PROJECT FLOW
FOR THE LOVE OF WATER

A Learning for a Sustainable Future Project

Grade 8 Ontario Water Unit with Integrated Action Project

PROJECT flow
FOR THE LOVE OF WATER

Goals:

- To teach the curriculum expectations through authentic opportunities to make positive changes in the local/global communities
- To provide action experiences which cultivate the attitudes, knowledge, skills necessary for students to take action in the future without the teacher's help
- To cultivate a sense of place
- To foster an appreciation for water and/or any natural resource

Learning for a Sustainable Future LSF L'éducation au service de la Terre LST

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RBC Blue Water Project™

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ON Curriculum Prescribed Learning Outcomes: Grade 8

Science

1. Assess the impact of human activities and technologies on the sustainability of water resources.
2. Investigate factors that affect local water quality.
3. Demonstrate an understanding of the characteristics of Earth's water systems and the influence of water systems on a specific region.

http://www.edu.gov.on.ca/eng/curriculum/elementary/scientec18currb.pdf

History

1. Describe key characteristics of Canada between 1885 and 1914 including social and economic conditions, the roles and contributions of various people and groups, internal and external pressures for change, and the political responses to these pressures.
2. Use a variety of resources and tools to gather, process, and communicate information about the factors that shaped Canada as it was entering the twentieth century.
3. Compare living and working conditions, technological developments, and social roles near the beginning of the twentieth century with similar aspects of life in present-day Canada.

http://www.edu.gov.on.ca/eng/curriculum/elementary/sstudies18curr.pdf

Health

1. Identify local support groups and community organizations that provide information or services related to health and well-being.

http://www.edu.gov.on.ca/eng/curriculum/elementary/health18curr.pdf

Language Arts

Water-related reading materials:

Beneath Their Blue, Blue Skins, (nv) **Spaceships & Spells**, ed. Jane Yolen, Martin H. Greenberg & Charles G. Waugh, Harper & Row 1987
**Portfolio of work*

The Big Questions

To plan this unit, we used a method consistent with the "design down" curriculum planning approach described in *Understanding by Design and Integrating Differentiated Instruction* by Carol Ann Tomlinson and Jay McTighe). We examined the curriculum expectations for grade eight in Ontario, the goals of education for sustainable development and our general pedagogical goals. Consequently, we formulated the following five "big questions" for the students:

1. Is water important?
    a. To humans in your community?
    b. To other animals in your community?
    c. To humans and other animals that live far away?
    d. To you?
2. How do water systems impact the place where ***you*** live?
    a. Local watershed
        i. Now
        ii. At the beginning of the twentieth century
    b. Importance of Great Lakes System
3. What are some concerns that other people have about water?
    a. Volume
        i. Not a lot to start with that is accessible/suitable for drinking
        ii. Impact of climate change
    b. Contaminants
        i. How do household activities in ***your community*** impact local waterways?
        ii. How do industries in ***your community*** impact local waterways?
        iii. How do things that ***you*** do impact local waterways?
    c. Ownership/access/fairness
        i. Beverage companies in your area?
        ii. Global access
4. What concerns do ***you*** have about water?
5. Do you want to make a change related to water issues?
    a. If so, what and how?
    b. If not, why not?

Sample Activities

Sample activities have been provided in an effort to make the unit outline more tangible. The sample activities are provided in two places:

1. Appendix A in this document.
2. In the Engaging Students in Sustainable Action Projects Guide (companion guide to forum teacher workshops). I will refer to this as the ESSAP guide.

Unit Plan

The unit plan is approximately 6 weeks long. The first 3 weeks of the unit involve teaching some content related to the first 3 'big questions'. This work will inform the students' choice of issue and action and ultimately enhance their action projects. The latter three to four weeks are dedicated to students' action projects.

Day 1 **A.** Start word wall (see Activity 1 in Appendix A). Add to word wall throughout unit. **B.** Is water important in your local area? **Suggested activity** (Activity 2 in Appendix A): Who Depends on Water?	**Day 2** *Is water important to humans and animals far away?* **Suggested activity** (Activity 3 in Appendix A): Exploring Water Around the World
Day 3 **Values clarification activity:** is water important to you? (Provide students with a choice of activities that can be done to express their response to this question. Revisit this response at the end of the unit).	**Day 4** *How do water 'features' impact the place where you live?* Make **watershed maps and models** that explain these processes (see Sample Activity 4 in Appendix A. If possible, arrange to display in community setting)
Day 5 Continue making models. (see Sample Activity 4 in Appendix A)	**Day 6** Divide groups in half (or allow students to choose): *research information about ***current*** commercial and industrial uses of water in your watershed. *research information about ***historical*** commercial and industrial uses of water in your watershed.
Day 7 Continue research from day 6.	**Day 8** *Visually display research on the watershed models.* **A.** Have groups pair up so that groups that did research about **current** uses teach groups that studied **historical** uses and vice versa. **B.** Have listeners take notes to prepare for quiz.

Day 9 *Share models with wider community.* **A.** Students prepare for quiz by circulating among models and asking questions.	**Day 10** *How does great lakes water system impact where you live?* a) How do great Lakes interact with your watershed? b) Compare temperatures inland and near lakes. c) Compare precipitation inland and near lakes. d) Wind currents… Etc. Explain effects using watershed models
Day 11 A. Quiz related to previous week B. *What are some concerns related to water?* **Focus on *Volume:*** (see Sample Activity 5 in Appendix A 'How Much Water do We Have') Government or non-profit organizations involved in this issue?	**Day 12** *What are some concerns related to water?* **Focus on Volume:** How does climate change impact the amount of available water in our area? In the world?
Day 13 Climate change (continued) Government or non-profit organizations involved in this issue?	**Day 14** *What are some concerns related to water?* **Focus on Contaminants**: How do they impact humans and other animals and plants? (see Sample Activity 6 in Appendix A: How does that Impact us?) Government or non-profit organizations involved in this issue?
Day 15 *What are some concerns related to water?* **Focus on fairness, Access, etc.** **Suggested sample activities:** 1. Examination of local industries' water 'rights' (eg beverage companies, golf courses, etc.) 2. Case study about people in Cochabamba, Bolivia. A private company bought the local municipal water rights. The people rioted. See 5 minute video at: Cochabamba video: http://www.youtube.com/watch?v=UwbdetTT3ws Government or non-profit organizations involved in this issue?	**Day 16** *How are some of these concerns related to your local watershed?* Connect concerns studied over past 5 days to Commercial/Industrial activities discovered week before. Also see Sample Activity 7 in Appendix A. **Suggested assessment activities**: mind map and reflection questions.

Day 17 *Identifying an Issue that genuinely bugs you*. (WHOLE CLASS WILL CHOOSE SAME ISSUE. SMALL GROUPS WILL CHOOSE OWN ACTIONS.) **A.** Class: "what bugs you" activity re WATER issues. See Value Line Activity D2 in ESSAP guide. Use camera to record whole group 'stance' on different topics (or have someone sketch diagrams). Review photos/sketches. Choose topic that whole class seems to care the most about. **B.** Put students into/ ask students to get into groups (max 3 people per group works best). **C.** "So What" activity in small groups. See Activity F in ESSAP guide. Teacher models first. Post so what posters around room & ask each group to point out the so what/reason that they are most passionate about.	**Day 18** Placemat research activity in ESSAP guide. Do this for the issue that students care about the most. **NOTE:** Preparation for day 19: Teacher finds articles related to students' questions.
Day 19 Provide students with 2-5 articles about the issue chosen yesterday. **Choices:** i) students read articles individually ii) jigsaw within groups—students summarize articles for one another QUIZ ON MATERIAL IN ARTICLES IN NEXT FEW DAYS.	**Day 20** **Reminder:** quiz next week on issue content from articles. **A.** Help students to distinguish between symptoms and root causes of chosen problem/issue (see Activity E2 in ESSAP guide). **B.** Expose students to different types of action students have taken. See Matching Activity D1 in ESSAP guide). Have students summarize various ways individuals and groups can influence legal systems and political structures. **C.** Activity: brainstorm ideas for how to act on chosen issue (Every group takes action about same issue) using first page of action planning template (see planning template item #4 in section H of ESSAP guide). Take up these ideas as a whole class & post them on chart paper around room **D.** As a class, develop criteria for choosing a particular action. Post these criteria. (see chart in step 2 of 12 planning steps in ESSAP guide)
Day 21 Quiz on issue. Students use chart in action planning template to compare 3 possible actions (see item #6 in planning template in ESSAP guide)	**Day 22** *Alternative decision making models:* Building consensus (see Activity C1 in ESSAP Guide).

Day 23 **A.** In small groups, students use consensus model to choose their group's action (whole class chooses same issue but small groups can take different actions).	**Day 24** **A.** Use planning template (ESSAP guide section H) to plan action. **B.** Students save different drafts to reflect their learning about the taking action process.
Day 25 **A.** Students submit plan and/or conference with teacher about action plan. **B.** Students do additional research about their chosen action as necessary.	**Day 26** *Students move through their action plan.* **A.** Students are expected to document their process and reflect on the process throughout this week. **B.** Provide skill-building opportunities as necessary.
Day 27 +… **(4-7 days)** Amount of class time students need to do their project will depend on: 1. Type of project chosen 2. Work habits of your students 3. Amount of time teacher can afford to allow Etc. For this age group, approximately 4-7 class periods may work.	**Final day(s)** **A.** Share your students' projects with as wide/authentic an audience as possible. **B.** Provide students with time to assemble their observations, planning template, reflections etc. for assessment.

APPENDIX A: SAMPLE COMPANION ACTIVITIES

ACTIVITY 1: WORD WALL

1. Ask each student to choose a word from the vocabulary list below. Ask the students to create signs to be displayed around the classroom in which:
   - The word is written in letters large enough to read while sitting at your desk
   - The meaning is conveyed using words, pictures or "props" in a way that is meaningful to all students.

Vocabulary List

riparian zone	resources	invasive species
area of influence	bubble pack (blister pack)	solid waste
'yellow fish'	tetrabrick	watershed
surface water	renewable	hydrosphere
ground water	non-renewable	biosphere
wetlands	syringe	reservoirs
hazardous	disposal	saline
personal products	endangered	…
storm drain	threatened	Etc.
aquatic	organism	
ecosystem	entanglement	
detritus	grey water	
environmental impact	sewage	
creek	leaching	
river	toxins	
tributaries	potable	

ACTIVITY 2: WHO DEPENDS ON WATER?

Materials

For each student:

- ✓ several piece of 8 ½ x11 scrap paper torn into squares
- ✓ A variety of felt pens, pens or pencils

Procedure

1. Give students a few minutes to brainstorm and write down on each of their scraps of paper names of businesses, groups, or others who could be collectively called a' user of water', i.e. the logging companies, a car wash, frogs, fishers, agricultural or recreational irrigation farmers, gardeners, etc.
2. Ask students to categorize their 'users'. For example, they might choose the following categories:
   a) Businesses
   b) Humans' Day-to-Day Activities
   c) Plants
   d) Other Animals
   e) Human Recreation/Enjoyment
   f) Others
3. Discuss the different classification systems.

As a class, look at the placement of the cards. Ask students what would happen if any one of the user groups no longer had access to clean water.

ACTIVITY 3: EXPLORING WATER AROUND THE WORLD

Description

Students read about specific sources and effects of one particular pollutant. Students depict the sources and effects in a detailed picture. Other students try to guess what is happening in the pictures. Students use words and pictures to explore the question 'so what'?

Materials

- ✓ Copy of Figure 1 (in Appendix A)
- ✓ Chart Paper, markers, tape
- ✓ get the information about 1 particular pollutant.

Preparation

Photocopy Figure 1 and cut out each row so that each group can:

1. Ask the whole class to give one-word suggestions to create a chart paper list of 10 things humans need to survive.
2. Beside the first list, have students brainstorm a second list of what other animals need to survive.
3. Make a third list of the things plants need to survive.
4. Discuss the commonalities among the lists. Tell the students that today's focus is 'water'.
5. Ask students to visit the websites below and identify photos related to water that think are important/interesting (Alternatively, you could print the photos before the class. Students could also do this using old National Geographic magazines if they are available; other sites can be located by doing searches like: 'photos water justice' etc.):
   - http://www.flickr.com/groups/ourworldourwater/
   - http://www.fotosearch.com/photos-images/water-contamination.html
   - http://www.fotosearch.com/photos-images/water-pollution.html
   - http://www.nationalgeographic.com/photography/
   - http://www.greenpeace.org/international/photosvideos/
6. Have students work in small groups. Ask each group to pick five photos and discuss how they feel looking at the pictures. What thoughts come to mind? What do the photos show about water and humans in other countries? What do the photos show about water, humans and other animals?
7. Have students choose a title for each of the images and place it on the wall. Students can also make their own cards, with hand-drawn images, based on their own knowledge.
8. In small groups, ask students to classify the photos and justify their classification system.
9. As a class, discuss the possible classification options.
10. Individually, ask students to choose one image and create another image (photography, drawing, collage,…) that either:
    - Explains why the image is important to her/him, or
    - Changes the image to something she/he would prefer to see, or
    - Represents the 'future life' of the characters/place in the photo.

ACTIVITY 4: YOUR WATERSHED-MAPS AND MODELS

Description

Students will study local maps and build their own three-dimensional model in order to understand the concept of a watershed and local water sources.

Materials

- ✓ a local map showing streams and rivers
- ✓ aluminum pie plates or cookie sheets (better)
- ✓ Monopoly-size models of homes
- ✓ clay
- ✓ spray bottle with water
- ✓ a bit of soil, cocoa powder and coloured drink mix
- ✓ historical, aerial photos of your area (optional—contact local museum)

Procedure

1. Ask students to sketch a map that includes the following information:
   a) The closest creek to the school
   b) The closest river to the school
   c) The closest lake to the school
   d) The source of the school's drinking water
   e) The (drinking) water treatment plant
   f) The sewage treatment plant
   g) The first place the water that runs off the school driveway goes after it goes down the storm drain
   h) The storm drain closest to their classroom
2. Find a large map (or several small maps) of the watershed in which your school is located. Your local drinking water management office, municipal office, or conservation authority may be able to help you to locate a map.
3. With a partner, ask students to find some of the items (creeks, rivers, lakes, etc.) on their own map (from step 1) on the official watershed map. Ask them to predict how the water will flow through the areas on the map. Explain to students that a watershed is the area that includes all the tributaries that lead into a local water body. You may want to point out that in urban and suburban areas, humans have covered over many of the creeks that run through our communities. Optional: historical, aerial photos of your area are often very interesting to students and informative about the nature and scale of changes to your watershed. You may be able to access these through your local museum. Many museums now have photos online.
4. Formative Assessment: create a little quiz to ensure that the students understand the different aspects of their local watershed before they build their model.
5. Ask students the following questions:
   - What is a model?
   - What is a three-dimensional model?

6. Explain to students that they are going to make a three-dimensional model of a watershed; students can work alone, in pairs or in groups of three.

7. Develop a rubric with the students to determine how the models and their understanding of the models should be assessed (a rubric has been provided below to assist you). You may wish to have the students audio or video tape their demonstrations and their explanation of what is happening in order to fully assess their understanding of the point of the models.

	Description Level 4	**Description Level 3**	**Description Level 2**	**Description Level 1**	**Self Assessment**	**Teacher Assessment**
Knowledge Model includes the requested elements of the local watershed and water treatment systems.	Thorough representation of elements accurately represented.	Considerable number of elements with considerable accuracy.	Some elements with some accuracy.	A limited number of elements with limited accuracy.		
Thinking/Inquiry Model includes locally relevant sources of pollution and/or other pertinent phenomena (eg. erosion, etc.).	Applies the information discussed in class and/or finds new information to accurately depict locally-relevant sources of pollution and other pertinent phenomena.	Applies the information discussed in class with considerable accuracy to depict locally-relevant sources of pollution and other pertinent phenomena.	Applies the information discussed in class with some accuracy to depict locally-relevant sources of pollution and other pertinent phenomena.	Applies the information discussed in class with limited accuracy to depict locally-relevant sources of pollution and other pertinent phenomena.		
Application Provide students with a new scenario (eg. about local source of pollution, anti-erosion activities, etc.) and ask them to use the model to explain what is happening.	Uses the model to explain scenario with a high degree of effectiveness.	Uses the model to explain scenario with considerable effectiveness.	Uses the model to explain scenario with some effectiveness.	Uses the model to explain scenario with limited effectiveness.		
Communication Clay, other materials and signage are used to communicate the information in the model.	Communicates ideas with a high degree of effectiveness.	Communicates ideas with a considerable effectiveness.	Communicates ideas with some effectiveness.	Communicates ideas with limited effectiveness.		

8. Provide a chunk of clay and an aluminum pie plate or cookie sheet for each group.

9. Ask students to use the clay to design their local watershed in the pie plate/cookie sheet. They should mold the local geographic features.

10. While students are molding their watersheds, a recording of water sounds can be played.

11. Ask students to experiment with the following ideas and record their observations:

    - Place some homes, factories, farms (i.e. the little Monopoly pieces) where they think they should go based on their model.
    - Use a spray bottle to spray their watershed and observe the runoff. How does the runoff appear? Cloudy? Clear? Dirty?
    - Place two tablespoons of soil on the highest part of the model. Spray their watersheds with water and observe runoff. Discuss what happens to the soil. How does the runoff appear? Cloudy? Clear? Dirty?
    - Ask students to predict how plants growing on the steep parts would affect water runoff. Challenge them to use materials of their choice to experiment with plants and water runoff.
    - Ask students to predict consequences to aquatic organisms and bodies of water when soil is washed into streams and rivers.

12. In their groups, ask students to brainstorm possible sources of water pollution (see Appendix A for background information to assist students). Choose a model with an appropriate scale to demonstrate the following:

    - “Where on this model could oil be found?” A possible response would be the gas station or on any road.
    - Use a mixture of cocoa and water to represent engine oil. Ask students to place the oil where suggested.
    - ”Where on this model could soil with pesticides be found?”
    - Use cocoa powder to represent soil with pesticides. Ask students to place where suggested.
    - “Where on the model could soil with other types of chemicals be found?”Use coloured drink mix to represent chemicals. Ask students to place the chemicals where suggested.
    - Use water spray bottles to mimic rain. Have students observe what occurs in the watershed. Discuss. What are the implications of this for your own watershed and the substances that we put down our drains, in our yards and on our roadways?

13. Individually, ask students to reflect on the following questions:

    a) Were there any surprises for you during these activities?
    b) What else would you like to know?
    c) If you could do a giant experiment on your watershed, what would you like to do?
    d) How is a watershed a system?

ACTIVITY 5: HOW MUCH WATER DO WE HAVE?

Description

Students will work in groups to predict how much potable water we have and use water bottles to show their predictions and chart paper to graph predictions.

Materials

One set of materials for each group

- ✓ 1-litre bottle filled with water
- ✓ 3 more identical empty 1-litre containers (preferably beakers or graduated cylinders)
- ✓ Scrap paper
- ✓ Different coloured pens or felt markers
- ✓ Rags for mopping up water
- ✓ Masking tape
- ✓ Demonstration bottles

Preparation – Demonstration Bottles

- A demonstration set of beakers that are clearly labeled with the following percentages to show to students after they have made their own estimates:

  - 97% of the Earth's water is salt water in the oceans and 3% is freshwater. Of the 3%, 69% of the 3% is stored as ice. A lot of the remaining water is deep within the Earth or in the air as condensation. That leaves about 1% of the 3% of fresh water for humans to have (fairly) easy access to ..

  NOTE to teacher: Be careful to model responsible use of water during this activity. Save the water used in this activity for something useful like watering plants ,etc.

Procedure

1. Place students in groups of three and give each one 4 identical 1-litre containers (1 filled with water), 1 piece of scrap paper and different coloured felt pens (4-7).

2. Ask students what makes water good, safe and healthy to drink, i.e. clean, no salt, etc.

3. Tell students that the water they have in the bottle represents **ALL** the water on the planet. Refer to the previous activity to emphasize that this is all of the water that there is—whether it be in glaciers, oceans, under the ground, etc. Ask each of them to create a pie graph to estimate how much water is:

   - Salt water
   - Frozen fresh water
   - Fresh water that is not frozen (underground and above ground in streams, rivers, etc.; water in the air, etc.)
   - Fresh and potable water that is available for us to drink

4. In groups, have students share their predictions and come to a consensus as to how much water is saline and how much is fresh. Have each group estimate and pour these representative amounts into two of

the bottles. Ask the students to label the bottles appropriately using masking tape. Have each group hold up their bottles and compare them to one another.

5. Ignore the "salt water" bottle. Of the water that the group has designated as fresh, have them use their predictions to estimate the amount of fresh ***flowing*** water compared to the amount that is not really available to us to drink, i.e. water that is too far underground to pump to the surface or in the atmosphere as condensation, etc. Using their "fresh water bottle", ask students to pour out the amount that is NOT 'available' fresh water into the empty bottle. Have each group hold up their bottles to compare.

6. Use a demonstration set of bottles to show the 'true' estimates or share the bottles of the group with the closest estimate. A teacher or pre-primed student can do the demo using commonly understood proportions of salt, fresh, potable water, i.e. 97% of the Earth's water is salt water in the oceans and 3% is freshwater. Of the 3%, 69% of the 3% is stored as ice. A lot of the remaining water is deep within the Earth or in the air as condensation. That leaves about 1% of the 3% of fresh water for humans to have (fairly) easy access to. .

7. Discuss reasons for the differences between the teacher's estimates and the students' estimates.

8. Tell students that you are about to give them two choices and you want them to vote for what choice they think is 'true' by giving a (discrete) thumb's up sign when you say the statement that they think is true. The choices are: a) new water comes to Earth each month from space or b) new water does not often come to Earth.

   Something to think about: Our only source of 'new' water is bits of comet that melt as they enter our atmosphere... who has seen one of those lately??? Most of the water on Earth has been around in one form or another since the beginning of time which means, in a sense, we've been drinking the same water that v was contained in the dinosaurs' pee!

9. Ask students to reflect on the amount of water that is available for us to drink using these guiding questions:

   - Before the demonstration I predicted that…
   - I was surprised that…
   - I wonder if…
   - I feel that…
   - I think that…

ACTIVITY 6: HOW DOES THAT CONTAMINANT IMPACT US?

1. Divide students into 10 different groups. Allow each group to choose one of the types of pollutants listed in Figure 1 (see Appendix A). Provide each group with a slip of paper that has the source and effects information related to their pollutant. Do not allow the other groups to see the source and effects information related to other students` pollutants.
2. Ask students to draw a picture of what is happening in the centre of a piece of chart paper. Ask them to make the picture as graphic as possible so that someone who had not read the information can tell what is happening.
3. Post the chart papers around the room. Ask each student to tour the pictures. Have the students choose five of the pictures and write a 1 paragraph description of what is happening in each picture.
4. As a whole group, ask volunteers to describe what they think is happening within a particular picture. Then, ask the authors/illustrators to add any missing details to the description.
5. Ask each group to take back their pictures. From each effect (for example, high concentrations of pollutants can kill fish eggs and adult fish), ask the students to draw a line to a rectangle. On the line, write the question 'so what?'. In the rectangle, use words and pictures to answer the question 'so what' (for example, if fish eggs die, there will be fewer fish). From the rectangle, create a new line (with the question 'so what') and a new rectangle (for example, if there are fewer fish, there will be less food for animals, including humans that eat the fish). Have students continue one line of thinking until they cannot answer any more 'so what's'. Then, have students determine if there are other directions the line should go in (e.g. a different consequence of the same effect). Ask students to repeat this process with all of the effects.
6. Post the pictures again and do another 'gallery' tour. Discuss.

Non-point Source Pollution

Non-point source pollution is pollution spread over a large area and not from one specific location; this type of pollution is hard to trace to its source , e.g. litter, acid rain, etc.

Point Source Pollution

Point source pollution is easily traced to its source, e.g. factories and sewage treatment plant wastewater. Nonpoint source pollution, unlike point source pollution, comes from many different sources[1].

Non-point Source Pollution is the single largest contributor to water pollution!

How does Pollution get into our Water System?

As runoff water from rainfall or melting snow moving over and through the ground passes through the watershed, it picks up and carries away natural and human-made substances such as chemicals, sediment and debris and deposits them into lakes, rivers, wetlands, coastal waters and underground sources of drinking water.

Pollutants do ***not*** enter the local water body through the storm drain system at a constant rate over the year. For example, there is a large increase in non-point source pollution in the springtime. This is the peak time for runoff from melting snow and rain which ends up in the storm drain system, untreated[2].
Water slowly moves through soil (groundwater) and naturally gets filtered. Since about 70% of towns and cities are paved or built over, about half of the precipitation that falls on our cities never touches the soil. Water running over pavement collects debris and chemicals and often goes directly into the storm drain system without moving through soil[3].

Where do these pollutants come from?

There are many sources of water pollutants, including industrial and agricultural sources. However, Canadian households annually generate more than 60,000 tonnes of hazardous wastes. Common examples of hazardous household wastes include: old car batteries, lighter fluid, turpentine, gasoline, used motor oil, antifreeze, pool chemicals and pesticides. Other pollutants that commonly end up in the water system are soap and fertilizer. These may not be toxic, but in high concentrations they can have a negativeimpact on the aquatic ecosystem by changing pH levels of water sources.

What are the effects of non-point source pollution?

Non-point source pollution in our waterways impacts not only humans but also the other animals and plants that depend on that water. Non-point source pollution can affect the food supply and is the major source of human exposure to persistent toxic chemicals. For example, food can become contaminated when it is

exposed to hazardous waste, which can happen at any point in its life; this is especially true with fish and wild game.

The water in your watershed continues on to the next community's watershed. Municipal water is treated before reaching households, but if the water going into the treatment plant is contaminated, it takes more time and energy to clean it[4].

Non-point source pollution also impacts the watershed ecosystem. Different levels of different pollutants will affect plants and animals in and around the water (Figure 1).

Figure 1: Pollutant Effects on Aquatic Ecosystems[5]

Pollutant	Source	Effects
Detergents	• Washing cars in the driveway • Dumping wash water onto the street • Washing siding or windows	• Can strip away the protective mucous coating on a fish – without this protective coating, fish will absorb more chemicals and are more susceptible to disease. • High concentrations can kill fish eggs and adult fish. • Phosphorous In detergents encourages the growth of algae. When the algae dies it uses up a lot of oxygen. This means that there is less oxygen available for other plants and animals. Many types of fish cannot survive in water with low oxygen levels.
Garbage	• Litter from people, houses, parks, industrial areas and construction sites	• Can cause unsightly debris and bad odours. • When ingested by an animal, litter can be dangerous, often causing death. • Sharp litter can harm people or animals (e.g. glass). • Animals can become entangled and strangled by litter, which is dangerous and can cause death (e.g. beer plastic rings and plastic bags).
Heat	• Even heat can be a pollutant! • Because the storm drain water is coming from runoff over land and roads, storm drain outfall is usually warmer than the local water body.	• Increased temperatures can affect certain species of fish, invertebrates and plants, which are adapted to living in a certain range of temperatures. Fish are particularly sensitive to temperature changes during spawning. • Warmer water holds less dissolved oxygen, which can be a problem for species that require a certain oxygen level in the water. Coldwater fish, such as trout, prefer waters that are cooler than 14°C.
Heavy Metals	• Industrial sites • Washing cars in the driveway • Metal corrosion (e.g. from cars and pipes) • Pesticides and herbicides	• The levels of heavy metals found in water are generally low, however, due to bioaccumulation, higher concentrations can be found in wildlife. • Bioaccumulation is an increase in the concentration of a chemical in an organism over time. As an organism drinks and eats contaminated sources, it will accumulate chemicals in its body over time.
Nitrates and Phosphates	• Nitrates come mainly from fertilizers, and some from animal waste • Phosphates are found in detergents	• Can cause eutrophication or algal bloom. • Nitrates and phosphates are nutrients that plants need for growth. Algae will grow very quickly if there is a high concentration of these nutrients in the water, causing algal blooms. • Too much algae in the water leads to less oxygen for other organisms, less light reaching other plants and can clog the gills of fish.
Oil and Grease (Hydro-carbons)	• Leakage of oil and other lubricating agents from cars and other motorized machines	• There is a wide array of hydrocarbon compounds, some of which are known to be toxic to aquatic life. • More oil comes from storm drain pollution than from oil tanker spills!

Pollutant	Source	Effects
Pathogens (disease causing organisms)	• Can be found in pet and livestock wastes and can move into the water system as a result of run off from lawns and farm fields. • Can get into the water system as a result of faulty septic systems.	• Pathogens include bacteria like E. coli and Salmonella, protozoan parasites like Giardia lamblia (beaver fever), and viruses like Norwalk. • They can cause illnesses in humans and wildlife.
Pesticides	• Excess herbicides and insecticides from residential and agricultural lands	• Can harm plants, wildlife and humans through chronic low concentration or sudden high concentration exposures. • Effects include: loss in production, changes in growth, development and/or behaviour and death of species. • Cancer, endocrine disruption.
Salts	• Sidewalk and roadway application • Irrigation practices	• Salt dissolves very easily in runoff and can increase the salinity of the local waterbody. In some places, spring runoff can cause the salinity of the local waterbody to reach ocean salinity levels! • Freshwater species of plants and animals are not adapted to the high level of salinity, like saltwater species are, and can be adversely affected. • The dissolved salts are difficult and expensive to remove. • High salinity water may also be corrosive to piping systems.
Sediments	• Includes organic debris, silt and sand from roadways, improperly managed construction sites, crop and forest lands and eroding stream banks	• Can increase turbidity, or the cloudiness of the water, which can clog fish gills, decrease the amount of dissolved oxygen in the water and suffocate trout and other organisms' eggs. • Added sediments can change the course of a river or a stream and damage habitat – it doesn't take much sediment to do this!

What can we do?

We can help improve storm water management in a number of ways:

- Reduce fertilizer, pesticide and insecticide use on gardens and lawns
- Don't dispose of used oil or grease down storm water drains, and clean up spilled brake fluid, oil, grease and antifreeze, i.e. do not hose them into the street where they can eventually reach local streams and lakes.
- Don't wash your car where the detergent water can run into the storm water drains
- Keep litter, pet wastes, leaves and debris out of the street gutters and storm drains
- Control soil erosion on your property by planting ground cover and stabilizing erosion-prone areas[6].

Water Cycle Overview

Precipitation that falls on the Earth's surface forms from condensation when water vapour in the air cools and condenses into drops of liquid water or ice crystals. Some of this precipitation infiltrates the ground and becomes part of the groundwater; some is intercepted by plants or by human structures while the remainder runs off the land as surface water. Water returns to the atmosphere through the combined processes of evaporation and transpiration through plants[7].

Approximately 97 percent of the Earth's total supply of water is found in the oceans. The remaining 3 percent is fresh water, which is mostly unavailable for use by plants, humans and other animals. Most of this water is either frozen in glaciers or polar ice caps or located deep beneath the Earth's surface where it is not economically feasible to extract. This leaves only 0.5% of the Earth's total water supply available as fresh water from rivers, lakes or underground aquifers.

- Our only source of 'new' water is bits of comet that melt as they enter our atmosphere... who has seen one of those lately??? Most of the water on Earth has been around in one form or another since the beginning of time which means, in a sense, we've been drinking the same water that was contained in the dinosaurs' pee!

Where does our drinking water come from?

Most cities of fewer than 5,000 people get their drinking water by drilling wells into groundwater supplies. Larger cities obtain their water from surface waters such as rivers and lakes. Cities that rely on rivers as a source usually dam the river. The average Canadian uses about 335 litres of water per day[8].

Treatment of Water Before it Reaches our Homes

Our public water systems supply cities with water. Since most water sources are not pure, water is treated before it reaches our homes.
Three processes are involved in water treatment.

1. **coagulation and settling**: mixing water with chemical coagulants to allow bacteria, mud and other impurities to stick to the chemicals and settle at the bottom.
2. **filtration**: water is passed through a filter or screen to trap particles
3. **disinfection**: chlorine and other chemicals are added to kill remaining bacteria.

Once drinking water is treated, the water flows to a pumping station where it is pumped through large water mains to homes, businesses, schools, etc.[9]

ACTIVITY 7: WHAT ABOUT OUR LOCAL WATERWAYS?

Before the Lesson (optional)

If possible, ask students to be on the look-out for bodies of water and access points to water in their local community (e.g. storm drains, wetlands, bridges or overpasses, ponds, creeks, rivers and lakes… etc.) Ask students to make any observations they can about the bodies of water and/or access points (e.g. Who is living there? Are there things that shouldn't be there? etc.) Photos of local water ways would be fantastic!

Materials

- ✓ Large pieces of paper
- ✓ markers, glue sticks, scissors, etc.
- ✓ Old magazines that have interesting photos in them (optional)

During Class Time

1. Ask students to share any observations that they made concerning local bodies of water (see note above). Generate a list of concerns about local threats to local bodies of water (for example, municipal workers and/or residents may mow grasses and reeds right to the water's edge of a creek. When this happens, the plants and animals that live in the water loses their natural barrier from human and animal intrusion as well as their food and shade sources. Provide each student with a large piece of paper (preferably something that has been used on one side or newsprint which was made from recycled paper). In a small box (or other shape) in the centre of the paper, ask each student to draw a picture of a body of water that they have visited and enjoyed. If students cannot think of one, challenge them to think of ditches, puddles, creeks, lakes, oceans…anything! If they are really stuck, they can imagine a place.
2. Show your students an example of a mind map and provide some explicit instructions. (for tips and examples, see the summative assessment activity in the techloop resource at www.techloop.ca)
3. Around the picture, have students develop a mind map with pictures that depict connections such as:
    - What else would you like to do in the water (e.g. swim, paddle a kayak, look for insects and fish, go windsurfing, etc.)?
    - Who else uses that water?
    - Sources of pollution
        - Obvious sources
        - Less noticeable/further away sources (eg soaps, fertilizers, etc. that we use on our lawns and in our driveways for more information, see the Yellow Fish Road kit at www.ecoleague.ca^¸)
    - What are the consequences of polluting the water?
        - For humans?
        - For other animals?
        - For plants?
4. Regarding consequences, encourage students to ask 'so what' regarding each consequence and to be explicit about why they do or do not care about the consequence. Ask them to depict these thoughts on their concept map.
5. Invite students to hang up their pictures. Make sure that they are all saved as they will be needed for an activity after the clean up.

APPENDIX B: SUMMARY NOTES – WHY CARE ABOUT WATER

Roughly 70% of the Earth's surface is covered with water but most of this is salt water. Only 3% is fresh water and most of that is frozen in polar ice caps and glaciers. Less than 1% of all the water on Earth is "usable water," the water that we depend on for our needs[10].

- We use water in many ways: for drinking, bathing and recreational activities such as swimming, etc.
- A common misconception amongst Canadians is that we all have an abundance of clean drinking water.
- Water is an integral part of our web of ecosystems, necessary for wildlife and plants.
- Water serves as habitat for aquatic wildlife.
- We need water to grow our food.
- It is important for students to start thinking about water issues so that they can shift their habits and change the way they use water and dispose of waste.

APPENDIX C: ACTION PROJECT PLANNING NOTES

- Groups of 2-3 students (4 max)
- Pre-emptive calls home as soon as it appears that an individual is not working well
- Checklists to track reflection completion each day
- Class list form to observe students work in groups
- Keep file folders in classroom for groups to keep documents etc. so that groups can continue to work if anyone is absent
- Formative assessment:
    - need to give feedback on reflection logs and action plan before end of project.
- Summative assessment:
    - Need to give summative assessment on project 1 in timely way to prepare students for project

APPENDIX D: ADDITIONAL RESOURCES

Me to We Teacher Resources: http://metowe.org/the-book/educator-resources.html

Take Action! A Guide to Active Citizenship By Craig Kielburger and Marc Kielburger

Active Citizenship: Student Action Projects Roland Case, Cliff Falk, Neil Smith and Walt Werner

Caring for Young People's Rights Editor: Roland Case

Taking it Global Action Guide http://www.takingitglobal.org/action/guide/Guide_to_Action.pdf

Amnesty International Activist Toolkit http://www.amnestyusa.org/activist_toolkit/index.html

Poverty toolkit

http://www.planusa.org/stuff/contentmgr/files/9776c545adaa1bed1f02966645829755/miscdocs/poverty_toolkit_final.pdf

Millennium Campaign - http://www.millenniumcampaign.org

Youth United for Global Action - http://www.planusa.org/contentmgr/showdetails.php/id/2166

Freechild Project - http://www.freechild.org/

Making a Commitment Matter Toolkit UN - http://www.un.org/esa/socdev/unyin/documents/toolkit.pdf

World Youth Congress Toolkit - http://www.scotland2005.com/wyc/files/Actiontoolkit.pdf

Peace Child - http://www.peacechild.org/

APPENDIX E: ADDITIONAL ACTIVITIES

Activity Pollutants, Health and Wildlife

NOTE: Insist that all students wear safety goggles! Please follow the general safety guidelines described at: http://www.education.gov.ab.ca/k_12/curriculum/bySubject/science/screport.pdf
Some of the materials suggested here are extremely dangerous. FOR DANGEROUS SUBSTANCES, USE EMPTY CONTAINERS OF THE MATERIALS OR FAKE CONTAINERS WITH THE LABEL FROM THE ORIGINAL CONTAINERS.

Description

Students will investigate different types of hazardous products by rotating through hands-on stations in the classroom. Web sites will be used to learn about proper waste disposal methods and the potential dangers of improper disposal.

Materials

- ✓ Internet access
- ✓ Some of these hazardous household products: tile cleaner, ammonia, oven cleaner, drain opener, batteries, mothballs, wiper fluid, antifreeze, furniture polish, paint, varnish, gasoline, pesticides, etc.
- ✓ Some of these natural items: citrus fruits, vinegar, borax, baking soda.
- ✓ Safety goggles

PREPARATION:

- ✓ Collect materials.
- ✓ Set-up five stations with 3-4 items at each (at least 1 hazardous product and 1 natural); Draw Table 1 on the board.

1. Discuss safe handling of the materials and the importance of safety goggles.
2. Ask students, “What are hazardous household products?” (“Hazardous household products are items we use in our home that are dangerous and harmful to humans, plants and/or animals.”)
3. Have students read the information on the following University of Missouri website: http://extension.missouri.edu/xplor/wasteman/wm6003.htm so that they can answer the following questions:
   - What makes products hazardous? Please explain your response in simple terms, i.e. some products can easily catch on fire, etc.
   - What type of words and/or symbols are found on products to let people know that they are harmful?
   - Where might hazardous products be found in the home?
4. Explain that many things we use at home are pollutants because they can be harmful in certain quantities. Brainstorm a few examples (please refer to **Appendix A - Figure 1**) of hazardous products that students think they have at home.

5. Create five stations around the room that include at least three items at each station. Ensure that each station has at least one hazardous product in it and at least one natural product (refer to the materials list).

6. Have groups of students cycle through each station. Ask students to complete the appropriate parts of the chart below at each station that they visit.

Station #	Substance	All possible uses for substance	Hazardous (H) or not hazardous (NH)?	Questions about the substance
1	mothballs			
	lemon juice			
2				
3				
4				
5				

7. Tell students that, with the help of an adult, they will need to conduct surveys of the hazardous materials in their homes (for students who cannot get an adult to help them, you may wish to provide an alternate task [for example, internet research] Tell the students that you would like them to collect the following data:
   - types of hazardous materials
   - symbols/words that indicate that it is hazardous
   - purpose of material (why do you have it at your house)
   - possible alternatives

   In class, ask students to create a chart to collect their home audit data (they can look at the one from the class hazardous materials activity found above). Have students compare their 'empty' charts with a partner to ensure that the chart will be suitable for data collection. Assign a date for the surveys to be completed.

8. When students return to class with their completed surveys, have them think about how to organize a large class chart of the data. Discuss. Compile their data.

9. Assign each group a pollutant from the class list, i.e. detergent, pesticides, insecticides, oil, etc. Have the group research and prepare a pamphlet, poster, TV commercial or skit that includes:
   - The proper/safe disposal method for this product
   - Consequences of improper disposal
   - Ways that people, wildlife and other parts of the ecosystem can be affected by these products
   - What chemicals/pollutant is in the products
   - Alternative products to use and ways to use less of this product at home.

Adapted by LSF from National Geographic Expeditions Lesson Plan
http://www.nationalgeographic.com/xpeditions/lessons/14/g912/tghazardous.html

ENDNOTES

[1] Yellow Fish Road™ Program Procedures Manual, Trout Unlimited Canada, 2004. pg. 1.

[2] Yellow Fish Road™ Program Procedures Manual, Trout Unlimited Canada, 2004. pg. 1.

[3] Yellow Fish Road™ Program Procedures Manual, Trout Unlimited Canada, 2004. pg. 2.

[4] Yellow Fish Road™ Program Procedures Manual, Trout Unlimited Canada, 2004. pg. 2.

[5] Yellow Fish Road™ Program Procedures Manual, Trout Unlimited Canada, 2004. pg. 3.

[6] The Truth about H2O: Teaching Guide http://www.teachingtools.com/H2O/stormwaterMngt.htm

[7] O'Connor, Maura and Kathy McGlauflin (1992). Living Lightly in the City. Milwaukee: Schlitz Audubon Center. pg. 146.

[8] Environment Canada. Did you know? Retrieved April 12th, 2007, http://www.ec.gc.ca/water/en/manage/use/e_facts.htm

[9] O'Connor, Maura and Kathy McGlauflin (1992). Living Lightly in the City. Milwaukee: Schlitz Audubon Center. pg. 150.

[10] MacMillan, Susan. Water: The Source of Life. Summer Institute, 2001. pg. 14.