Senior lesson plans

Rationale

Up a Dry Gully is an online education portal that can be adopted by schools and integrated with the curriculum to promote the 'water story', from catchment, store, treat and supply in South East Queensland.

Implementation of this program is important to ensure that the community of South East Queensland has an awareness and understanding of water in our region. This project is very topical given the challenge Queenslanders face in securing water in a climate of extremes. The knowledge, skills, perspectives and values this education resource offers will enhance the development of the children and their knowledge of Seqwater infrastructure.

Up a Dry Gully lesson plans are designed to engage all learners in a variety of research and hands-on activities related to water conservation and sourcing in the South East Queensland region. Each learning experience is inclusive of all types of learners. Teachers are encouraged to adapt the activities to best suit the students' needs.

Key learning areas

- Geography
- Science
- Economics.

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Lesson one

Water – getting a handle on the hydrological cycle (evaporation and condensation)

Student objectives

By the end of this lesson students will:

- Have a greater understanding of how the natural process of the hydrological cycle functions (some of this should be prior knowledge).
- Have a sound understanding (by practical application) of the concepts of evaporation and condensation by having completed two practical experiments.

Introduction

Begin the unit with a class discussion about water. Discuss the importance of water for life and whether students can recall the hydrological cycle.

Discussion points

- Why is water important?

Guide the discussion and if possible illustrate on the board (or use a student hand out if preferred), to demonstrate the hydrological cycle key principles of:

- evaporation
- transpiration
- condensation
- precipitation (including rain, hail, sleet and snow)
- infiltration
- run-off
- storm water
- catchment.

Activity - experiment

Students are going to conduct several experiments in the lab for the various elements of the water cycle. How far you get through this sequence of experiments will be determined by how long you have for a lesson.

Experiment 1

Evaporation

Low-pressure zones create clouds because the rising hot aid carries moisture with it. The moisture is in the form of a gas called water approx. When the water approx cools, it forms water droplets that join together to then form clouds. How does the water approx. get into the air in the first place? Most of it comes from evaporation.

Evaporation happens when water molecules warm up – they gain enough energy to change from a liquid into a gas, and then they rise up into the air to be carried on rising convection currents. You have seen this happen in your kitchen when steam rises from boiling water.

Are there factors that can change how fast water evaporates? You can find out by setting up an experiment to test the effect of wind, temperature and surface area on the rate of evaporation. The following procedure will give you the basics, but feel free to come up with your own methods of testing and measuring the results. This experiment would make a great science fair project (be patient as some of these tests can take more than one day).

Materials

- two kitchen sponges
- electric fan
- lamp
- small glass or beaker
- pie pan or shallow dish
- measuring cup.

Question and hypothesis

Ask students to write down their predictions. These questions will guide their predictions:

- How do factors such as wind, temperature and surface area affect the rate of evaporation?
- Will wind or heat cause water to evaporate faster?
- Will a greater surface area speed up or slow down evaporation?

Procedure

1. Test the effect of temperature using an incandescent lamp to provide heat. Place two kitchen sponges on plates and pour 1/8 cup of water over each of them (depending on the size of the sponge, you may need to use a bit more water. Use enough to get the sponge wet all the way through). Place one of the sponges directly under a lamp and the other at room temperature out of direct sunlight. Observe the sponges at regular intervals, and record the time between each observation as they get nearer to drying. Record how long it took for each sponge to dry completely. Which sponge dried faster?
2. Test the effect of wind using an electric fan. Wet the sponges as you did in step 1. Set one sponge 12 inches away from an electric fan and turn the fan on. Set the other sponge some place out of the draft. Observe the sponges at regular intervals. Record how long it took for each sponge to dry completely. Which one dried faster? Did the sponge in the fan dry faster than the one under the lamp in step 1?
3. Finally, test the effect of more or less surface area. Pour 1/8 cup of water into a small glass. Pour 1/8 cup of water into a pie pan or wide shallow dish. Set the cup and the pan on the counter and check them a few times a day. Which water evaporates faster - the water with the small surface area or the large surface area?

Conclusion

Ask students:

- Were your predictions correct?
- Which speeds up evaporation more, wind or heat?
- Based on your results, do you think the temperature or speed of wind would affect the evaporation rate?
- Can you think of other factors to test or a more precise way to test these factors again?

Experiment 2

Condensation

Clouds require three key ingredients to form:

- water
- dust particles
- temperature or pressure changes.

Materials

- a clear soft drink bottle
- small amount of very warm water
- matches.

Method

1. Remove the label from your 'cloud bottle' and give it a thorough rinse. Do not use soap and do not dry the inside of the bottle.
2. Add a very small amount of very warm water to your cloud bottle. Replace the cap and shake it up so that the water droplets are sticking to the sides. Pour out any excess water.
3. Carefully light a match and drop it into the bottle. Then give the bottle a good shake so that the match goes out. You've just added a key ingredient in making a cloud – dust (from the smoke).
4. Immediately replace the cap and shake it up. Now add the second ingredient, water. Make sure the cap is on tight.
5. Using both hands, squeeze the centre of your cloud bottle as hard as you can. Then, release both hands evenly and very quickly. You're now simulating the third and final ingredients in the cloud recipe – temperature and pressure changes.
6. After several squeezes you should see that a cloud appears when you release your hands (watching out for this with a dark background can be helpful).

Conclusion

Revisit the key concept words in the form of a quick revision quiz for students to demonstrate the understanding of the water cycle.

Resources

For the teacher	For the student
Two kitchen sponges	As per experiment materials.
Electric fan	
Lamp	
Small glass or beaker	
A clear, soft drink bottle	
Small amount of very warm water	
Matches	
A clear, soft drink bottle	
Measuring cup	

Lesson two

Water – getting a handle on the hydrological cycle (transpiration and precipitation)

Student objectives

By the end of this lesson students will:

- Have a greater understanding of how the natural process of the hydrological cycle functions (some of this should be prior knowledge).
- Have a sound understanding (by practical application) of the concepts of transpiration and precipitation by having completed two practical experiments.

Introduction

Begin the unit with a class discussion about water. Discuss the importance of water for life and whether students can recall the hydrological cycle. Can you students recall evaporation and condensation (as per lesson one)?

Experiment 1

Transpiration (allow 1-3 days)

All plants rely upon water for survival. Transpiration is one component of the water cycle where water and moisture travels up the plants roots to the underside of the leaves.

Materials

- flask or bottle
- plants - wash the soil off the roots and store in a container of water (one plant per group)
- scales or balance (1-2 per class).

Procedure

1. Label each bottle or flask with your initials.
2. Fill each vessel with water to within 1cm of the rim.
3. Place the uprooted plant in one of the vessels.
4. Weigh the vessel with the plant and record its mass. Weigh the other vessel (no plant) and record its mass.
5. Leave both vessels in a sunny position in the lab.
6. After one day, weigh the vessels and record their masses.
7. If there has been little change, the experiment can be continued for several days.
8. At the end of the experiment, work out the mass lost by each vessel. Subtract the mass lost by the vessel with water only, from the mass lost by the vessel with the plant. This will give the loss in mass resulting from the plants transpiration.
9. Calculate the rate of transpiration in grams per day.

Focus points

- The vessel with the plant will be losing water (a) from the shoot and (b) from the exposed water surface. The vessel lacking a plant enables us to calculate the amount of mass loss resulting from (b).

- The mass lost in the vessel with the plant is made of these two components. By deducting the mass loss resulting from direct evaporation, we are left with the mass loss caused by transpiration from the plant.
- The plant will interfere with direct evaporation from the vessel, depending on the shape and size of the stem and the position of the lower leaves.
- In the vessel with the plants, the water may drop below the neck, exposing a greater surface area for evaporation.

Experiment 2

Precipitation

This is a basic experiment to demonstrate how water condenses, reaches saturation and then forms rain.

Materials

- glass jar
- plate
- hot water
- ice cubes.

Procedure

1. Pour approximately 5 cm of very hot water into the bottom of the jar.
2. Cover the jar with the place and then wait a few minutes.
3. Place the ice cubes on the outer surface of the plate and observe what happens over the course of the next few minutes.

Extension activity

- How does acid rain form (emphasise the human influence impacting this natural process)?
- What impact does acid rain have on our environment?

Conclusion

Explain what has happened and how this relates to the hydrosphere. How do the different types of precipitation form (rain, hail, sleet and snow)? Ask the students to draw a diagram to illustrate this process.

Resources

For the teacher	For the student
Flask or bottle	
Plants (wash the soil off the roots and store in a container of water. One plant per group)	
Scales or balance (1-2 per class)	
Glass jar	
Plate	
Hot water	

Lesson three

Water – getting a handle on the hydrological cycle (percolation and infiltration)

Student objectives

By the end of this lesson students will:

- Have a greater understanding of how the natural process of the hydrological cycle functions (some of this should be prior knowledge).
- Have a sound understanding (by practical application) of the concepts of percolation and infiltration by having completed two practical experiments.

Introduction

The purpose of this lesson is for students to understand that different soils have different percolation rates and water holding capacities. To conduct this experiment you will need to follow the below outlines.

Experiment 1

Soil profile

This is a basic experiment to demonstrate how water condenses, reaches saturation and then forms rain.

Materials

- large test tubes (approximately 300ml, five per group)
- test tube holder for the five test tubes
- measuring cylinder
- sand sample
- loam sample
- clay sample
- sticks to pack the soil samples
- stop watch
- ruler.

During this experiment we will be aiming to complete three different tasks:

- making the soil profile
- testing the water percolation process
- testing the water holding capacity of the soil profiles.

Procedure

1. Label your test tubes.
2. In tube 1, carefully fill it with approximately 100mm of sand. Carefully tamp the sand to pack it. Continue to add sand until the soil line is approximately 70mm from the top of the test tube.
3. Follow the same procedure for tube 2, filling it with loam soil.
4. Follow the same procedure for tube 3, filling it with clay soil.
5. In tube 4, fill and tamp with loam soil to a depth of 100mm. Add 50mm of clay and tamp well.

6. Then add approximately 50mm of sand and tamp well. Then add more loam soil until it is approximately 70mm from the top of the tube.
7. In tube 5, fill and tamp with loam soil to a depth of approximately 200mm. Add clay soil to the top and tamp firmly, with a depth of approximately 50mm or within 70mm of the top of the test tube.

Your soil profiles are now completed. All should have a similar depth from the top of the test tube to the soil level.

Experiment 2

Water percolation

This is a basic experiment to demonstrate the speed of water percolation through various soil types.

Materials

For this test you will need:

- tube 1, 2, 3, 4 and 5 (experiment 1)
- measuring cylinder
- stop watch
- ruler.

Procedures

1. With your stopwatch ready, add 45ml of water to tube 1. Time how long it takes for all the water to percolate into the soil and record in a table as shown below.
2. Use a ruler to measure the depth of percolation at 30 second intervals and record until all the water has penetrated the soil or until 5 minutes is up, which ever takes longer.
3. Wait for 30 minutes after all the water has penetrated and take one more measurement with the ruler to see if the water continued to percolate the soil. Record your measurements.
4. Repeat this process for all the test tubes and record your results.

	Profile 1	Profile 2	Profile 3	Profile 4
Rate of percolation				
Depth of percolation, 30 second intervals				
30 seconds				
60 seconds				
90 seconds				
120 seconds				

Discussion points

- Was the rate of percolation the same for all profiles? Why/why not?
- Was the depth of percolation the same for all profiles? Why/why not?
- What affect did the limiting layers have on the rate and depth of percolation?
- How could this information be used in the urban environment?

Experiment 3

Water holding capacity

Your first set of results will be from the 'water percolation test' where you added your first 45ml of water to the soil profiles.

Procedures

1. Add another 45ml of water to tube 1 and use the stopwatch to record the time needed to percolate into the soil. Record your data in a table like the one shown below.
2. Repeat this step for the remaining test tubes.
3. After 15 minutes, add another 45mls of water (and if necessary repeat this step again) until the water has reached a depth of 300mm. When the water has percolated to 300mm, stop adding water.

	Profile 1	Profile 2	Profile 3	Profile 4
Rate of percolation				
Depth of percolation,30 second intervals				
30 seconds				
60 seconds				
90 seconds				
120 seconds				

Discussion points

- Did the rate of percolation stay the same each time water was added? Why/why not?
- Did the 5 profiles take the same amount of water to wet the soil to the depth of 300mm?
- Why/why not?
- How did the limiting layers affect percolation?
- How could this information be used in the urban environment?

Conclusion

Write a conclusion about each of the profiles you have tested. How would this impact the rate of percolation in the hydrological cycle. Discuss the importance of these profiles to the hydrological cycle.

Resources

For the teacher	For the student
Large test tubes	As per the group experiments
Test tube holder	
Measuring cylinder	
Sand sample	
Loam sample	
Clay sample	
Sticks	
Stop watch	
Ruler	

Lesson four

Water – getting a handle on the hydrological cycle (ground water)

Student objectives

By the end of this lesson students will:

- Have a greater understanding of how the natural process of the hydrological cycle functions (some of this should be prior knowledge).
- Have a sound understanding (by practical application) of the concepts of ground water movement, permeability and porosity by having completed two practical experiments, looking at permeability and water movement through porous and non-porous sub-strata.

Introduction

Students will need to have some idea of the difference between porosity and permeability.
By definition, porosity is the percentage of the volume of rock that is open (pore space). This in turn determines the amount of water that a rock can contain. In this instance, students are to see if they can observe natural pores in the beaker contents with the naked eye.
Permeability is a measure of the degree to which the pore spaces are interconnected (and the size of the interconnections).

Materials

- four beakers (approximately 500ml–1000ml size should be sufficient)
- gravel
- sand
- loam
- clay
- stopwatch.

Procedure

1. With one of each of the samples listed above, fill each of the beakers to within 50mm of the rim and tamp the contents down well.
2. Into each beaker pour a measured volume of water. Observe the water movement between the particles in the beaker. Time and record how long it takes for the water to reach the bottom of the beaker.

	Gravel	Sand	Loam	Clay
Time taken to permeate				
Permeability (1-4)				
Most highly visible porosity				

Discussion points

- Which of the samples tested was the most permeable? Draw an annotated diagram to demonstrate how this permeability works.
- Which had the greatest porosity? Draw an annotated diagram to demonstrate how this porosity works.
- Is there any connection between the two?
- Can a rock or soil type be highly porous but have poor permeability? How would this work?
- Can a rock or soil type have excellent permeability yet poor porosity?
- What if these different samples were in layers instead of individual samples? If you were looking to drill a well, which sequence order would you prefer these samples to be in? Justify your response.

Conclusion

From the perspective of a 'well driller' write a conclusion (report) on which of these samples would be the best in which to drill for a well.

Resources

For the teacher	For the student
Four beakers	As per the experiment materials.
Gravel	
Sand	
Loam	
Clay	
Stop watch	

Lesson five

Water where it is not needed – introduction to flooding

Student objectives

By the end of this lesson students will:

- Understand the difference between a natural hazard and a natural disaster.
- Have a greater understanding of flooding and the different types of flooding.
- Have a basic understanding of where flooding in Australia occurs.
- Have been introduced to the Murray-Darling Basin.

Introduction

Students begin to think about some different global events that highlight the difference between a natural hazard as opposed to a natural disaster (the effect of a natural hazard – social, economic or environmental loss).

Natural hazard	Natural disaster
Earthquake	Christchurch
Tsunami	Japan
Flood	Brisbane 2010, 2011 and 2013 floods
Volcano	Ruapehu volcanic eruption
Landslide	Threadbo
Cyclone	North Queensland cyclone Yasi

Discussion points

- What is a natural hazard? What is a natural disaster?
- Do people have to be severely impacted for it to be a natural disaster?
- What is a flood? Ask the students to define what they think a flood is (most will talk about rainfall).
- What can cause flooding? Examples include rainfall, surface run-off, tsunamis, storm surge, flash flooding, dam failure, etc.
- What is the definition of a flood, tsunami, volcano, earthquake, landslide, cyclone, hurricane etc.? You may wish to conduct a research activity using printed and internet references to define each natural hazard.

Activity

Using two columns or titles, ask the students to brainstorm and discuss some positive and negative aspects of flooding.

Positive aspects	Negative aspects
Replenishes water table and catchments	Damages infrastructure
Breaks drought	Can kill livestock
Flushes out water systems	Disrupts business and impacts human life
Etc.	Etc.

Discussion point

- Where do major floods occur in Australia?
- Why is the Great Dividing Range so important?
- How do floods west of the Great Dividing Range compare with those to the east?
- Why do they differ?

Activity

Using a blank outline map of Australia, students need to show the Great Dividing Range along the eastern coast of Australia. On this map, students need to identify the location of the Murray Darling Basin and major rivers in this system. Identify five towns and/or cities in Queensland that have been affected by severe flooding and identify three towns and/or cities in each other state that have also affected by severe flooding.

Extension activity

Introduce students to the concepts of different types of flooding – ensuring they record the differences between the different flood types.

1. Flash-floods - Flash flooding results from relatively short, intense bursts of rainfall, often from thunderstorms. It can occur in almost all parts of Australia and poses the greatest threat of loss of life. People are often swept away after entering floodwaters on foot or in vehicles. These floods can also result in significant property damage and major social disruption. They are a serious problem in urban areas where drainage systems are often unable to cope.
2. Slow-onset floods - Inland rivers in the vast flat areas of Western Australia, central/western New South Wales and Queensland can often flood. These floods may take days to build-up and they can last for one or more weeks and can even last for months on some occasions. The damage caused by floods in these areas can lead to major losses of livestock, cutting-off rural towns and damaging crops as well as major roads and railways.
3. Rapid-onset floods - Rapid-onset flooding can occur more quickly than slow-onset floods. These floods can be potentially much more damaging and can pose a greater risk to loss of life and property. This is because there is generally much less time to take preventative action, and a faster, more dangerous flow of water. This type of flooding can affect most of our major towns and cities. Students can use a colour coding system to show different types of floods on their maps.

Conclusion

Students are asked to differentiate between a natural hazard and disaster. Revise the key terms and principles of the lesson with a quiz format.

Resources

For the teacher	For the student
Blank outline map of Australia	Blank outline map of Australia
Unit information for teacher	Computer access
Internet access	

Lesson six

Flooding in South East Queensland

Student objectives

By the end of this lesson students will:

- Be able to locate areas of major flooding in Australia since 1970.
- Have gained through student initiated research an understanding of past flooding events in South East Queensland.
- Have started to look at ways that humans have attempted to ameliorate the effects of flooding.

Introduction

Begin the lesson with a class discussion about flooding in Australia. Use reflective or personal experiences as a basis for flood history and build from there.

The flood events of South East Queensland in 1974, 2010, 2011 and 2013 were significant and catastrophic. Several different types of flooding have occurred, each of which impacted the residents of the affected areas in similar yet different ways.

Have students identify areas of South East Queensland that had each of the flooding types, based on definitions from an earlier lesson:

- slow-onset flooding
- fast-onset flooding
- flash flooding.

Activity

Find or research a list of notable floods in Australia from 1900 to present. Present this information as a history road, marking the major flooding events (this should include the Brisbane floods of 1974, 2010, 2011 and 2013). Use a blank outline map of Australia to locate each major flood event and mark it on the outline map. Focus on South East Queensland and the floods that have occurred here since colonisation.

Discussion points

- Try to identify any patterns.
- What would cause a particular location to flood more often than others?
- What would be some effective flood prevention strategies for these areas?
- Historically, why were settlements made near and on rivers?
- How have these decisions impacted us today?
- Think of five ways humans have attempted to control water to minimise flooding and the risks associated with flooding.

Activity

Have students chose (or assign) one of the types of flooding from above, and an area of flooding that occurred in the 2010 and 2011 event.

They will need to research the experiences of at least three different people impacted by the flood event. These can include those who have been flooded or an emergency response person. In their research they will need to answer these questions:

- location at the time of flood event
- occupation
- information about the rate of water level rise
- how they responded to the flood event
- what assistance they needed (if any) and who supplied it
- concerns they had (e.g. for themselves, family, neighbours, friends)
- information regarding any losses.

Use these primary sources of data to complete an original fictitious version for one of the following activities:

- Write a newspaper article reporting on your event.
- Create a letter to a pen-friend overseas explaining what has gone on in your own story.
- Complete a journal/diary entry for the day of the most significant flooding.
- Create a news bulletin for a radio station about the flooding, including an interview with a person impacted by the flooding.
- Write a blog updating readers of what you are experiencing (first person).These activities then be displayed on the wall for others to share.

Optional activity

Movie “The Deluge” (1999 – G rating).

Conclusion

Recall through a class discussion major flooding events that are significant to Australian history and where these were located. Discuss any patterns.

Resources

For the teacher	For the student
Blank outline map of Australia	Blank outline map of Australia
South East Queensland map	South East Queensland map
Movie ‘The Deluge’ (G) (1999) starring Ray Barrett	

Lesson seven

Impact of floods on the environment

Student objectives

By the end of this lesson students will:

- Have a basic understanding of the importance of flooding to the ecosystem.

Introduction

Begin a revision activity on the board of the water cycle. Get the students to name the different parts of the cycle and give a basic explanation of how that part of the cycle works.

Activity

Read the Article "Environmental Impact of Floods – Feb 2011" from the Wildlife Rescue website www.wildlife.org.au/news/2011/flooding5.html

From your reading, construct a flow diagram that shows the environmental impact of the 2010 and 2011 Queensland floods on the environment. The starting point of your flow diagram needs to be "high rainfall". Be sure to show which effects are short term (such as algal blooms) versus those which are longer term (such as the loss of life of some species due to contamination). Based on this article, are the floods a positive or negative thing for the environment?

Extension activity

For those that like a bit more of a challenge, show how humans can alter the effect of the flooding by different activities. This may include controlling water release from dams or relocating flora and fauna to safe locations.

Discussion points

For most of the environment it seems all 'doom and gloom' when flooding hits. What are some of the positive aspects of the flood event for the environment? Try to steer the discussion in the direction of recharging the water table (especially good for the Murray Darling system) to help reduce salinity in the soil. Distribution of sediment provides fresh nutrient for flood plains and thus increases soil fertility.

Conclusion

Give the students a quick quiz about how we can minimise the impacts of flooding through our daily lives (watching rubbish placement), developing an emergency plan for our homes, animals and yards etc.

Resources

For the teacher	For the student
Environmental Impact of Floods - www.wildlife.org.au/news/2011/flooding5.html	Article as supplied by the teacher.
Resource 1a: The water cycle (appendix)	

Lesson eight

Flood mitigation

Student objectives

By the end of this lesson students will:

- Understand the need be prepared for flood events.
- Have a basic understanding of ways humans attempt to control waterways so that floods can be 'managed' (within reason).

Introduction

Begin the lesson discussing the floods and all previous lesson covered on the significant impact this posed on the people and environment.

There are several ways in which man can attempt to control or manage flooding. Some of these methods are extreme in action while others are less significant.

Activity

The most extreme methods to mitigate flooding hazards involve engineering. This can be broken down into two key categories:

1. hard engineering - the construction of dams
2. soft engineering - land drainage.

Ask the students to classify each of the following types of engineering into either hard or soft categories. Some of these might be debatable and these are dependent on the size of the structure.

- flood walls
- embankments and levees
- channel improvements
- relief channels
- flood reservoirs
- flood plain zoning
- flood proofing
- flood abatement.

To show examples of hard engineering, have students come up with the names of as many different dams in South East Queensland in two minutes (may want to do this activity in pairs/small groups). Share ideas on the board. Below is a less comprehensive list of several Seqwater dams and their names. For a full comprehensive list of Seqwater dams please visit www.seqwater.com.au

Dam name	
Atkinson Dam	Baroon Pocket Dam
Bill Gunn Dam	Borumba Dam
Bromelton Dam	Cedar Pocket Dam
Clarendon Dam	Cooloolabin Dam

Enoggera Dam	Ewen Maddock Dam
Gold Creek Dam	Hinze Dam
Lake Kurwongbah	Lake Macdonald
Lake Manchester	Leslie Harrison Dam
Little Nerang Dam	Maroon Dam
Moogerah Dam	North Pine Dam
Somerset Dam	Wappa Dam
Wivenhoe Dam	

History of Wivenhoe dam

Research the basic history of Wivenhoe dam, starting with the 1974 floods. In your research, find and include the dates for the following highlights:

- 1974 flood
- proposed dam building
- research into the proposed area. Are there any features of significance?
- starting the dam
- capturing water
- completion of the dam
- first time maximum capacity reached
- dam capacity today.

Display your research in cartoon form, using a 5cm x 5cm grid for each key piece of information. You must have a minimum of eight squares in your cartoon.

Activity

For this activity you will need access to the Seqwater website, via www.seqwater.com.au/water-supply/dam-levels. The Seqwater dam fact sheets will be useful for this activity and can be found at www.upadrygully.com.au/factsheets

Using the Historical Dam Storage Data, answer the following questions:

- The data recorded in this graph goes back to when?
- What was the average volume of water (%) at the start of the graph?
- What is the lowest overall water storage volume (%) in the past decade (show % and date)?
- What is the highest overall water storage volume (%) in the past decade (show % and date)?
- What are the current levels for the following dams:
    a. Wivenhoe dam (ML and %)
    b. Somerset dam (ML and %)
    c. Dam of your choice (ML and %).
- How does this graph illustrate the capacity we have for flood mitigation? Is there any data shown to support your theory?

Extension activity

Dam building and flooding of land areas in dam catchments are quite controversial at the best of times. Before a dam can be built, what has to be considered? Think in terms of important social, economic and environmental factors. Were there any important historical or cultural sites that had to be considered and relocated as a result of building the Wivenhoe dam catchment area? (e.g cemeteries, buildings of historical significance) and how was this achieved?

Conclusion

Has Wivenhoe Dam been able to help control water and hence flooding in the way it was intended? What possible scenario could we have faced in January 2010 and 2011 had Wivenhoe Dam not been in place?

Resources

For the teacher	For the student
Internet access to the listed website links	Internet access for the graphing activity
Possible data projection of the image as an introduction	
Seqwater dams and levels – www.seqwater.com.au/water-supply/	
Seqwater dam fact sheets – www.upadrygully.com.au	

Lesson nine

Urban development - planning

Student objectives

By the end of this lesson students will:

- Understand how people can use scientific knowledge to inform the monitoring, assessment and evaluation of risk in relation to urban planning.
- Understand how science can be limited in its ability to provide definitive answers to public debate; there may be insufficient reliable data available, or interpretation of the data may be open to question.
- Have a clearer understanding of urban planning and what it entails in the real world by viewing at least one current urban plan (local government).

Introduction

There have been many severe weather events occur in the past few years in South East Queensland – severe droughts, floods, some of the biggest cyclones in recorded history (Cyclone Yasi) and tornadoes to name a few.

Have students name as many different severe weather events as possible for a set period of time (such as in the past five years) on a national and on a global scale. What would be considered a severe weather event?

Ask students to provide a broad definition for urban planning. Drawing a mind map on the board may be an excellent way to get the ideas flowing. Ultimately, the desired outcome is a definition.

Activity

Historically, people have settled where water and food were abundant. However, often these locations have a high risk of severe weather events, such as fire and flood.

In groups of approximately 3–5 students, form a small research task group. Your mission is to research one particularly severe weather event and how it impacted one location, such as the Black Saturday bush fires in Victoria (2009) or Cyclone Yasi, Far North Queensland (3 February 2011).

Each topic will need to have at least two groups researching for key information. You will have just 10 minutes to find out as much as you can about this topic. It is recommended that you have people research different aspects such as:

- key people involved (witnesses or people that can provide primary evidence)
- evidence of government action, support, implementation of policy
- basic scientific facts – area covered, dates, times, wind speeds, rainfall
- press coverage or reports
- visual data – images or video files from reports taken at the time
- other information as deemed necessary.

Once students have gathered as much data as possible in the 10 minute allocation of time, toss a coin to decide for and against and have the two topic groups spend another 15–20 minutes preparing an argument/debate either for or against the following:

During their debate they will need to provide factual and scientific evidence to back up their claims and support any points that are made.

Activity

Brisbane City Council recently updated their city plan to an ePlan (electronic version) as at 30 June 2014 (link provided in resources). Go to your local council website and view their publications available. If possible, find a copy of the new city plan. Does it include the key points included in your class's definition of urban planning?

You will need to look for the following:

- land use
- design of the urban environment
- transportation networks
- evidence of strategic thinking
- architecture
- public consultation
- policy recommendations
- implementations guides
- any other aspects of importance.

How does your local Council urban plan accommodate the threats faced in Queensland by severe weather events? What strategies have been implemented since we faced these severe flooding in 2001 and 2013?

Conclusion

Summarise the lesson by pointing out that people all have different points of view and perspectives on how we control urban development, especially when it comes to planning for severe weather events. It is up to people and governments as to how we balance all these different points of view and still keep people and places safe.

Resources

For the teacher	For the student
Local Council urban and/or city plan. Brisbane City Council ePlan - www.eplan.brisbane.qld.gov.au/	Computer
Black Saturday bush fires information	Internet
Computer lab	
Internet	
Department of State Development, Infrastructure and Planning, Queensland Government Interactive Mapping System - www.dsdip.qld.gov.au/about-planning/spp-mapping-online-system.html	

Lesson ten

Dams – meeting the needs of all

Student objectives

By the end of this lesson students will:

- Understand that different people have differing values and hence perceptions.
- Be able to argue either for or against an idea (in this case a dam) but using points of view and persuasion.
- Have a basic understanding of how/why political decisions are made.

Introduction

From the previous lesson, students should have some understanding of the research and consultation that has to be completed before a major development such as a dam can take place. The purpose of this lesson is to give students the opportunity to see things from a different point of view and see how political decisions are made. Introduction to this lesson may best be made with a role play, where the teacher takes on the role of a protestor who has a particular point of view and really drives their point home (ie. placard with a slogan against new development– in this case the dam).

Alternatively, if role play is outside your comfort zone or just not your thing, a video presentation from: www.youtube.com/watch?v=uNbF8isrOLs&NR=1 shows a commercial against the dam and www.youtube.com/watch?v=v3BcveG2DZg&NR=1 gives an overview of the proposed project, with a view opposing the dam. This does show people passionate about saving their properties and many of the key players. Both videos provide a good basic introduction.

Case study – Traverston Crossing dam

The Traverston Crossing dam on the Mary River has been controversial and was widely covered by the media (2009). Find out the key facts about this issue and hold a class debate about whether or not it should have gone ahead, with those that support the proposed dam and those opposed to the concept.

Before getting into the research, have students place stakeholders along a values continuum line - those that strongly agree with the dam and those that are strongly opposed to the dam. Suggested stakeholders to include:

- local farmer
- local resident
- downstream resident
- an environmentalist
- a lung fish
- an earth moving business contractor
- a local diesel mechanic
- a concrete business owner
- two different residents of Brisbane
- an elderly lady living in the Mary Valley
- a fisherman
- a local MP

- state premier
- prime minister.

Once the students have completed a values continuum, have them divide into groups representing one of the above parties (or work as individuals) to complete their research and consolidate an argument either for or against the proposed dam.

Hold a class debate, with an adjudicator (or a mock hearing with an elected council) and try to make your own decision as to whether or not the proposed dam should go ahead.

Finally, formulate a class opinion as to whether or not you agree with the final outcome building the dam. Was this the best decision for all the stakeholders concerned?

Conclusion

Using the above debate activity, gauge students understanding of the various viewpoints involved when a new development is proposed and constructed. Ask students to express their own personal summary on the final outcome of the debate activity.

Resources

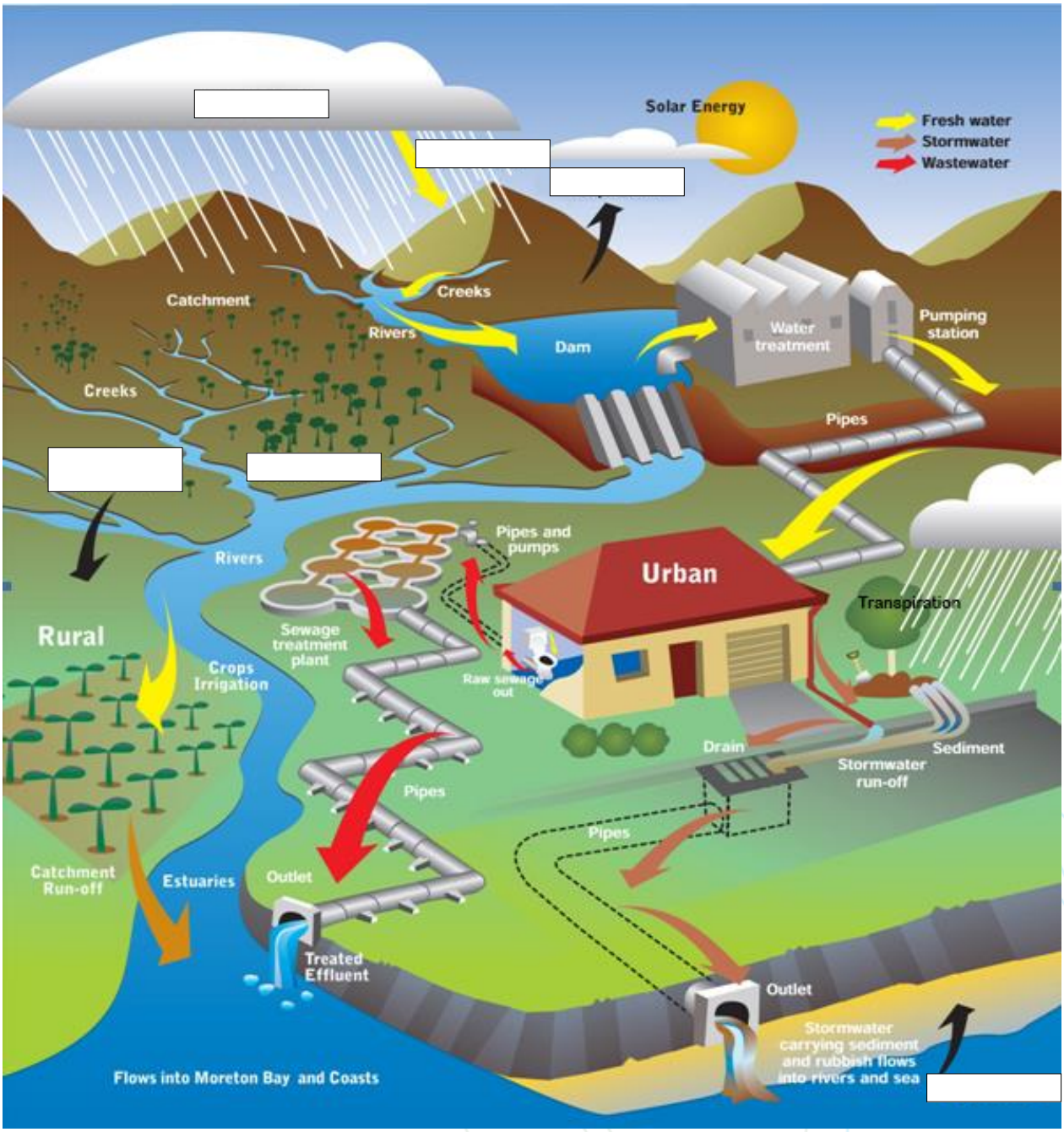
For the teacher	For the student
Internet access if displaying videos as part of the introduction	Internet access to research debate points of view
Computer lab	Computer
YouTube video commercials and overviews on dams: www.youtube.com/watch?v=uNbF8isrOLs&NR=1 www.youtube.com/watch?v=v3BcveG2DZg&NR=1	

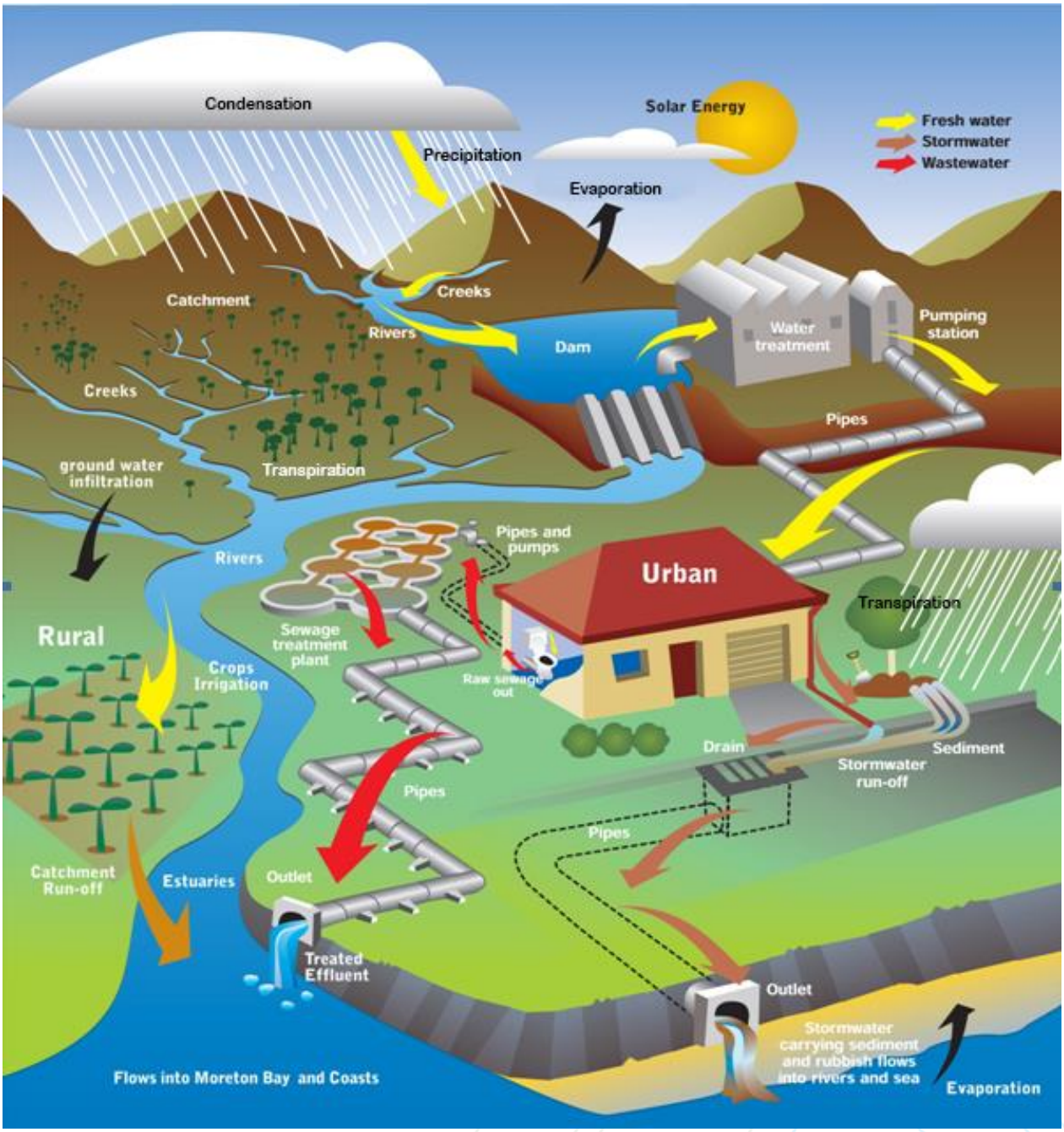
Appendix

Resource 1a: The water cycle

Introduction

The water cycle activity is a coloured poster that can be used to display on your classroom wall or offered to students as a regular reference point when discussing the water cycle.




Condensation
Solar Energy
Fresh water
Stormwater
Wastewater
Precipitation
Evaporation
Catchment
Creeks
Rivers
Dam
Water treatment
Pumping station
Creeks
Pipes
ground water infiltration
Transpiration
Pipes and pumps
Rivers
Urban
Transpiration
Rural
Sewage treatment plant
Crops Irrigation
Raw sewage out
Drain
Sediment
Stormwater run-off
Pipes
Pipes
Catchment Run-off
Estuaries
Outlet
Treated Effluent
Outlet
Stormwater carrying sediment and rubbish flows into rivers and sea
Evaporation
Flows into Moreton Bay and Coasts