After the Drain
Wastewater Treatment & Constructed Wetlands
Pre Water Festival or Independent Lesson

Students develop an understanding of the wastewater treatment plant process in a fun interactive way, as well as an alternative way of wastewater treatment being a constructed wetland. Students will then discuss the similarities and differences between a wastewater treatment plant and constructed wetland.

At a Glance

Grade Level: 5
Learning Environment: Classroom
Prep Time: 10 minutes
Length of Lesson: 45 minutes
Key Vocabulary: Waterways, biota, aeration, bacteria, settling tanks, ultraviolet light, pollutants, containments, heavy metals, settlements, biofilter, nutrients, biological
Staffing: 1 educator
Materials:
- Photo copied sheets for students
- Pencil
- Pencil crayons/markers
- 10 cue cards with the following terms written on them: sink, toilet, washing machine, bar screens, wastewater treatment plant, grit chamber, settling tanks, aeration tanks, filtered, waterways
- 2 images ready to show students: 2 constructed wetland images
- Overhead copy of blank Activity # 2 Create Your Own Constructed Wetland sheet

Groupings: Groups of 10, Individual
Teaching/Learning Strategies:
- Presentation, reading, discussion, individual problem solving

Connect with the Georgian Bay Biosphere

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Georgian Bay Biosphere: Lesson in a Backpack Program
Lesson Outline

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<td>Wastewater Treatment Plant Process</td>
<td>Classroom</td>
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<td>20 minutes</td>
<td>Create Your Own Constructed Wetland</td>
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Curriculum Expectations

Understanding Life Systems: Human Organ Systems

*Overall Expectations*
Analyse the impact of human activities and technological innovations on human health.

*Specific Expectations*
1.1 Assess the effects of social and environmental factors on human health. Propose ways in which individuals can reduce the harmful effects of these factors and take advantage of beneficial factors instead. Assess human impacts on biodiversity and identify ways of preserving biodiversity.

Understanding Structures and Mechanisms: Forces Acting on Structures and Mechanisms

*Overall Expectations*
1. Analyse social and environmental impacts of forces acting on structures and mechanisms

*Specific Expectations*
1.2 Evaluate the impact of society and the environment on structures and mechanisms, taking different perspectives into account and suggest ways in which structures and mechanisms can be modified to best achieve social and environmental objectives.

Understanding Matter and Energy: Properties of and Changes in Matter

*Overall Expectations*
1. Evaluate the social and environmental impacts of processes used to make everyday products

*Specific Expectations*
1.1 Evaluate the environmental impacts of processes that change one product into another product through physical or chemical changes
1.2 Assess the social and environmental impact of using processes that rely on chemical changes to produce consumer products, taking different perspectives into account and make a case for maintaining the current level of use of the product or for reducing it.

Understanding Earth and Space Systems: Conservation of Energy and Resources

*Overall Expectations*
1. Analyse the immediate and long-term effects of energy and resource use on society and the environment, and evaluate options for conserving energy and resources

*Specific Expectations*
1.1 Analyse the long-term impacts on society and the environment of human uses of energy and natural resources, and suggest ways to reduce these impacts
1.2 Evaluate the effects of various technologies on energy consumption and propose ways in which individuals can improve energy conservation
Background

Wastewater needs to be treated before being returned to the environment and this is done in different ways across the province and country. Commonly, local municipalities create water treatment plants to address wastewater treatment needs.

In a treatment facility, the influent wastewater first passes through a bar screen to remove large objects carried in the sewage stream. This is commonly done with an automated raked bar screen in modern plants serving large populations, while in smaller or older plants, a manually cleaned screen may be used. Then the water flows into a grit channel or chamber, where the velocity of the incoming sewage is adjusted to allow the settlement of sand, grit, stones, and broken glass. The water is then sent to secondary treatment where basins temporarily hold incoming sewage during plant maintenance and thin and distribute discharges of toxic or high-strength waste. The water is then treated using a process called aerobic biological processes. To be effective, the bacteria require oxygen and food to live. The bacteria consume organic contaminants (e.g. sugars, fats, organic short-chain carbon molecules, etc.) and bind the less soluble materials into a loosely clumped mass. The process can be broken down further into filtering or disinfecting with chlorine or ultraviolet light to ensure containments are removed. The treated sewage is usually pumped into a large body of water, such as a nearby river or lake.

Constructed wetlands can be defined as a “cleaner” way of filtering out pollutants/contaminates; clean meaning more environmentally friendly by naturally filtering out pollutants. Wetlands naturally act as a filter, removing sediments and pollutants from water, and constructed wetlands can be designed to mimic these features. Surface-flow wetlands, copy naturally occurring processes in marshes or swamps. As the waste moves above the soil the particles in the waste settle, pathogens are destroyed and nutrients are used by plants and organisms. Constructed wetlands possess a rich bacterial community to affect the biochemical (chemical substances and their processes in living organisms) transformation of pollutants. Constructed wetlands are biologically productive, and they are self-sustaining.

A constructed wetland at Fleming College, Lindsay ON

Photo Credit: Fleming College
Part A. Wastewater Treatment Plant Process

1. Hand out the Wastewater Treatment Plant Process worksheet.

2. Discuss what a wastewater treatment plant is and where your local water supply comes from as well as why water treatment is important as well as why water protection is so important.

3. Play How Do Wastewater Treatment Plants Work? www.youtube.com/watch?v=FvPakzqM3h8
   Ask students to listen carefully and fill out the worksheet during the video (stop the video at 2:31. Play the video again if the majority of the class missed blanks

4. Break the class into groups of 10, ask the students to arrange themselves into the correct order of the wastewater treatment process from the video using the 10 cards (each card naming one step of the wastewater treatment process).

5. After everyone is in the right spot in the process, they must come up with a sound and action that represents their word.

Part B. Create Your Own Constructed Wetland

1. Hand out the Create Your Own Constructed Wetland worksheet.

2. Display the images of the constructed wetlands on either an overhead slide or on a computer projector screen. Have students brainstorm what they might be looking at. Display the image with the blanks for each step/component within the constructed wetlands on the screen. Involve the students in answering/guessing what each step is and in filling in the blank for each while referring to the sheet constructed answer wetland

3. Have students draw their own plants and colour in the sections of the constructed wetland as well as the sun, pollinator’s ext.

4. When the two activities are complete, have a discussion with the students about the similarities and differences between a wastewater treatment plant vs a constructed wetland. Hang student’s constructed wetland designs around the classroom for classmates to see each other’s work.
1. What is a watershed?
____________________________________________________________________________

2. Why do you think that the protection of watersheds is so important?
____________________________________________________________________________

3. Listen closely to the video Wastewater Treatment and answer the following questions on the steps of a wastewater treatment plant:
Step 1.) Name the three places where wastewater comes from?
________________________________
________________________________
________________________________
Step 2.)_____________________________ block large materials from passing through.
Step 3.) Where does the water go next?
____________________________________________________________________________
Step 4.) Grit material is settled and removed here_____________________________________________
Step 5.) Sludge that float or sink get removed and treated else where later in ______________________ tanks.
Step 6.) Air is forced into water here
___________________________________________________
Step 7.) Microorganisms_______________________up the organic material in the wastewater. They help breakdown the solids so they can move to the solids treatment plant.
Step 8.) The wastewater then goes to the ____________________________tanks.
Step 9.) The treated water then can go onto to be______________________, disinfected with chlorine and ultraviolet light.
Step 10.) The treated wastewater is then sent into different _____________________ways (Lakes and rivers).
Activity # 1: Wastewater Treatment Plant Process **ANSWER SHEET**

1. What is a watershed?
- An area that holds qualities of water and drains into lakes, rivers, streams, marshes and groundwater

2. Why do you think that the protection of watersheds is so important?
- Water to live and protect our aquatic habitats/ecosystems (fish communities, plant life, turtles etc.)

3. Listen closely to the video Wastewater Treatment and answer the following questions on the steps of a wastewater treatment plant:

   Step 1.) Name the three places where wastewater comes from? (Step 1)
   - toilet
   - sink
   - washing machine

   Step 2.) Bar screens block large materials from passing through.

   Step 3.) Where does the water go next? Sewage treatment plant

   Step 4.) Grit material is settled and removed here - grit chamber

   Step 5.) Sludge that float or sink get removed and treated else where later in settling tanks.

   Step 6.) Air is forced into water here aeration tanks

   Step 7.) Microorganisms eat up the organic material in the wastewater. They help breakdown the solids so they can move to the solids treatment plant.

   Step 8.) The wastewater then goes to the settling tanks.

   Step 9.) The treated water then can go onto to be filtered, disinfected with chlorine and ultraviolet light.

   Step 10.) The treated wastewater is then sent into different waterways (Lakes and rivers).
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Activity #2: Create Your Own Constructed Wetland