

Grade 8 Lesson Outline

Lesson Title: All About Treatment	Duration: 40 minutes
Introduction:	
In this lesson, students will learn how our drinking water and wastewater are treated in the Region of Peel. Students will also learn more about their water footprint and water choices around the world. This will help understand why conserving water is a necessity	
How to use this resource:	
Refer to the list below for all resources required for this lesson: <ul style="list-style-type: none">• Grade 8 – Presentation PPT includes all slides, speaking notes and video links required for the lesson• All About Treatment worksheet where students match the stages of water and wastewater treatment with definitions• Home Water Audit worksheet where students will track how much water is being used at home• Water Conservation Challenge worksheet where students look for leaks and ways to conserve water at home Print the following files before you begin the lesson: <ol style="list-style-type: none">1. All About Treatment worksheet (1 per student)2. Home Water Audit optional worksheet (1 per student)3. Water Conservation Challenge optional worksheet (1 per student) **Audit will need more than 1 period to complete	
Key Messages:	
<ul style="list-style-type: none">• How water moves through cycles• The important services that water treatment plants provides that keeps our water safe and healthy for everyone• We need to save water, so it stays clean for everyone in the community and the environment• Water footprints and learn how much water is used for every day stuff	
Key Topics:	
<ul style="list-style-type: none">• Water Treatment• Wastewater Treatment• Water Quality• Water Conservation• Water Footprint (Physical versus Virtual Water)	
Curriculum Connections:	
For a complete list of curriculum connections, refer to the Curriculum Connections for Grade 8	
Science & Technology:	
Understanding Structures & Mechanisms: Systems in Action	
<ul style="list-style-type: none">• 1.1	
Understanding Structures & Mechanisms: Fluids	
<ul style="list-style-type: none">• 1.2	
Understanding Structures & Mechanisms: Water Systems	

- 1.1, 1.2 & 1.3

Lesson Outline:

Slide 2: The Region of Peel

- Ask students – what city or town do they live in?
 - Region of Peel includes the Town of Caledon and 2 cities – City of Brampton and City of Mississauga
 - The Region of Peel is a level of municipal government and some of the programs and services that the Region of Peel provides to our communities includes:
 - Recycling and Waste collections and disposal
 - Maintenance of regional roads, including snowploughing in the winter and paving in the summer
 - Health services
 - Ambulance services
 - Peel Regional Police and services and
 - **Peel Region also provides you with clean, safe drinking water and wastewater treatment**
 - Peel has a population of 1.51 million people, that make up this vibrant community where people live, work and play
- Region of Peel has 2 water treatment plants in Mississauga, 2 Water resource recovery facilities, 2 for South Peel, and 15 municipal wells that treat water that we use daily
 - Most of these plants are located in Mississauga, close to Lake Ontario as it allows the Region to treat and clean water faster and more efficiently.

Discussion Questions:

- Think about how we use water in our every day lives
- Water footprint – what do you think this term means?
 - Have students discuss their ideas in groups or in a classroom discussion
 - This will be covered later in the lesson
- This short video coming up next, will look at how the Region of Peel invests in water. Listen for some interesting facts on water to share as a class after watching the video

Slide 3: Video

- Video: Investing in Water
<https://www.youtube.com/watch?v=XMr0JqGOX0A>
- Length of video: 1.46 minutes

Did you know?

- Did you know that the Region of Peel has over 200 staff who treat and maintain our water to make sure every time you turn on the tap, the water is fresh and healthy to drink?
- And every time you flush your toilets, or take a shower, these dedicated staff also work to make sure that dirty water gets cleaned before putting it back to the lake
 - They work to make sure all our water gets treated for everyone, 1.51 million people living and working in Peel
 - Every day the Region of Peel treats 570 million litres of water
 - That's enough fill 228 Olympic sized swimming pools
- Region of Peel is committed to 'Providing Clean Water for Life'

Slide 4: Water Cycle

- Review the water cycle with the students
 - Where do we in the Region of Peel get our water from?
 - Brampton, Mississauga and Bolton get water from the Lake. Other people who live in Caledon get water from wells, either on their own property, or municipal wells that are owned by the Region
 - Water from Lake Ontario is fresh, which means that the water is not salty like the water in oceans and seas
- The water cycle is a continuous circulation of water from rivers, lakes and oceans into the atmosphere onto the land and back
 - **Sun:** the source of energy that drives the whole cycle
 - **Lake Ontario:** this is our water source
 - **Evaporation:** the sun heats up the water in lakes, rivers and oceans and turns it onto vapour
 - **Condensation:** water vapour in the air gets cold and changes back into liquid form
 - **Precipitation:** the clouds get heavy and water falls back to the earth in the form of rain, hail, sleet or snow
 - **Runoff:** moves water across land and makes its way to the nearest body of water such as a lake
- **This process is called the natural water cycle. But humans also change the path of water**

Slide 5: Human Water Cycle

Introduction to Human Water Cycle:

- **Ask:** Has anyone ever heard about the human water cycle? What could this be all about?
 - Have students share their thoughts
- **Ask:** What happens when we use water to brush our teeth, shower, go the bathroom – where does it go?
- **Ask:** Do we send it directly to the Lake?
 - **Answer:** NO
 - NO! Why not?
 - Have students share their responses (i.e. water is dirty, not treated, has pet waste, trash in the water, bacteria and germs)
 - The water in Lake Ontario might have bacteria, viruses, and germs in it. All those things could make us very sick if not treated.
- That is why we have to send the water to get treated so it can be cleaned and made safe for us to drink. The dirty water travels through underground pipes and gets treated again at our wastewater plant before we return it back to Lake Ontario
- The next few slides will cover how we treat our water and wastewater

Slide 6: Video

This short video will show footage of the Arthur P. Kennedy water treatment plant
Before watching the short video, discuss with students what is the purpose of a water treatment plant?

- Video: Peel's tap water from the Arthur P. Kennedy water treatment plant
<https://www.youtube.com/watch?v=J9wY-qMrqZg>
- Length of video: 0.48 seconds

Discussion points after watching the video:

- That Arthur P. Kennedy Plant can treat up to 1.2 billion litres per day
- Every day the Region of Peel treats 570 million litres per day
- In the year, 2041 another 21 years from now, it is estimated that almost 2 million people will live in Peel. That means we will have to continue treating water for even more people in Peel, a task that the Region takes great pride in doing.

Discussion Questions:

- Do you think the Region of Peel can treat water for 2 million people?
- Explain your reasoning?
 - **Answer:** Yes, the Region of Peel can treat up to 1.2 billion litres per day. There's always room for more capacity to treat water per day. Forecasting for future population growth is something that the Region of Peel plans for
- Region of Peel is committed to providing safe and reliable drinking water to everyone

Slide 7: Water Treatment

- Introduction to Water Treatment
 - Have students complete the 'All About Treatment' worksheet while watching Barry's Water Treatment Tour video

Answer Key: All About Treatment - Water Treatment

A) OMB2 B) Raw Intake Pipe C) Ozone D) BACC E) UV F) Membrane Filtration G) Lab Testing H) Chlorine I) Fluoride J) Drinking water must be kept...

Slide 8: Video

This video will highlight the stages of water treatment

- Barry's Water Treatment Tour
<https://www.youtube.com/watch?v=xc4zoS9EgY4>
- Length of video: 6:07 minutes

Slide 9: Arthur P. Kennedy Water Treatment Schematic (Optional Slide)

For further review of Water Treatment, this slide will cover the schematic

- If you wish not to proceed with this slide, please right click the slide in PPT, and select 'Hide Slide' before the lesson

Stages of Water Treatment

At Arthur P. Kennedy Water Treatment Plant, there are 3 separate and different water treatment plants (Conventional, OBM and OBM2, **but we will focus on OMB2**)

- **1. Water source is Lake Ontario:** A large intake pipe extends 2km out into Lake Ontario. The intake pipe is so big, you could drive an SUV inside it. This is how we get water from the Lake to get treated.
- **2. Travelling Screens:** Large rotating mechanical screens remove materials such as branches, fish, garbage, and zebra mussels
- **3. Low Lift Pumps:** brings water into the facility from the Lake to begin the stages of treating water
- **4. Liquid Oxygen:** Ozone is used to disinfect the water. Ozone gas is unstable and therefore cannot be transported, so Ozone is generated on site from liquid oxygen and electricity
- **5. Ozone Generator:** we use a process called electrolysis to convert O₂ to O₃ where an electrical current is passed through the oxygen to create ozone gas.
- **6. Ozone Contactors:** The ozone is bubbled through the water in ozone contactors. Ozone kills the bacteria and breaks down large particles

- **7. BACC – Biologically Activated Carbon Contactors:** after ozone, the water passes through the BACC. Here removal of organic materials from water takes place
- **8. UV – Ultraviolet Light:** is where filtered water passes through a lighting unit which uses the UV rays to inactivate microorganisms like bacteria, so they can't make people sick, or be able to reproduce their DNA
- **9. Membrane Filters:** is an ultra-filtration membrane system. During this stage, removal of small particles and microorganisms takes place
- **10. Weir Chamber:** Filtered water is directed to the weir box where water is stored and is also the location where chlorine and fluoride are added. Chlorine is used to disinfect bacteria and Fluoride is added for dental health
- **11. Storage Reservoir:** treated water flows by gravity into the water storage reservoirs
- **12. High Lift Pumps:** treated water leaves the reservoir by way of high lift pumps and enters the distribution system.
- **13. Distribution System:** before treated water reaches our homes, schools and businesses in Peel, water is sampled from various stages of the treatment process. Water is sampled 4 times a day, for over 150 parameters and sent to an independent laboratory for testing. These laboratories must be certified by the Ministry of Environment. Treated water flows by gravity into the water storage reservoir. Total time for water treatment is 2-3 hours.

Slide 10: Video

This short video will show footage of the GE Booth wastewater treatment plant

- Video: How the Region of Peel cleans your wastewater
<https://www.youtube.com/watch?v=4uxYZdnxuz8&feature=youtu.be>

Length of video: 1.11 minutes

Discussion Questions before watching the video:

- What do you already know about wastewater treatment?
 - Looking back historically with human settlements expanding, water treatment was something that rarely existed, and this is why we treat water
 - Historically, major factors including settlements, agricultural practices, garbage, water pollution and even raw sewage being dumped directly into the lake or street, were things that got overlooked. But it caused major concerns for the environment and even resulted in sickness and death due from lack of water treatment
 - Think of all the communities near bodies of water, animal life and plants
 - If wastewater that is used never got treated, would you enjoy living around this body of water, go for a swim, enjoy a boat ride, or go fishing in water that is full of stuff we poured or flushed down from our home?
 - If time permits, or if students are interested on this topic, have them research water treatment from the past. This can be completed during another period.

Did you know?

- The Region of Peel treats 518 million litres of wastewater per day
- That's enough water to fill 200 Olympic sized swimming pools

Slide 11: Wastewater Treatment

Introduction to Wastewater Treatment

- Have students complete the 'All About Treatment' worksheet while watching Barry's Wastewater Tour

Answer Key: All About Treatment – Wastewater Treatment

A) Municipal waste B) Headworks C) Primary Settling Tanks D) Aeration Tanks E) Secondary Clarifiers
F) Chlorination & Dechlorination G) Biosolids H) Anaerobic Digesters I) Ash Lagoons J) Final Outfall

Slide 12: Video

This video will highlight the stages of wastewater treatment

- Barry's Wastewater Treatment Tour
<https://www.youtube.com/watch?v=vC42YTIjxpM>
- Length of video: 8:16 minutes

Slide 13: Clarkson Wastewater Plant Schematic (Optional)

For further review of Wastewater Treatment, this slide will cover the schematic

If you wish not to proceed with this slide, please right click the slide in PPT, and select 'Hide Slide' before the lesson

Stages of Wastewater Treatment at Clarkson

- **1. Raw Sewage:** all the water that gets poured down the drains at homes, schools, and businesses in Peel will eventually end up at our wastewater treatment plant. The Region of Peel has 2 wastewater treatment plants – Clarkson and GE Booth Wastewater Treatment Plants
- **2. Mechanical Screens:** large material is caught by the mechanical screens. Things like rags, sticks, food particles, bones, plastic, stones, wipes get removed
- **3. Vortex Chamber:** removes all the grit by spinning and creating a vortex. Grit is removed because it causes wear on the pumps at the facility, also clogs pipes and takes up room in the digestion process
- **4. Grit Removal:** trucks will haul the grit and screenings to landfill
- **5. Primary Treatment:** wastewater travels to these tanks. Heavy things (sludge) sink to the bottom, and lighter things (scum) float to the top. The sludge and scum are pumped to the Biosolids facility for treatment and disposal
- **6. Aeration Tanks:** the remaining water (effluent) flows by gravity to the aeration tanks. Oxygen is pumped into the tank which allows good bacteria to live and grow. The good bacteria eat the waste, our poop
- **7. Phosphorous Removal:** During this stage, removal of nutrients such as phosphorous from the wastewater takes place.
- **8. Secondary Clarifiers:** The wastewater, along with microorganisms flows into secondary clarifiers where 90% of the solids settle to the bottom. The remaining water flows over weirs. The wastewater is now very clear. A portion of the sludge is pumped back to the aeration tanks
- **9. Anaerobic Digesters:** sludge enters into a digester, where the tank is completely void of oxygen. The tank breaks down complex organic material into smaller compounds. This process takes 24 hours and reduces the volume of sludge in the tanks producing liquids and gasses
- **10. Gas Storage:** methane is collected through stacks at the top of the digesters and is sent to the flaring buildings (dome). The methane gas generates electricity to power the plant
- **11. Dewatering Centrifuges:** the digested sludge contains liquid and only 2% solids are in the sludge, so it gets dewatered and thickened using a centrifuge to aim for 30% solids, similar to a cake batter
- **12. Cake Storage Hoppers:** where the thickened solids get stored
- **13. Truck hauls biosolids:** to GE Booth for incineration
- **14. Chlorination:** Sodium Hypochlorite is added to the secondary clarifier to kill any remaining bacteria and **Dechlorination** Sodium Bisulphite gets added after, since water with chlorine in it cannot be sent to Lake Ontario. Sodium Bisulphite is added to remove the chlorine in the water
- **15. Outfall:** the water is now discharged into Lake Ontario through a pipe 1.88m long, extending 1.5km offshore. The pipe lays 70m below the surface of water

Slide 14: Region of Peel – Water Distribution

How water gets to our schools, homes and businesses

Discussion Questions:

- Ask students if they can spot the difference between the blue and brown lines?
 - **Blue lines:** represents treated water moving from the water treatment plants to our communities
 - **Brown lines:** represents the wastewater travelling downhill from our communities back to the wastewater treatment plant
- Water needs to reach many homes, schools and businesses all across Peel. High lift pumps are used to pump it across the Region, and we need them to be straight for the water pressure to reach all the way to Caledon
- Wastewater lines are curvy as they mimic the lay of the land, which it takes a longer time for all that wastewater to travel to the plant. There isn't a rush to get all the wastewater flowing down all at once to the plant for treatment
- **Ask:** What do you notice about Caledon compared to Brampton and Mississauga?
 - **Answer:** Caledon is rural, and many homes use wells for drinking water

Slide 15: Water Footprint

Cover the difference between physical and virtual water by calculating your own water footprint. Have students watch this short video:

- Where is Water? – The Water Rooms #2
<https://www.youtube.com/watch?v=b1f-G6v3voA>
- Length of video: 6.50 minutes

Discussion Questions after the video:

- How much freshwater is available on earth?
 - **Answer:** 2.5% of the world's water makes up freshwater
- What makes up the total amount of surface water?
 - **Answer:** 1.2%
- What amount of water makes up the agricultural industry?
 - **Answer:** 70%

The next few slides will be an activity for students to calculate their own water footprint

- Each student will need GOOS paper to track their results
- Total of 8 questions

Slide 16: Our Water Footprint – Shower

Question: How many times a week do you shower?

- A) 1-2 times a week (1 point)
- B) 3-4 times a week (2 points)
- C) 5-6 times a week (3 points)
- D) 7 or more times a week (4 points)

Question: How long does your typical shower last?

- A) Less than 5 minutes (1 point)
- B) 5-10 minutes (2 points)
- C) 10-15 minutes (3 points)
- D) More than 15 minutes (4 points)

Slide 17: Our Water Footprint – What We Eat

If you consume red meat, how many times a week do you consume it (e.g. beef, pork)?

- Never (0 points)
- B) 1-2 times a week (1 point)
- C) 3-4 times a week (3 points)
- D) 5 or more times a week (5 points)

Slide 18: Our Water Footprint – What We Drink

Do you drink tap water or bottled water?

- A) Always tap water (1 point)
- B) A mix of both (2 points)
- C) Always bottled water (3 points)

Slide 19: Our Water Footprint – What We Buy

How often do you go shopping for clothes?

- A) Almost never (1 point)
- B) Every couple of months (2 points)
- C) Once a month (2 points)
- D) Once a week (5 points)

Slide 20: Our Water Footprint – What We Watch

How many hours a day do you spend in front of a screen (TV, computer, phone, etc.)?

- A) Less than 1 hour (1 point)
- B) 1-3 hours (2 points)
- C) 3-5 hours (3 points)
- D) More than 5 hours (4 points)

Slide 21: Our Water Footprint – What We Wear

What do you do with your old clothing?

- A) Donate or recycle (0 points)
- B) Use it for rags (1 point)
- C) Throw it away (3 points)

Slide 22: Our Water Footprint – Transportation

How do you usually get to school?

- A) Walk or bike (0 points)
- B) Bus (1 point)
- C) Carpool with friends (3 points)
- D) Get a ride to school (4 points)

Slide 23: Our Water Footprint

Have students tally their results

Physical Water

- Direct uses of water, water that we can use for drinking, showering, washing hands and flushing toilets

Virtual Water

- Non-direct uses of water, water that we can't see, touch, taste or feel, and it makes up a big part of our water footprint
 - We wear water, it takes 8500L of water to make 1 pair of jeans
 - Furniture, houses, cars, roads, all these things we build, also needs water
 - We also spend money on generating electricity with our phones and watching TV which also uses water and
 - Farming uses huge amounts of water and
 - Many other uses of water that we use daily

Below Average:	6-11 points
Average:	12-20 points
Above Average:	21-32 points

Discussion Questions:

- Can anyone guess the average water usage per Canadian?
 - The average water usage **per person per day in Peel is 300L**, and this is physical water, like taking a shower, washing our hands before we eat a meal, but when we consider our virtual water usage, **our average jumps to 4700 L per day!**
 - That's a lot of water! In fact, **Canadians are among the highest consumers of water in the world!**
- If you're above average user, the purpose of this exercise is not to make anyone feel guilty, but to be more aware of how much water you use. Remember that our freshwater we have available is 1.2%. So, it's important that we conserve the water we have for future generations to be able to enjoy.
- What does conserving water look or mean to you?
 - Think about some adjustments in your own life that you can make to help conserve our water?
 - Just a 10-minute shower can use up to 85 L of water
 - Think of water and wastewater treatment and all the energy used to treat water, pump water, heat water in your home and schools
 - Look into comparing water footprints from other areas around the world

Slide 24: Home Water Audit

Watch this short video on how to read your water meter for completing the water audit

- Video: Reading your meter
https://www.youtube.com/watch?time_continue=5&v=xPapGbWk9rs&feature=emb_title
- Length of video: 2.27 minutes

Students will evaluate personal water consumption for an entire week

- Students will track how much water their family uses for an entire week
- Have students share and graph their results with the class

Discussion Questions:

- Look over the data, are there ways to save and conserve water at home?
 - Wash your fruits and vegetables in a pan of water instead of running water from the tap
 - We all love a cold glass of water, keep a pitcher of drinking water in the fridge, instead of running the tap
 - When washing dishes by hand, fill the sink to save water
 - Any surprises during the week that you noticed about your family's water use?
 - Discuss with your family how you can look at ways to save water around the home?
 - Commit to taking shorter showers
 - Using dishwasher with only a full load
 - Create a Water Pledge with your family
 - Write down 2 ways to save water in your home?

Slide 25: Conclusion

End of the lesson, ask students

- What have you learned today about water?

- Have students share their findings
- Share with students that everyone including them, have a part in protecting and conserving water

Extension Activities:

- Looking for ways to extend your learning, check out our extension activities at peelregion.ca/enviroed and [Teach Green in Peel](#)

The Great Stink – London 1858

- If students are interested in learning about historical water and wastewater treatment, they can do more research and learn about this topic <http://www.choleraandthethames.co.uk/cholera-in-london/the-great-stink/>
- Get students to learn how other municipalities treat water
- Have the students also research areas around the world that have no water treatment and learn about these environmental, social and economical impacts

Peel Water Story:

These modules will help develop understanding of local watersheds, water sources, water quality and how these aspects can impact water supply and distribution

<https://www.peelregion.ca/waterstory/>

- Module 1: Lay of the Land
- Module 2: Rain to drain
- Module 3: Taking the plunge