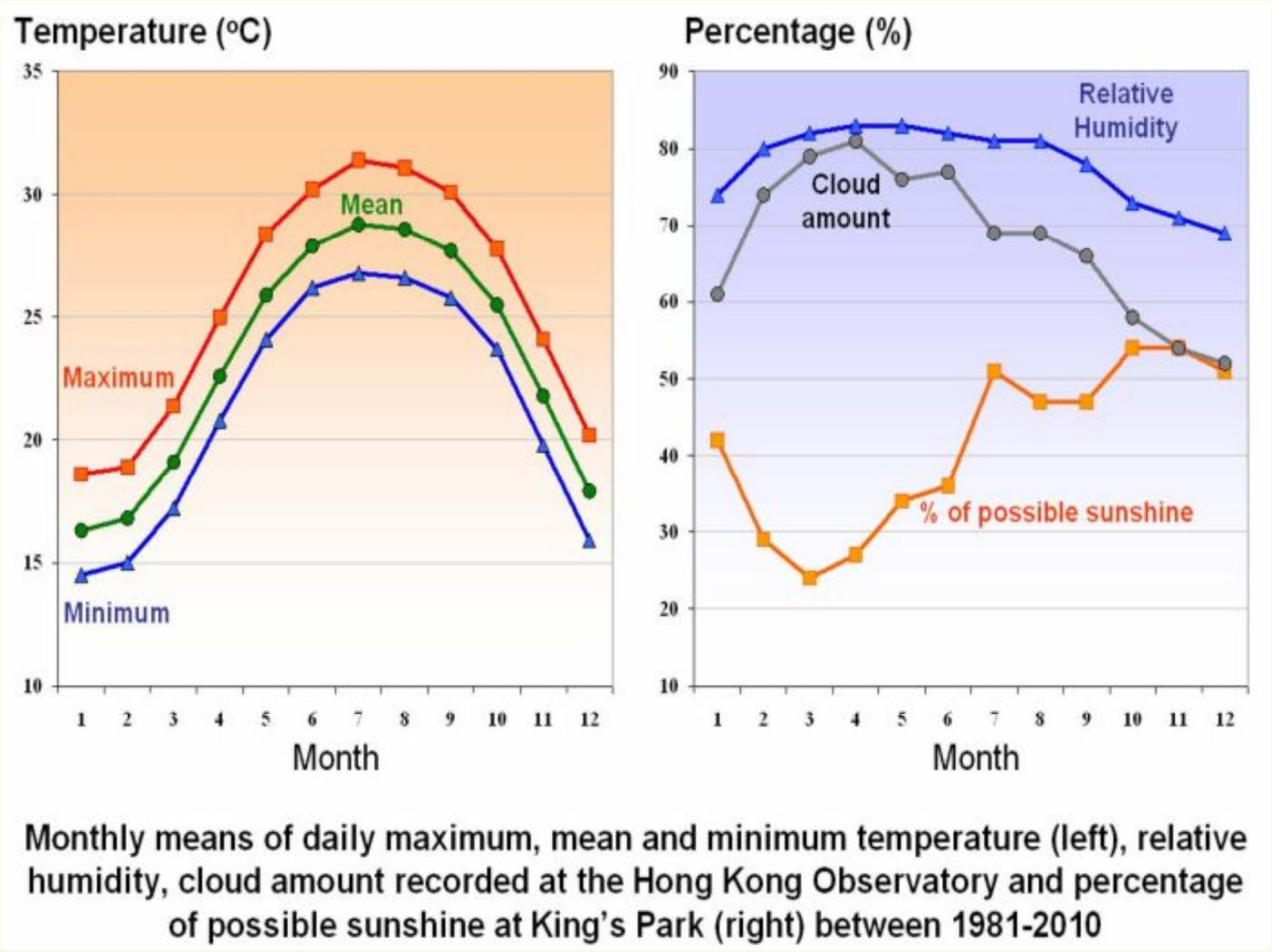
How does rainfall change over 12 months?

_____

Explain why some areas in Hong Kong get more rain:

_____

Could you have come up with the right answers without looking at the images? _____



Monthly means of daily maximum, mean and minimum temperature (left), relative humidity, cloud amount recorded at the Hong Kong Observatory and percentage of possible sunshine at King's Park (right) between 1981-2010

Reference http://www.weather.gov.hk/cis/climahk_e.htm

Explain how data over many years is used to describe climate.

_____

_____

_____

What is the difference between weather and climate?

_____

_____

After watching these short videos, explain how temperature and CO_2 in the atmosphere is changing. When has the change started to speed up?
https://vimeo.com/175317504 CO_2 concentration
https://vimeo.com/175317500 Temperature

_____

_____

It only takes a couple of degrees change in the Earth's average temperature to have a dramatic effect on the climate of most regions around the world. Research is being done to find how an increase in average temperature could affect Hong Kong. Use this website to find out how a change in Hong Kong's climate might affect its future.
http://www.weather.gov.hk/climate_change/climate_change_hk_e.htm

Summarise how Hong Kong's climate could be affected by more greenhouse gases.

_____

_____

_____

Activity 5. Is geoengineering the solution?

Sea level rise is due to two factors. As the ocean's water warms, it expands. As more ice on Greenland and Antarctica melts and falls into the ocean, the sea rises even further. Over 100 years we can expect the sea level to rise by one meter. One meter does not sound like much. Within 50 years the world's coastal cities will be commonly flooding when there is a combination of big storms and high tides. Many populated Pacific Islands will have to be abandoned because seawater will have flooded the water table and crops can no longer grow. Within 100 years these cities will need drastic action to save their lowest lying land from the sea.

One of the ideas being explored to prevent global warming is geoengineering. Some scientists have come up with many ideas to stop the climate getting warmer. These would be large scale projects. More ideas are being developed all the time. One of the biggest dangers associated with geoengineered solutions is that they are not possible to test on a large scale. Some solutions could lead to even bigger, new problems that were impossible to anticipate.
These are some of the suggestions that are being seriously considered to reduce the effects of greenhouse gases or climate change. Their potential disadvantages are also included.

Class survey - tick up to two solutions you think are best for Hong Kong:

- ☐ Seawalls to protect Hong Kong's cities from storms and coastal surges. Seawall would impact on intertidal zones, marine animals and birds.
- ☐ Reflectors positioned in space could lower the Earth's temperature. This could reduce sea level rise and impact of storms. With the reflectors many regions may not necessarily keep their previous climate. The cost of the sun reflectors in space would be very high.
- ☐ More pollution, particularly sulphur pollution would reduce temperature. It would, however, also affect the health of people and the environment.
- ☐ Placing chemicals in atmosphere could lower the Earth's temperature. We may still have changes in climate but not have the destructive impact that higher temperatures will cause. These chemicals may also cause pollution or affect the ozone layer.
- ☐ By fertilising the sea, some hope that more CO_2 could be captured and the resulting dead plants and animals settling on the bottom of the ocean would reduce CO_2. We don't know if it would really work and if it would have an impact on the oceans.
- ☐ Reducing greenhouse gases faster than we are already doing won't be too expensive over the long term, but could have many economic consequences in the short term. It is very difficult to get every country on board. Many poorer countries want to give their citizens better lives so they need to be able to use more resources.

Discuss your preferred options. Can you find other options for reducing climate change? What conclusion did your class come to?

_____

_____

Extension - Meteorological research

Follow the path of a typhoon on a website
https://scijinks.gov/hurricane-simulation/

Lesson 4. Using the land wisely

Activity 1. Why we need regulations

What is your opinion about how the limited land in Hong Kong is used?

_____

_____

_____

_____

_____

_____

_____

Activity 2. The big land carve up.

The pie graph on the next page shows the percentage land use for Hong Kong. Describe how the land is used in Hong Kong. What occupies most of the land?

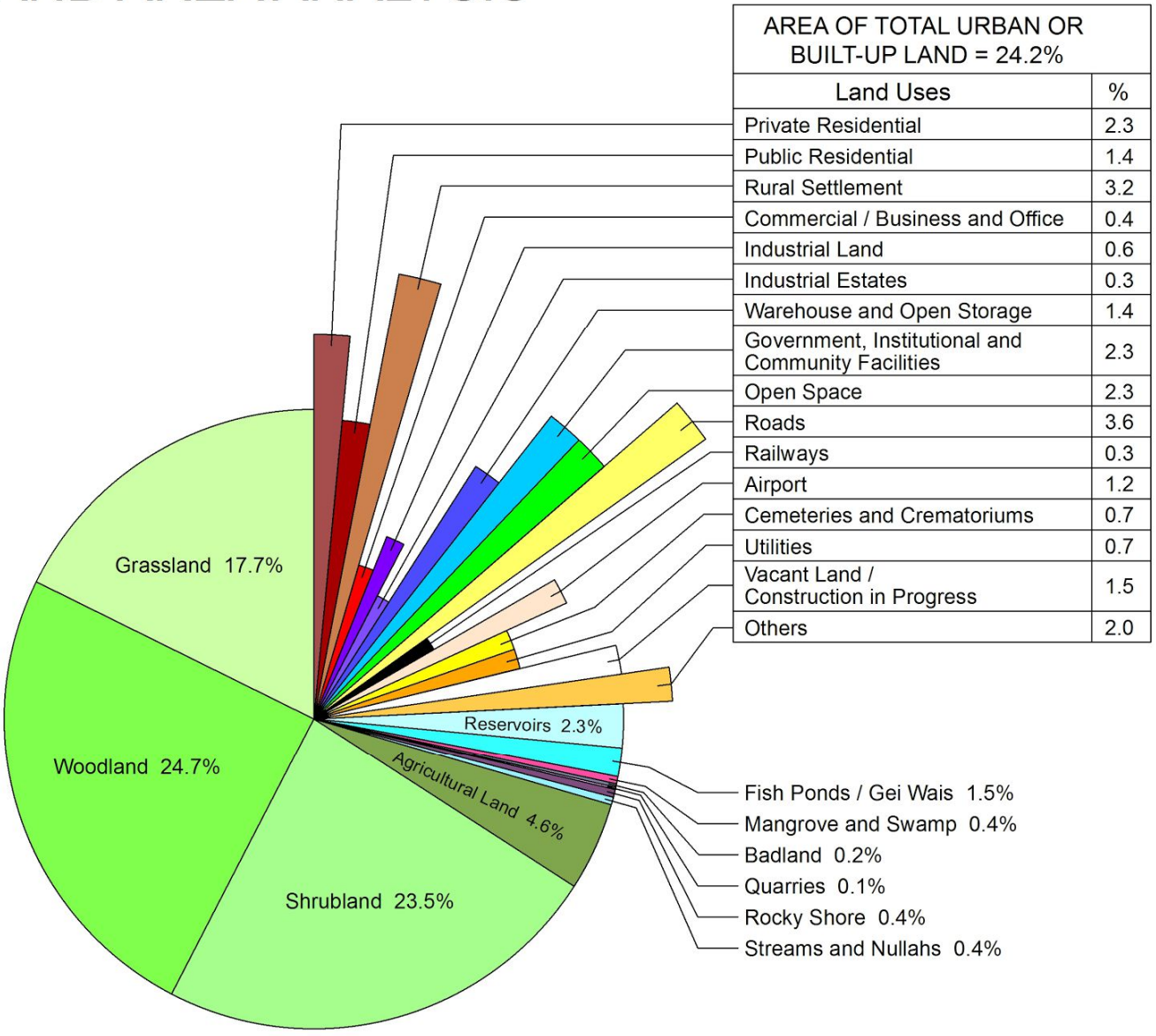
_____

_____

_____

_____

LAND AREA ANALYSIS



AREA OF TOTAL URBAN OR BUILT-UP LAND = 24.2%	
Land Uses	%
Private Residential	2.3
Public Residential	1.4
Rural Settlement	3.2
Commercial / Business and Office	0.4
Industrial Land	0.6
Industrial Estates	0.3
Warehouse and Open Storage	1.4
Government, Institutional and Community Facilities	2.3
Open Space	2.3
Roads	3.6
Railways	0.3
Airport	1.2
Cemeteries and Crematoriums	0.7
Utilities	0.7
Vacant Land / Construction in Progress	1.5
Others	2.0

Total land area = 1,110 km^2 (including about 4 km^2 of Mangrove and Swamp below the High Water Mark)
Vegetated area cover about 78.7% of the land area of Hong Kong
Country Parks, Special Areas and Mai Po Ramsar Site cover about 41.8% of the land area of Hong Kong

Source http://www.pland.gov.hk/pland_en/info_serv/statistic/landu.html

How much of the land in Hong Kong has been developed?

_____

_____

What part of Hong Kong would you expect to find the shrublands, woodlands and grasslands?

_____

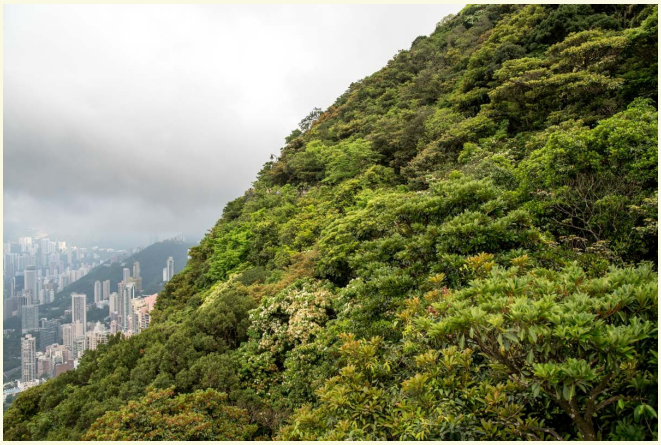
_____

Why do you think the woodlands, scrublands and grasslands have not been cleared?

_____

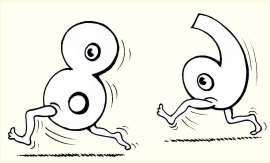
_____

How would the shrublands, woodlands and grasslands look if the government didn't regulate how land can be used?



Look at the pie graph on page 28. Besides natural areas and open space, what are the ten most common land uses in Hong Kong?

Activity 3. Avoiding danger



The Hong Kong Slope Safety website informs Hong Kong residents about the safety issues associated with steep terrain. Use the website to research some safety issues. http://hkss.cedd.gov.hk/hkss/eng/natural_terrain.aspx

Use the website to find about Hong Kong's natural terrain and what topography (e.g. slope) this terrain occurs in.

Choose one safety issue to research on the webpage. Safety issues to be researched include:

- What is more dangerous - natural terrain landslides or failures of constructed (man made) slopes?
- In what terrain are landslides most likely to occur?
- How can dangers be avoided when developing near natural terrain?

http://hkss.cedd.gov.hk/hkss/eng/natural_terrain.aspx
http://hkss.cedd.gov.hk/hkss/eng/communityEdu/HKL.pdf
http://hkss.cedd.gov.hk/hkss/eng/photovideo_gallery.aspx

Design a simple pamphlet using an illustration and text that explains the safety aspects of the issue you chose to research.

Activity 4. Hong Kong land use

Land use classification

Land in the Hong Kong territories is divided according to land use by the Lands Department and Planning Department. They determine which lands can be developed and which remain 'Green Belt'. Land use directly affects water's ability to move over the landscape.

The idea of Green Belts are a legacy of the British occupation of the Hong Kong territories who used this strategy to limit urban development and allocate enough natural landscape to aid, in part, water movement through the landscape to recharge water supplies.

How is Hong Kong planning benefiting your quality of life?

_____

_____

_____

_____

What would Hong Kong be like if there were fewer planning restrictions?

_____

_____

_____

_____

Activity 5. Effects of different land use on our watershed

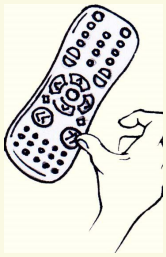
From what you have learned, what are the effects (good or bad) on the watershed for the different terrains pictured below? Consider the following issues:

- Recharging aquifers
- Polluting aquifers
- Increased risk of landslip
- Increased risk of floods
- Surface water quality

Natural terrain	
Roads on steep slopes	
Large buildings on steep slopes	
Large buildings on flat land	

Agriculture	
Most of the land is covered by buildings, roads and hard surfaces	
Green belts separate dense living and other constructed zones.	

Activity 6. Looking forward



Share your knowledge with younger students

Produce something for a younger audience that communicates the concept of watersheds.

Example 1. Use a shoebox to build a diorama of a watershed with mountains, valleys, streams and an outlet to the sea. Show natural, agricultural and constructed areas. Show the role of the ridgeline in funnelling the water down through the landscape.

Example 2. Write and illustrate a children's story book about an engaging creature making their way down through a watershed. Show some of the good things that the creature encounters in its environment. Create an adventure by identifying some of the hazards on the way to the sea. Explain how the landscape changes as the creature travels.

Criteria for the book:

- Target audience can understand the concepts.
- Explains how watersheds work.
- Shows how people affect our watersheds.

Or Plan an education walk

Plan an educational walk relating to your local watershed - either organised for the class to door in your own time outside of school. It is to be a real experience.

Criteria for the walk:

- The walk is to be planned using a map.
- The walk starts from your home or school.
- It takes about 30 minutes to complete the walk and get back to the starting point.
- As part of the plan, it will be explained how you or your class will remain safe.
- Along the walk, various aspects of the watershed will be pointed out. Some features will be up close while other features could be in the distance.
- The walk should attempt to point out the major watershed features in Hong Kong including ridge lines, topography, natural terrain, green belts, constructed areas, stormwater system and any remnants of past streams.

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