GRADE 8

WATER SYSTEMS

TEACHER RESOURCE BOOKLET

TO THE TEACHER

Welcome! This resource guide has been designed to help you enrich your students' learning both in the classroom and at the Toronto Zoo. All activities included in this grade 8 booklet are aligned with the Understanding Life Systems strand of The Ontario Curriculum, Grades 1-8: Science and Technology, 2007. The pre-visit activities have been developed to help students gain a solid foundation about biodiversity before they visit the Zoo. This will allow students to have a better understanding of what they observing during their trip to the Toronto Zoo. The post-visit activities have been designed to help students to reflect on their Zoo experience and to make connections between their experiences and the curriculum. We hope that you will find the activities and information provided in this booklet to be valuable resources, supporting both your classroom teaching and your class' trip to the Toronto Zoo.

WHERE DOES IT FIT IN?

Strand: Earth and Space Systems **Topic**: Water Systems

Specific Expectations Met:

Understanding Basic Concepts

- **3.1** identify the various states of water on the earth's surface, their distribution, relative amounts, and circulation and the conditions under which they exist
- **3.3** explain how human and natural factors cause changes in the water table

Developing Investigation and Communication Skills

- **2.4** use scientific inquiry /research skills to investigate local water issues
- **2.6** use appropriate vocabulary, including water table, aquifer, polar ice-cap and salinity in oral and written communication

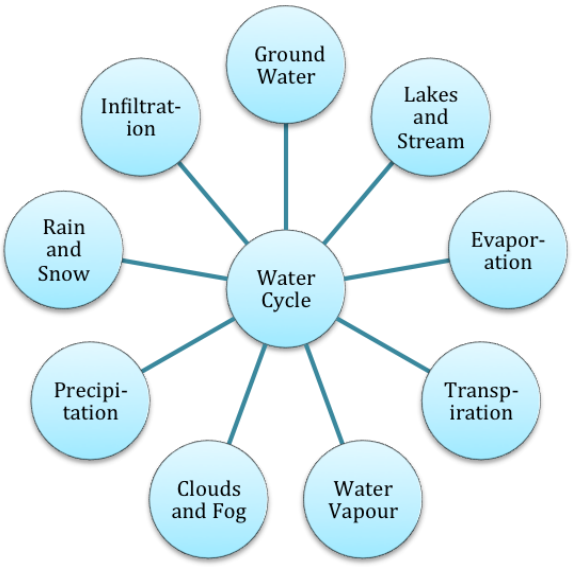
Relating Science and Technology to Society and the Environment

- **1.1** evaluate personal water consumption and propose a plan of action to reduce personal water consumption to help address water sustainability issues
- **1.3** assess the impact on local and global water systems of a scientific discovery or technological innovation

INTRODUCTORY ACTIVITIES

1. WATER WEBS

Individually, in pairs, in small groups, or as a class construct concept maps related to the subject of water. Encourage students to think laterally and include all ideas they feel are related to water. Students should be encouraged to include visual representations of their ideas. Teachers can ensure that some key ideas to be covered later are included (see 'Concept Map Idea Starters below). Use the summary and vocabulary list included in this package as a guide to important concepts to be included. Have students present their ideas in a visual format. This activity will serve as a diagnostic assessment of students' prior conceptions of the importance of water.



Concept Map Idea Starters

- water as a part of the climate
- water cycle and the different stages
- physical forms of water
- how the media presents water
- water as a resource
- human impact on water
- what we use water for every day
- how does water affect us
- how water becomes polluted
- how water can be cleaned
- water is required for all living things to survive
- how humans manipulate water to their advantage
- the elements that form water
- how plants/animals use water
- which commercial industries require water
- the effects of polluted water

2. BUT NOT A DROP TO DRINK?

(Adapted from http://www.urbanrivers.org)

This activity will help students learn where water on the planet is found and to begin to understand the limited quantity that is available to us.

Materials

(One set of materials for each group of students. If materials are scarce this may simply be done as a demonstration in front of the class)

- 1 litre pop bottle
- a graduated cylinder
- an eyedropper
- blue food colouring

Direct students with the following instructions:
1. Fill the one-liter soda bottle with tap water, and add enough blue food coloring to make it a rich shade of blue.
2. This bottle of water represents all the water on the planet. Pour three ml from it into a graduated cylinder. The amount left in the soda bottle is water from the ocean.
3. The amount in the cylinder is all the fresh water on the planet. This cannot be used readily since most of this is frozen. Pour one-half of one ml into another container. The amount left in the cylinder is the amount of water in frozen icecaps and glaciers. The amount poured off represents liquid freshwater found in ponds, lakes, rivers, and groundwater.

After this demonstration, discuss the following questions with students: What happens if the small amount of water that we do have available to us becomes polluted? Can we get water from other sources? Desalination, or removing the salt from ocean water, is very costly. What happens when we use too much water? Near coastal areas, salt water encroachment can occur, and freshwater supplies can be ruined. What can people do to avoid these problems?

Tying It All Together
Language Strand: Oral Communication
1.2 demonstrate an understanding of appropriate listening behavior by adapting active listening strategies to suit a wide variety of situations, including work in groups
1.6 extend understanding of oral texts by connecting, comparing, and contrasting the ideas and information in them to their own knowledge, experience and insights; and to the world around them
2.3 communicate in a clear, coherent manner, using a structure and style appropriate to the purpose, the subject matter, and the intended audience

3. WATER USAGE LOG

(Adapted from http://www.watercan.com/h2oh/)

This activity is designed for students to discover the uses of water in their daily lives and why it is so important. They will track their personal and family use of water over the course of two days, and compare and graph their results. They will also identify the activities that use the most amounts of water, and begin thinking in terms of reducing wastes of water.

1. Brainstorm the daily uses of water on the board/overhead (some may be review from the Water Webs activity) and review the items on the water log (water log has been attached to the end of the booklet). If there are activities missing, have students add them to the log.
2. Instruct students to track their use of water using the water log; for missing activities, have students determine the volume of water used for each
3. (2-3 days elapsed) Tally the total amounts of water used for each category, by student and by class.
4. Have students construct graphs to represent their individual data; assign groups to create graphs of class data.
5. Discuss the ways in which we use water every day, and how dependent we are on this resource. Ask students to identify activities in their daily lives that do NOT require the use of water in one way or another (is there such a thing? For instance, technically all energy produced by the body to perform any function essentially requires water) in order to indicate the importance of water in the students' lives.

6. Referring to the graphs produced, discuss which activities use the most/least amounts of water, and which activities seem to be the most wasteful uses of water.

Feeling Bold?
As an extension to this activity, have students write a brief paragraph on how it would feel if Canada had extreme restrictions on water usage, or a world without water, or perhaps even a poem or creative writing piece about the importance of water. As an alternate version of this game, each group could be given assigned to represent a different country, and have a different daily water limit to begin with. This would increase the challenge, and provide awareness of global water distribution and use (see chart provided).

Tying it All Together
Math Strand: Data Management and Probability
- collect data by conducting a survey or an experiment to do with themselves, their environment, or content from another subject, and record observations or measurements
- collect and organize data and display the data in charts, tables, and graphs using a variety of tools
- read, interpret, and draw conclusions from data presented in charts, tables and graphs
- explain the relationship between a census, a representative sample, and a population
- make inferences and convincing arguments that are based on the analysis of charts, tables, and graphs

Language Strand: Oral Communication
1.6 extend understanding of oral texts by connecting, comparing, and contrasting the ideas and information in them to their own knowledge, experience and insights; and to the world around them
2.3 communicate in a clear, coherent manner, using a structure and style appropriate to the purpose, the subject matter, and the intended audience

Language Strand: Writing
1.1 identify the topic, purpose, and audience for more complex writing forms
1.2 generate ideas about more challenging topics and identify those most appropriate to the purpose
1.3 gather information to support ideas for writing, suing a variety of strategies and a wide range of print and electronic sources
2.5 identify their point of view and other possible points of view

FOLLOW UP ACTIVITIES

1. WATER CYCLING

(Adapted from http://www.watercan.com/h2oh/)

Water is essential for sustaining life on Earth. The amount of water on the planet remains constant, but all of it is constantly being cycled between the atmosphere, the ocean and land. In this activity, students will examine the water cycle and pictorially represent the cycle on a large piece of poster paper. Provide the handout titled 'The Water Cycle' (attached at the end of the booklet) and have students read over the information in groups. Allow students to ask questions and make clarifications before beginning their task of creating pictorial representation of the water cycle. Once students are finished they may present and explain their posters to the class.

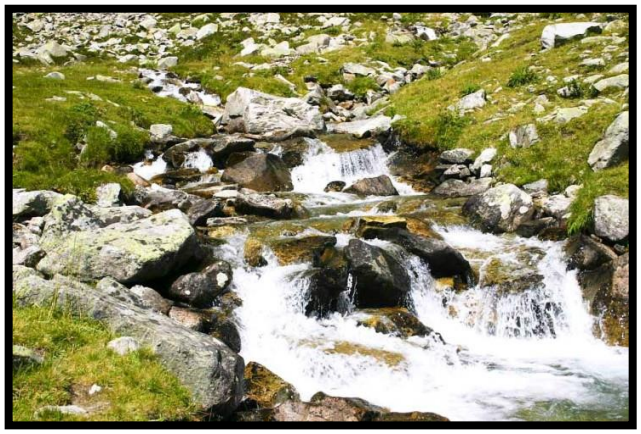
Tying It All Together

Language Strand: Oral Communication

2.3 communicate in a clear, coherent manner, using a structure and style appropriate to the purpose, the subject matter and the intended audience

2.4 use appropriate words, phrases, and terminology from their full range of vocabulary

2.7 use a variety of appropriate visual aids to support or enhance oral presentations



The Arts Strand: Visual Art

D1.1 create art works, using a variety of traditional forms and current media technologies that express ideas and issues

D1.3 use elements of design in art works to communicate ideas, messages, and understandings for a specific audience and purpose

2. NUTRIENTS AND AQUARIA

(adapted from an activity found in Investigating Aquatic Ecosystems by William Andrews)

In small groups, have students build an aquatic ecosystem. Weight the bottom of a wide-mouth jar or a cut-off 2L soda bottle with sand. Fill the aquarium with pond water and stock it with a few snails and freshwater plants. Ecosystems should maintain themselves well if placed in indirect sunlight and kept from over or underheating. Once they are established, have students experiment with their ecosystems by adding nutrients. Commercial fertilizer, manure, even food scraps can be added to ecosystems in *very small amounts*.

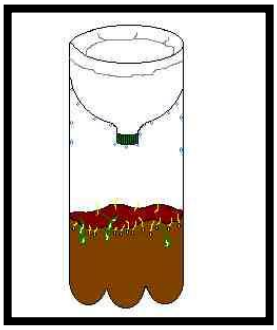


Image from http://www.relia.net/~thedane/ecosyste

Have the students observe the effects of added nutrients in their ecosystems. Each student can then compose a report, in paragraph form, of the effects of added nutrients to aquatic ecosystems. Students should be encouraged to draw general conclusions about The impact of human nutrient addition to natural waterways and wetlands as well as provide concrete examples occurring in nature: golf courses, agricultural lands – fertilizer run off, coastal cities dumping sewage into the ocean, etc.

Tying It All Together
Language Strand: Writing
1.1 identify the topic, purpose and audience for more complex writing forms
1.5 identify and order main ideas and supporting details and group them into units that could be used to develop a summary or a report of several paragraphs, using a variety of strategies and organizational patterns

3. STREAM TABLE

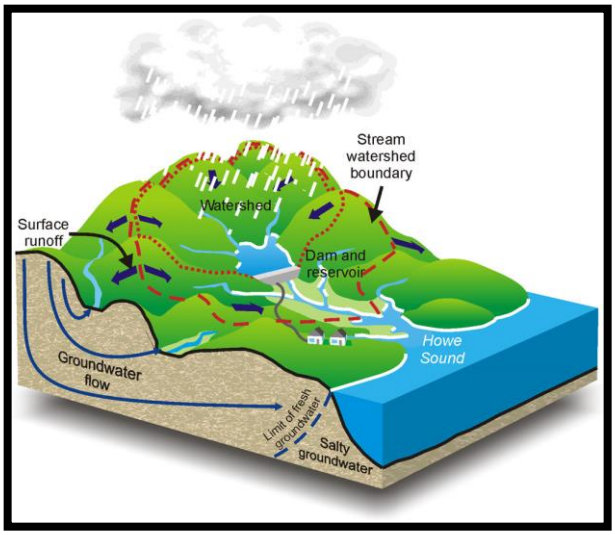
(Image from http://enasco.com)

Create a model of a natural waterway right in your classroom. Attach an outlet tube to a large, rectangular pan (a hamper sized plastic container will work). Elevate the end of the pan opposite the outlet tube using books or scraps of wood. Fill the upper half of the pan with a mixture of sand and rocks materials to a depth of 4-5 cm. Add water to the lower half of the pan to create a pool. Flow water into the upper part of the pan using a garden hose. Adjust the flow of water so that it creates a channel through the rocks and sand down to the pool. Have the students observe the path of the water as it cuts through the "land" and how it reaches the pool. Experiment by changing the angle of the pan, the rock material used, and the flow rate of the water. Have students experiment by adding dams or diverting the flow of the "river." Initiate a class discussion on the physical effects of water as it moves over land. You could also discuss how humans impact on the flow of water for our own purposes.

Tying It All Together
Language Strand: Oral Communication
1.3 identify a variety of listening comprehension strategies and use them appropriately before, during, and after listening in order to understand and clarify the meaning of increasingly complex and challenging oral texts
1.6 extend understanding of oral texts, including increasingly complex or difficult texts, by connecting, comparing, and contrasting the ideas and information in them to their own knowledge, experience and insights; and to the world around them
2.3 communicate in a clear, coherent manner, using a structure and style appropriate to the purpose, the subject matter, and the intended audience

4. MODEL WATERSHED

Working in small groups, students can create individual watersheds and investigate how precipitation and pollution drains through them. In small rectangular pans, have students create a model of at least two separate watersheds using modeling clay. Building a mountain in the middle of the pan will allow students to create drainage basins on opposite sides of the mountain. When the clay has hardened, have the students "rain" on their models using a watering can. Students can observe how water drains



separately into different watersheds. Have students experiment with adding a surface pollutant (eg. tea leaves or confetti) to either watershed and observing where the pollutants (Image from http://nrcan.gc.ca)
end up. Have students modify their water shed by adding wetlands made of turf. Students can see how wetlands can filter out pollutants. Have the students present their wetland models and findings to the class in a presentation.

Feeling Bold?
As a class, try building a scale model of a real watershed. Using a topographical map and measurements from a local watershed, create a large and accurate model of the watershed. Try to include as many real features and buildings as possible. Experiment with the impact of adding or removing wetlands to this model in order to make decisions about management of the watershed.

Tying It All Together
The Arts Strand: Visual Arts
D1.1 create art works, using a variety of traditional forms and current media technologies, that express ideas and issues
D1.2 demonstrate an understanding of composition, using multiple principles of design and other layout considerations to create art works on a them or topic
D1.3 use elements of design in art works to communicate ideas, messages, and understandings for a specific audience and purpose

5. TECHNOLOGY & WATER RESEARCH PROJECT

This activity will require students to use their research skills to discover and assess the ways in which technological innovations or scientific discoveries are impacting local and global water systems. Students will be required to select one of the research topics below and create a pamphlet to promote awareness of the technology. Their pamphlets should meet the following criteria:

- Introduction to the technology and a well developed explanation of how the process works
- Materials, money and time that is required for the technology to successfully work
- Positive and negative effect of the technology on the water being used and the source the water was taken from
- Positive and negative effects on the surrounding environment
- Positive and negative effects of the technology for humans
- Description of long term effects (if unknown make sure this is stated in the pamphlet)
- List of resources where people may go to find out more information

Explain to student that their pamphlets need to include, graphics, titles, subtitles and that their information needs to organized in an easy to read manner. If you have access to computers, once students have finished their research and organized their information into a rough layout of what their brochure will look like, you may wish to use Microsoft Word to created professional looking pamphlets using the Microsoft brochure template feature.

<u>Possible Research Topics</u>
- forms of *bioremediation*:
    - *biostimultion* (water is modified by motivating the bacteria when oxygen and other nutrients are introduced to the water)
    - *bioaugmentation* (microorganisms are used to remove particular contaminants from water
- *desalination* (method that allows sea water to be made into fresh water)
- using water as a source for *hydroelectric power*
- the *decomposition of water*: using radio waves to split water into its elemental compounds, hydrogen and oxygen, which then burn, reforming water

- *flocculation* (a process which clarifies water by causing a precipitate to form in the water which can be removed using simple physical methods)
- *burning oil* to clean up after oil spills
- *using dispersants* to clean oil spills (dispersants act as detergents, clustering around oil globules and allowing them to be carried away in the water)

Tying It All Together
Language Strand: Writing
1.3 gather information to support ideas for writing, using a variety of strategies and a wife range of print a electronic sources
1.4 sort and classify ideas and information for their writing in a variety of ways that allow them to manipulate information and see different combinations and relationships in their data
1.5 determine whether the ideas they have gathered are relevant, appropriate and sufficiently specific foe the purpose, and so more planning and research if necessary
3.7 use a wide range of appropriate elements of effective presentation in the finished product, including print, script, different fonts, graphics, and layout

VOCABULARY

biomagnification	the buildup of a toxic substance as it moves through the levels of a food chain.
bloom	a rapid increase in the algal population in an aquatic ecosystem.
condensation	the process of a substance changing from a gas to a liquid.
conservation	methods employed to reduce demands for a resource and therefore increase supplies.
dissolved oxygen	gaseous oxygen that is found dissolved in water.
eutrophication	a process by which an excess of nutrients in an aquatic ecosystem leads to a proliferation of plant life and a reduction in available oxygen.
evaporation	the process of a substance changing from a liquid to a gas, slowly and over a wide range of temperatures.
groundwater	water that lies beneath the surface of the Earth.
nitrate	a salt of nitric acid (NO_3^-), an essential nutrient and commonly occurring pollutant
pH	a measurement of the concentration of hydrogen ions (H^+) per unit volume: used to determine the degree of acidity and alkalinity of solutions.
phosphate	a salt of phosphoric acid (PO_4^-), an essential nutrient and commonly occurring pollutant
pollution	substances that contaminate natural environments.
potable	water suitable for human consumption.
precipitation	water that falls to the earth in solid or liquid form (eg. rain, sleet, hail, snow).
transpiration	the evaporation of water from the surface of a plant.
vitamins	help control body growth and functions
water cycle	the movement of water thorough different locations and physical forms.
wetland	an area of land that is partly covered by water for some part of the year.
Nutrients	a substance that provides nourishment essential for growth and the maintenance of life
Aquifer	a body of permeable (allowing liquids or gases to pass through) rock that can contain or transmit groundwater.
Polar Ice	sea ice that is more than a year old; the thickest form of sea ice
Salinity	a measure of salt concentration in water
Water Table	upper surface of groundwater below which soil is saturated with water

RESOURCE LIST

*__S__ = student friendly site
*__T__ = teacher appropriate site

http://www.ec.gc.ca/eau-water/default.asp?lang=En&n=CD467AE6-1?WT.mc_id=water **(T&S)**
The Environment Canada website. Contains a variety of links to environmental websites including many sites related to water.

http://www.ec.gc.ca/education/default.asp?lang=En&n=AB816A56-1 **(T&S)**
Another Environment Canada website with lots of information on how water quality affects students and the environment, how students themselves affect water quality and how they can make a difference.

www.ene.gov.on.ca **(T)**
The Ontario Ministry of the Environment website. Focuses mainly on Acts and Regulations, but contains downloadable documents on monitoring, pollution, and rehabilitation programs.

ga.water.usgs.gov/edu **(S&T)**
USGS water education website. Lots of information and activities, including quizzes and games.

www.cwra.org **(T)**
Canadian Water Resources Association website. Comprehensive links to water related groups and organizations.

www.epa.gov/safewater/kids **(S&T)**
U.S. Environmental Protection Agency website. Contains activities related to water sorted by grade level.

http://www.watercan.com/h2oh/about.shtml **(S&T)**
A fantastic website that includes games, experiments, handouts, activities and fact sheets that are ready for use in the classroom (all of which are organized according to grade level). There are also posters, dvds, and *Water for Life* campaign coordination kits that can be ordered and sent to you free of charge.

http://nsidc.org/cryosphere/glaciers/index.html **(S&T)**
Explore nearly all aspects of glaciers including data and science, facts, a gallery, a glossary and much more.

Books

Hickman, P. (1993). Wetlands. **(S)**
Primarily aimed at younger students, but contains a variety of activities that could easily be adapted.

Kesslelheim, B., et. al. (1995). WOW! The Wonders of Wetlands. **(T)**
A complete educator's guide to wetlands education. Contains activities suitable for a range of ages from pre-school to secondary. Also contains detailed background information.

Wick, Walter (1997). A Drop of Water: A Book of Science and Wonder. Scholastic Press **(T&S)**
Filled with stop-action and close-up photography, an early scientific book features such images as a single snowflake and a falling drop of water, accompanied by introductions to such concepts as evaporation and condensation.

Water Log

You would probably be amazed at the amount of water you actually use. If you're interested in finding out, try keeping track of your water use over the course of a week. It could help you pinpoint areas where water savings could be easily achieved. Water use away from home can account for twenty percent of your weekly use – so keep track of those uses as well.

Did you know? A person living in Sub-Saharan Africa uses 10 to 20 litres of water a day, while on average, a Canadian uses 326 litres a day.

What You Do	How Many Times – By Day							Average	Actual	Total
	M	T	W	T	F	S	S			
Bathroom										
toilet flushes								x 20 litres		
showers								x 100 litres		
baths								x 150 litres		
teeth brushing								x 10 litres		
shaving								x 20 litres		
Kitchen										
cooking								x 20 litres		
dishes by hand								x 35 litres		
dishwasher								x 40 litres		
garbage disposal								x 20 litres		
Utility Room										
washing								x 225 litres		
Outdoors										
car washes								x 400 litres		
watering								x 35 L/min		
other								estimate		
Total - Daily								**Total - Weekly**		

The chart allows you to keep track of your water use on a daily basis. The figures under 'Average' give typical water consumption figures for various appliances and devices. The appliance and devices in your home may use great or lesser amounts of water. Use the column marked 'Actual' where the difference is known.

THE WATER CYCLE*

The water cycle is an extremely important process because it ensures the availability of water for all living organisms as it regulates weather patterns on our planet.

In your groups, examine the information below. You have been asked to create a diagram to explain the Water Cycle to a group of grade 5 students; you can use chart paper and markers to do so. As part of your diagram, you may want to include other activities affected by the water cycle. For example, you could use a farmer and his crops as part of the precipitation component of your work. The water cycle consists of 6 important processes:

1. Evaporation

- Liquid water becoming water vapour (in the atmosphere).
- Factors favoring it are low air pressure and higher temperature.
- Heat from the sun evaporates water found in the ocean, lakes and rivers. Since impurities are left behind, the water that goes into the atmosphere is cleaner then when it was on earth.
- Water also evaporates of the leaves of plants – this is called transpiration

2. Condensation

- This process is the opposite of evaporation – water leaves the vapour state and returns to the liquid state
- Lower temperatures favour condensation.
- Water droplets formed from condensation that are small remain suspended in the atmosphere in the form of clouds in the sky or fog at ground level. Dust particles need to be present around which the droplet can form.

3. Precipitation

- Under the correct temperature and atmospheric pressure, the small water droplets in clouds become larger and precipitation occurs
- This can be in the form of rain, hail, sleet or snow.

4. Surface runoff

- As water returns to the earth (precipitation) it moves over the land and flows downhill (gravity) into streams, rivers, ponds and lakes.
- The direction of flow is: small streams → large streams → rivers → oceans
- This step is important because the water returns to the ocean as surface runoff where it once again is evaporated = A CYCLE!!

5. Infiltration

- When precipitation occurs, not all the water returns to the ocean as surface runoff. Some is also soaked into the ground. As water filters through the soil and rock layers, it becomes cleaner (impurities are filtered out)
- Some of this water returns to the surface (springs) or is taken up by plants.
- Some of this water becomes groundwater

6. Transpiration

- Plants absorb water from the soil. This water moves from the roots, up the stem and to the leaves
- Water evaporates off the leaves and into the atmosphere

*Adapted from www.watercan.com