Wastewater Treatment Virtual Tour

Teacher Guide

Region of Peel
working with you

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Introduction

Welcome to Peel's wastewater treatment virtual tour. This resource has been developed to support you as you lead your students through the wastewater treatment process. This guide will provide you with practical suggestions and ideas to support inquiry-based learning, as you explore every stage of the treatment process with your students. The suggested discussion questions and extension activities can be adapted to meet the curriculum expectations for grades 7 to 12. Topics covered include the stages of wastewater treatment and what should and should not be put down the drain at home.

The virtual tour can be used as a stand-alone activity or can kick-start further exploration and learning.

Why a virtual tour?

Children of all ages are naturally curious about what happens to the waste they flush down the drain. Yet, surprisingly few can actually explain that a vast network of underground pipes carry this waste away to be treated and safely returned to Lake Ontario. The Wastewater Treatment Plant Virtual Tour was created to provide students with the information to understand this necessary process and for teachers to have the tools to teach about it. With this virtual tour, both students and teachers have unlimited virtual access to the Region's wastewater treatment process at no cost.

Program Overview

Key Themes:

- Wastewater treatment
- Source water protection
- Human water cycle
- Careers

Learning goals:

At the end of the virtual tour, students will be able to:

- Identify the main stages of wastewater treatment
- Explain the importance of wastewater treatment and source water protection

Technology requirements:

To access the tour, students will need access to a computer lab, tablets or other internet-enabled devices or have shared access to a smart board/projector screen. The tour can be accessed on a smart phone but works best on a large screen.

The virtual tour can be accessed in different internet browsers but is optimized for Google Chrome.

How to use the tour

There are two delivery methods for this tour:

Student self-exploration: Students can access and explore the tour on their own devices while using the provided handout as a guide.

Teacher-led: If there is access to a class smart board/projector screen, the teacher can facilitate the virtual tour, and use this guide and accompanying discussion questions to facilitate class-wide discussions.

We recommend reviewing the optional pre-tour PowerPoint with the class before navigating through the virtual tour. The PowerPoint includes short videos and discussion questions that will help introduce the topic of wastewater treatment. They can be found on our tour website by visiting peelregion.ca/water-education

Navigation

The virtual tour is easy to navigate. There are 11 tour stops (not including the introduction, process map, and closing) and each stop can be navigated to using the left-hand panel of images. You can also navigate between stops by selecting the "past location" and "next location" 

buttons at the bottom of the screen. As you move between stops, a text box will pop-up summarizing the importance of that stage in the tour.

Each tour stop has clickable interactive icons to provide more information and photos.

Button	Purpose
	Additional information
	Video clips

You can use the computer mouse or trackpad to click and drag around each stop for a 360-degree panoramic view. You can also zoom in on areas of the tour for a closer look – simply scroll forward and backwards using your mouse or pinch your laptop trackpad. If you're working from a touch screen, you can move by touching the arrows icons, dragging across the screen to move, and pinching out to zoom in. There is a blue "Navigation" button in the bottom-right corner of the screen that brings up a small process map. An icon identifies your current location, and you can also navigate to a different location by clicking on the blue icons.

Option 1: Student self-exploration

(in-class or virtual learning)

In this option, students navigate through the wastewater treatment tour at their own pace and can use the accompanying handout to guide their learning. Each location may have multiple stages and each stage has a 360-degree view and students are encouraged to explore as much as they can. Each location has clickable interactive icons. These contain additional information, images, videos and online quizzes.

If students are unsure which wastewater treatment stage they are in, they can click the stages on the left-hand side of the screen or click the next or previous buttons on the bottom of the screen. Furthermore, there is a blue "Navigation" button in the bottom-right corner that will open a small map.

Option 2: Teacher-led exploration

(on smartboard/screen)

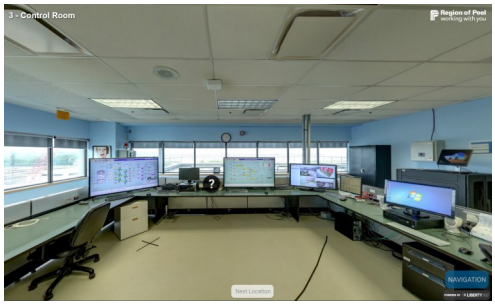
In this option, the teacher leads the class through the virtual tour as a group while using a smart board, computer and projector, or online learning platform.

Below you will find a step-by-step guide for exploring the virtual tour as a group, including speaking notes, a summary of interactive points within the tour and suggested discussion questions.

Control Room

What happens in the Control Room?

The control room is the central location for monitoring and management of the wastewater treatment facility. Operators use a system called SCADA (Supervisory Control and Data Acquisition) to monitor, gather and process real-time data. Water levels in tanks, pressure levels in pipes, and chlorine levels in the effluent are some examples of data shown on the control room screens.



Navigation

There is one interactive icon to help students learn more about the control room. The icon includes images and text.

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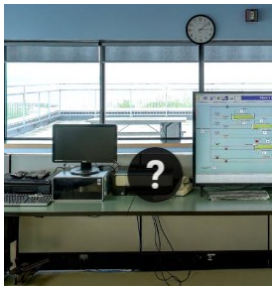


1. Careers: Navigate to the interactive icon to explore career options in the wastewater sector. There are seven images with descriptive captions.

Discussion Questions

Why do you think it's important that people are always monitoring the treatment process?

What education do you think is needed for a career in wastewater treatment?

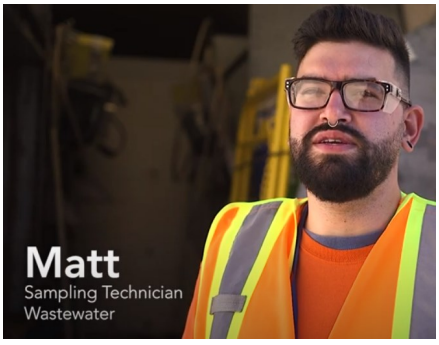
Hint: Monitoring ensures the process is running properly and that the wastewater is being treated correctly.

There are many careers related to wastewater treatment. Many operators pursue a Diploma or Degree in environmental science or engineering before taking their Operator-in-Training exam. You can also dive into a career right out of high school by first passing a written exam and taking an entry-level drinking water operator course, prior to applying for a job! For more career information, check out the Ontario Clean Water Agency website.

Extension Activities

Use this lesson plan to explore careers in water and wastewater with students.

Matt is a sampling technician with the Region of Peel. Watch this video to learn how his role supported the response to the COVID-19 pandemic.

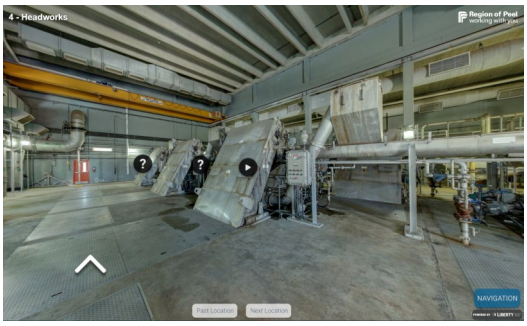


Wastewater testing is an important role for this wastewater technician at the Region of Peel.

Headworks

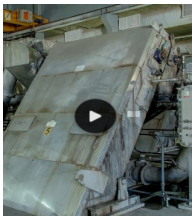
What happens at headworks?

Headworks is where the wastewater first enters the treatment plant. Here, rotating screens remove larger items that could damage or clog downstream equipment. The screened items are removed and sent to landfill for disposal. Grit (and sand) are also removed at headworks to avoid clogging or damaging pipes. A vortex is created in the grit vortex chamber which settles and removes the grit.



Navigation

There are three interactive icons to help students learn more about the headworks. These include videos, images, text, and an online quiz.

1  **2**  **3** 

1. Screens: Click on the interactive icon on the left to learn more about how mechanical screens remove large debris from the wastewater. There are three images with descriptive captions.
2. Quiz: Click on the interactive icon in the middle for a quiz to test your knowledge.
3. Video: Click on the interactive icon on the right to watch an animated video that shows what happens at the headworks.

Discussion Questions

Brainstorm items that may end up in wastewater. Why might they be a problem?

Which of these items do screens help remove and which cannot be screened out?

Hint: Anything other than pee, poo or toilet paper should not go down the drain.

Common items such as dental floss, hair, cotton balls, and food scraps will be screened and removed at headworks. Chemicals poured down the drain including household hazardous waste and pharmaceuticals cannot be physically removed during this phase.

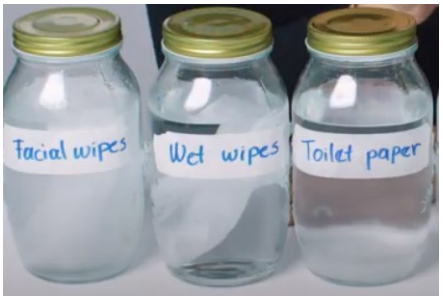
Extension Activities

One of the functions of headworks is the removal of inorganic materials from the wastewater. Explore the concept of biodegradability with the activities below.

Watch this video to see how wipes labelled as flushable can cause serious challenges in the wastewater collection and treatment process.

Do this simple experiment to see this concept in real life:

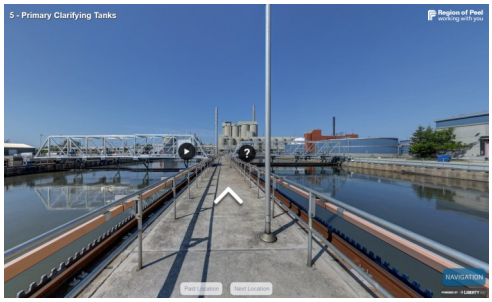
- Add regular toilet paper to one jar and a wipe to a second jar.
- Shake the jars and have the students observe the changes throughout the lesson.
- Discuss their observations.
- Discuss how this can impact wastewater collection and treatment.



Primary Clarifying Tanks

What happens in the Primary Clarifying Tanks?

In the primary clarifying tanks, the wastewater is given time to slow down and settle. Heavier solid materials called sludge sink to the bottom of the tanks while lighter materials (like fats, oils and greases) float to the top. Skimmers remove the layer of scum that forms on the surface and a collection system collects the sludge from the bottom of the tanks. Both the sludge and scum are pumped to the biosolids facility for processing.



Navigation

There are four interactive icons to help students learn more about the primary clarifying tanks. These include videos, images, and text.

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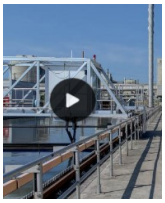

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1. Bridge: Click on the interactive icon on the right of the first screen to see an aerial view of the scum floating on top of the water tanks. The scum will be removed by collectors.
2. Video: Click on the interactive icon on the left of the first screen to watch an animated video of the primary clarifying tanks.
3. Scum: Click on the interactive icon on the left tank in the second screen to learn more about the scum that is floating on the surface.
4. Collector: Click on the interactive icon on the second screen closer to the rails of the tank to see an operator collecting the scum on the surface of the tank.

Discussion Questions

What do you do with used cooking oil in your home? Where should it go?

Hint: Oil should never be poured down the drain. Large amounts of used oil can be dropped off at a Community Recycling Centre. Small amounts of used cooking oil can be collected, cooled and scraped into the organics (green) cart.

Extension Activities

In these tanks the wastewater is given time to settle and separate. **Try this simple experiment** to model this process for students:

- Fill a clear jar with two cups of water
- Add one tablespoon oil and 1/2 cup of soil and stir all the contents
- Discuss observations with students

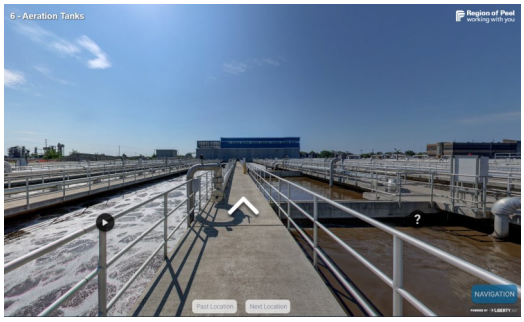
Discussion: Gravity will force the solids in the water to settle to the bottom. The oil will float to the top. This is because water molecules are polar and oils are non-polar. Oils are referred to as hydrophobic which means 'water fearing' and are repelled by water molecules. As a result, when you add oil to a cup of water the two don't mix with each other. In the primary clarifying tanks oil rises to the top and heavier materials sink to the bottom before they are scraped away.

Watch this video to further explain the terms hydrophobic and hydrophilic.

Aeration Tanks

What happens in the Aeration Tanks?

There are still small particles and dissolved organic material in the wastewater that are too small to settle on their own. In the aeration tanks microorganisms (bacteria and protozoa) consume the remaining materials in the wastewater. Diffusers at the bottom of the tanks bubble oxygen through the wastewater which helps the microbes live and grow and complete their role of consuming the remaining nutrients, organic matter and bacteria.



Navigation

There are three interactive icons to help students learn more about the aeration tanks. These include videos, images, and text.

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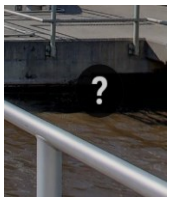

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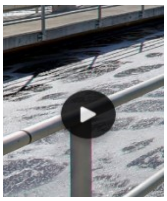

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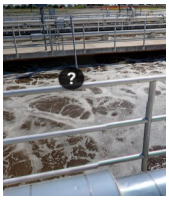


1. Anoxic zone: Click on the interactive icon on the right of the first screen to learn more about the anoxic zone.
2. Video: Click on the interactive icon on the left of the first screen to watch an animated video on the aeration tanks.
3. Bubbles: Click on the interactive icon on the left of the second screen to learn more about the chemical and biological processes that occur in the aeration tanks. This icon contains three images with descriptive captions.

Discussion Questions

Do you think of bacteria as helpful, harmful or both? What are some examples?

What do you think bacteria "eat" to survive?

Hint: There are both harmful and helpful bacteria. For example, in the human digestion system good bacteria are needed to help breakdown organic material in our gut (i.e. the food we consume). But, the presence of harmful bacteria (such as salmonella or H. pylori) can make us sick.

Extension Activities

Watch this video to discuss how bacteria in wastewater play a similar role to bacteria in the human digestion system.

Discuss with students the common characteristics between stomach bacteria and wastewater bacteria.

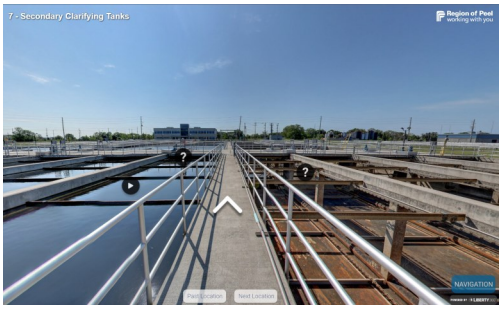
Hint: Some common characteristics include:

- The presence of many different types of bacteria;
- Lactobacillus digest carbohydrates and sugars similar to how bacteria in wastewater consume organic waste;
- Similar to how lactobacillus produce lactic acid as a by-product, bacteria in wastewater also break down organic matter into harmless by-products. For example, in the anoxic zone of the aeration tanks, special bacteria strip the oxygen from nitrate which results in the production of nitrogen gas. The bubbles on the surface are the released nitrogen gas.

Secondary Clarifying Tanks

What happens in the Secondary Clarifying Tanks?

The secondary clarifying tanks are large tanks that slow the wastewater down to allow solids to sink to the bottom of the tank. This settled material forms a sludge layer called activated sludge. This layer is collected by a slow-moving collection system. A portion of the sludge is returned to the aeration tanks to benefit the microbes and the remainder is sent to the anaerobic digesters.



Navigation

There are four interactive icons to help students learn more about the secondary clarifying tanks. These include videos, images, and text.

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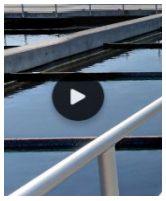

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1. Video: Click on the interactive icon on the left of the first screen closer to the front to watch an animated video of the secondary clarifying tanks.
2. Warm water: Click on the interactive icon on the left of the first screen closer to the rear to learn more about why the water in these tanks is warm.
3. Chain and flight: Click on the interactive icon on the right of the first screen to learn about the scrapers that pull sludge off the bottom of the tanks.
4. Weirs: Click on the interactive icon on the right of the third screen to learn more about the function of the weirs chambers.

Discussion Questions

What are pharmaceuticals? How do they get into wastewater? Why is this a concern?

Hint: Pharmaceuticals are medications that we take into our bodies to prevent disease or relieve pain.

They get into wastewater when people go to the bathroom, or when people flush leftover medicine or pills down the toilet. This can cause lots of different chemicals to enter the water that the plant isn't designed to remove. These chemicals will then enter the environment and affect organisms such as fish and vegetation.

Extension Activities

Watch this video and have students discuss what they learned and share other objects or substances they may have in their own home that they should never flush down the toilet.

Hint: There are some things that will clog your plumbing or even become very difficult to filter out at the wastewater plant. For example, baby wipes and food grease can clump together and form "fatbergs" that cause blockages and are very costly to remove.

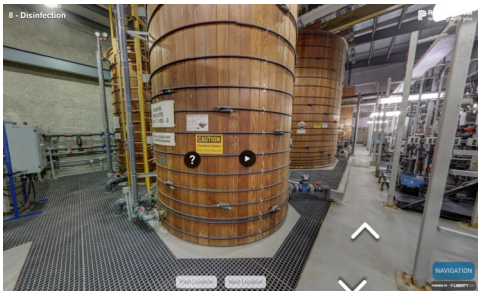
Read this article and discuss with students the challenges with pharmaceuticals in wastewater and how findings from this research could guide the future regulation of wastewater.

Unused or expired pharmaceutical products should never be flushed down the toilet.

Disinfection

What happens in the Disinfection Building?

Sodium hypochlorite (bleach) is added to the water as a final disinfectant. After this, the water is then dechlorinated with sodium bisulphite so that the treated water can be returned to Lake Ontario. The sodium bisulphite is added part way down the outfall pipe to allow enough time for the chemical reaction to take place. There are strict rules about the quality of the water that can be returned to the Lake.



Navigation

There are four interactive icons to help students learn more about disinfection. These include videos, images, and text.

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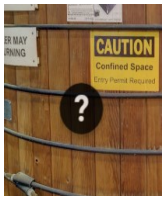

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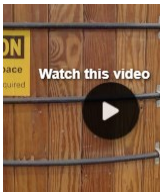

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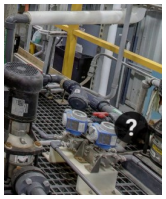

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1. Disinfection: Click the interactive icon to the left of the yellow caution sign on the first screen, to learn more about the chemicals used for disinfection.
2. Video: Click the interactive icon to the right of the yellow caution sign on the first screen to watch an animated video of the disinfection stage.
3. Sampling: Click on the interactive icon on the right of the first screen to learn more about how and why wastewater is sampled.
4. Outfall: Turn 180 degrees from the caution sign and proceed to the next screen. Click on the interactive icon to learn more about how the outfall simulator is used to help regulate the chemicals used in disinfection.

Discussion Questions

What does disinfection mean?

How would you distinguish between cleaning, sanitizing and disinfecting?

Hint: Cleaning removes dust, debris and dirt from a surface by scrubbing, washing and rinsing. Sanitizing reduces bacteria to a safe level, and disinfecting destroys or inactivates both bacteria and viruses.

Why does the chlorine have to be removed from the water before it is returned to the Lake? What might happen if it's not removed?

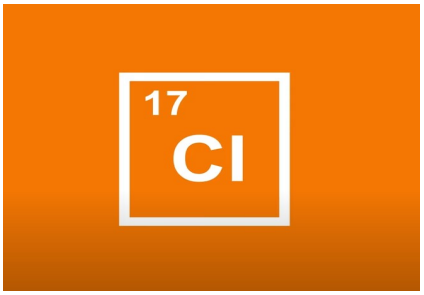
Hint: There are strict rules about the quality of water that is returned to the lake. Chlorine must be removed as it can have a negative impact on our source water and the environment.

Extension Activities

The disinfection of water is considered one of the most important public health achievements of the 20th century. Watch this video to learn more about how chlorine is important to this process.

The Peel Water Story online modules combine text, interactive maps and multimedia content. Learn more about source water protection in Peel Water Story: Taking the Plunge.

Use this lesson plan to explore sharing key messages related to source water protection. Students can select an audience and explore different media forms to share their chosen message.



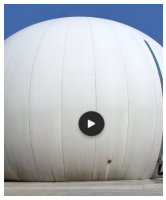
Anaerobic Digestion & Biogas Recovery

What happens in the Anaerobic Digesters?

The sludge and scum are pumped to the anaerobic digesters which are large enclosed tanks without any oxygen. The material is mixed and heated to 38°C and microorganisms in the wastewater break down organic material in the sludge. This also reduces bad odours and pathogens. Biogas is produced which contains carbon dioxide and methane. The biogas is reused onsite for heat and electricity generation. The biosolids that are removed from the digester are 98% liquid and 2% solid.

Navigation

There are four interactive icons to help students learn more about the anaerobic digesters and biogas recovery. These include videos, images, text, and an online quiz.

1 

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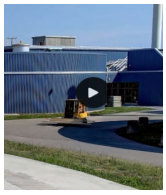
3 

4 

1. Video: Click on the interactive icon on the left of the first screen for an animated video explaining the anerobic digestion process.
2. Biosolids: Click the interactive icon in the middle of the first screen to learn more about what biosolids are.
3. Video: Click on the interactive icon on the right of the first page for a video that shows an aerial view of the digesters.
4. Quiz: Click the interactive icon on the second page for a quiz to test your knowledge.

Discussion Questions

How do you use gas for energy at home?

Where does that gas come from?

Hint: Natural gas barbeques or stoves, hot water heaters, and furnaces can all use gas in a home. Utility companies supply natural gas by piping it underground to our homes. Natural gas is a naturally occurring gas made up of mostly methane. It can be found deep underground typically near coal beds or petroleum deposits. It's formed when decomposing organic matter (plants and animals) is exposed to heat and pressure.

Extension Activities

At the wastewater treatment plant, large anaerobic digesters are used to breakdown sludge. A Canadian horticultural specialist named Jane Squier has been operating a small digester to generate fuel and fertilizer from food scraps on her farm since 2012.

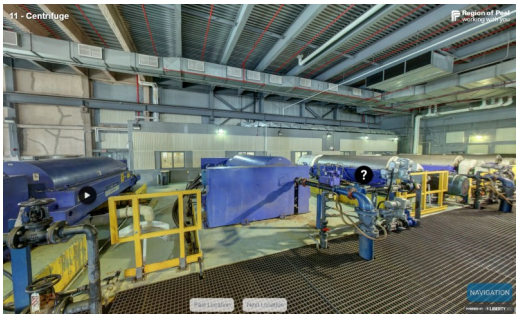
Watch this video and discuss the benefits and challenges associated with this system. Have students discuss how else we can beneficially reuse our waste products (i.e. reusing household materials such as yogurt containers for seedlings, coffee grounds for gardening, and recycling paper and plastic.

Jane explains how gas from her anaerobic digester is purified and compressed.

Centrifuges

What happens in a centrifuge?

In the centrifuges, remaining solids are separated from the liquid using high speed forces. A rapidly rotating centrifuge uses centrifugal force to separate solids from liquids due to their difference in densities. Similar to a washing machine, the centrifuge spins the biosolids to dewater the material and reduce its volume.



Navigation

There are two interactive icons to help students learn more about the centrifuges. These include videos, images, and text.

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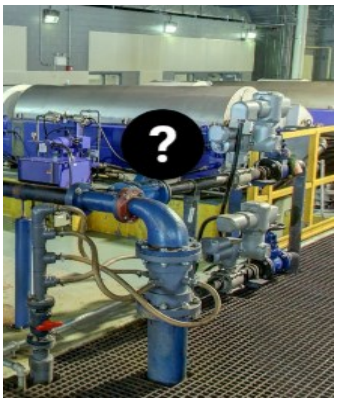


1. Video: Click on the interactive icon on the left of the first screen for an animated video on the centrifuge.
2. Biosolids: Click on the interactive icon on the right of the first screen to learn more about biosolids and how centrifuges are used to extract water from them. There are three images with descriptive captions.

Discussion Questions

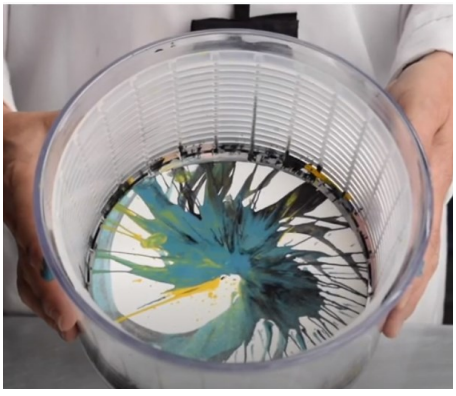
Can you think of any examples where centrifugation (very fast spinning) is used to separate substances?

Hint: Separating cream from milk or curd from milk, separating blood sample components for testing, separating water from wet clothes during the spin cycle of a washing machine, and even amusement park rides are all examples of centrifugal force at work.

Extension Activities

Watch this video to learn about how a centrifuge works and it's application. After watching the video, share these 15 examples of centrifugation to further explore this topic with students.

Watch this video to get creative while learning about centrifugal force. This video from the Kennedy Space Centre demonstrates a centrifugal art exercise using some paint, paper and a salad spinner!

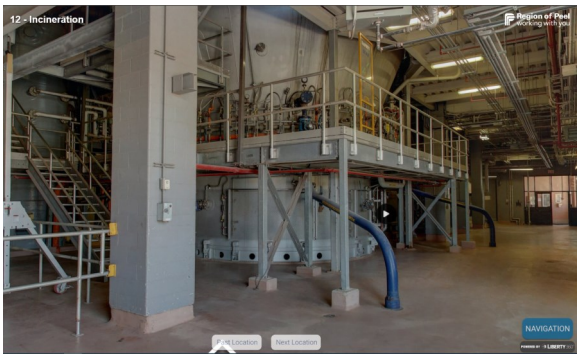


An educator demonstrates an art activity that demonstrates centrifugal force.

Incineration

What happens in the incinerators?

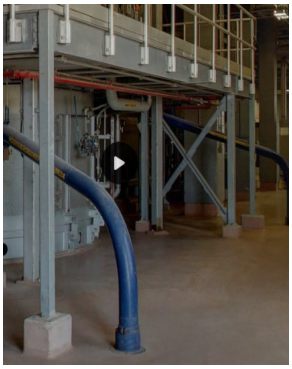
The incinerator heats up to 840°C and burns the cake from the centrifuges, leaving inorganic material behind such as phosphorus and iron. The remaining ash is then removed and stored in ash lagoons. All emissions are constantly checked by a continuous emissions monitoring system.



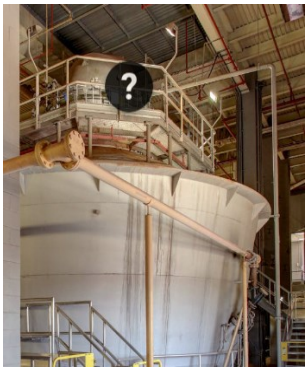
Navigation

There are two interactive icons to help students learn more about the incinerators. These include videos, images, and text.

1



2



1. Video: Click on the interactive icon on the first page for an animated video on the incineration process.
2. Ash: Head upstairs and click on the interactive icon to learn more about the air quality system in the wastewater treatment plant and where the leftover ash is sent after incineration. There are two images with descriptive captions.

Discussion Questions

What does the term circular economy mean to you? Give examples of a linear economy process and a circular economy cycle.

Hint: In a linear economy raw materials are mined, processed into a product that is thrown away after being used. In a circular economy, we close the cycle and reuse the materials, limiting or reducing the need for additional raw materials.

Extension Activities

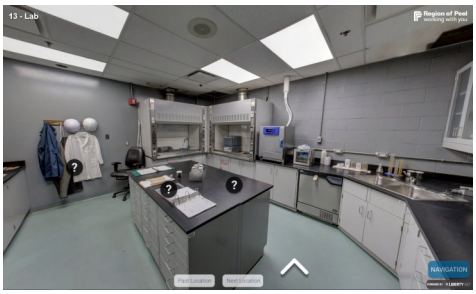
The Region of Peel is researching the re-use of ash from the incineration process. This material is rich in Phosphorus (P). P is a mineral that is mined and a main component in the production of fertilizers. Watch this video to learn how other regions are using these innovative technologies for P resource recovery.

Watch this video to further understand the concept. Discuss with students how resource recovery from wastewater is an example of a circular economy solution.

Lab

What happens in the lab?

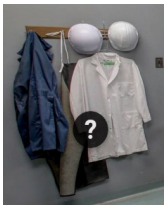
Wastewater is continuously monitored and tested throughout the treatment process. Samples taken from different stages of treatment are brought here to be tested. Samples are also sent to ministry licensed laboratories for analysis. Before the wastewater is returned to the lake, it is tested one final time to make sure it meets all regulatory requirements.



Navigation

There are three interactive icons to help students learn more about the incinerators. These include videos, images, text, and an online quiz.

1



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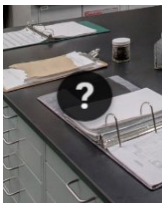

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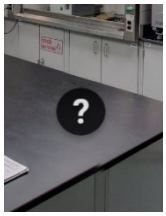


1. Safety Equipment: Click on the interactive icon on the left to learn more about the safety equipment the operators use and wear.
2. Sampling: Click on the interactive icon in the middle to learn more about the samples that are brought into the lab for testing.
3. Quiz: Click on the interactive icon on the right for a quiz to test your knowledge.

Discussion Questions

Have you participated in any lab experiments? What safety rules were you required to follow in the lab?

Hint: Common safety requirement for labs include wearing protective equipment (goggles, gloves, and apron/lab coat), following directions, safely disposing of used materials, and knowing the location of emergency safety equipment (eye wash station and fire blanket/extinguisher).

Extension Activities

Every lab needs SOPs (standard operating procedures) to operate safely. Have students review the virtual lab section of the tour and then write the SOPs for this wastewater treatment plant lab. Have students brainstorm five actions operators should take when working in the lab.

Watch this video to learn how wastewater samples have been used to identify COVID -19 outbreaks. What other substances might we be able to look for in wastewater that can tell us more about our communities? In what locations do you think this testing would be useful?

Hint: unused or excreted pharmaceuticals and recreational drugs could also be tested for. Operators can collect data on the contents of wastewater over time to look for trends and potentially identify other virus causing illnesses such as the flu. These studies could happen at a treatment facility, or in areas where many people congregate such as resorts, universities, or even concert halls.

Appendix A: Curriculum Connections

Grade 7

Subject & Unit	Specific Expectations
Geography: Physical Patterns in a Changing World	Describe various ways in which people have responded to challenges and opportunities presented by the physical environment and analyze short and long-term effects (e.g. water pollution from industry) Form questions to guide investigations into the impact of human activities that change the physical environment Describe some key human activities that create and change water bodies and systems
Science & Tech: Understanding Structures and Mechanisms: Form and Function	Evaluate the importance for individuals, society, the economy, and the environment of factors that should be considered in designing and building structures and devices to meet specific needs
Science & Tech: Understanding Matter and Energy: Pure Substances and Mixtures	Assess positive and negative environmental impacts related to the disposal of pure substances and mixtures (e.g. sewage) Assess the impact on society and the environment of different industrial methods of separating mixtures and solutions Investigate processes used for separating different mixtures

Grade 8

Subject & Unit	Specific Expectations
Science & Tech: Understanding Structures & Mechanism: Water Systems	Investigate how municipalities process water (e.g. obtain it, test it, treat it) and manage water (e.g. distribute it, measure consumption and dispose of wastewater) Assess the impact on local and global water systems of a scientific discovery or technological innovation
Geography: Global Settlements: Patterns & Sustainability	Describe various ways human settlement has affected the environment (e.g. water pollution from industry). Describe some practices that individuals and communities have adopted to help make human settlements more sustainable (e.g. reducing water use)

Grade 9

Subject & Unit	Specific Expectations
Geography: Livable Communities	Assess the impact of urban growth on natural systems (e.g. impact of urban sprawl (what impact might an increase in population density have on treatment processes and on nearby bodies of water?) Identify various ways in which communities dispose of their waste material (e.g. incineration, primary and secondary sewage treatment) and describe potential environmental impacts of these methods
Geography: Interactions in the Physical Environment	Explain how human interactions in their local region can have an impact on natural processes
Technology: Technology, the Environment, and Society	Describe how various technologies (e.g. water purification) affect the environment and identify important environmental considerations associated with different

Appendix A: Curriculum Connections

Grade 10

Subject & Unit	Specific Expectations
Technology – Technology, the Environment, and Society	Identify ways in which green industry activities affect the environment (e.g. Contamination of water)
Technology – Health Care, the Environment, and Society	Identify current environmental issues and describe their implications for human health and well-being (e.g. water quality and human health)
Careers	Identify some recent and evolving technological, economic and social trends that have influenced the world of work and analyze the possible impacts of those trends on their own choices Use a research process to identify and compare a few postsecondary options that suit their aspirations, skills, interests, values and personal circumstances Identify the pathways towards their preferred destinations

Grade 11

Subject & Unit	Specific Expectations
Chemistry	Analyze the properties of commonly used chemical substances and their effects on human health and the environment, and propose ways to lessen their impact Analyze chemical reactions used in a variety of applications, and assess their impact on society and the environment Analyze the origins and cumulative effects of pollutants that enter our water systems (e.g. landfill leachates, agricultural run-off, industrial effluents, chemical spills) and explain how these pollutants affect water quality
Environmental Science	Analyze initiatives (both governmental and non-governmental) that are intended to reduce the impact of environmental factors on human health Investigate environmental factors that can affect human health and analyse related data Identify the basic components of soil, water and air and describe some of the effects of human activity (e.g. chlorination on water quality, chemical spills, etc.)

Grade 12

Subject & Unit	Specific Expectations
Chemistry	Assess the impact on human health, society, and the environment of organic compounds used in everyday life Evaluate the risks and benefits of some commonly used chemical substances Analyze the processes in the home, the workplace, or the environmental sector that require an understanding of accurate chemical calculations (testing water quality, adding chlorine to drinking water)
Biology	Evaluate some of the human health issues that arise from the impact of human activities on the environment (e.g. effects of medication released into water systems) Analyze the effects of human population growth, personal consumption and technological development on our ecological footprint

Appendix B: Student Handout

Wastewater Treatment Plant Virtual Tour

Fill in the table below as you complete the wastewater treatment plant tour.

	Describe the importance of this stage to wastewater treatment	What did you find interesting about this tour stop?
1. Introduction		
2. Process Map		
3. Control Room		
4. Headworks		
5. Primary Clarifying Tanks		
6. Aeration Tanks		
7. Secondary Clarifying Tanks		
8. Disinfection		
9. Outfall		
10. Anaerobic Digestion & Biogas		
11. Centrifuge		
12. Incineration		
13. Lab		

Appendix C: Student Handout Answer Key

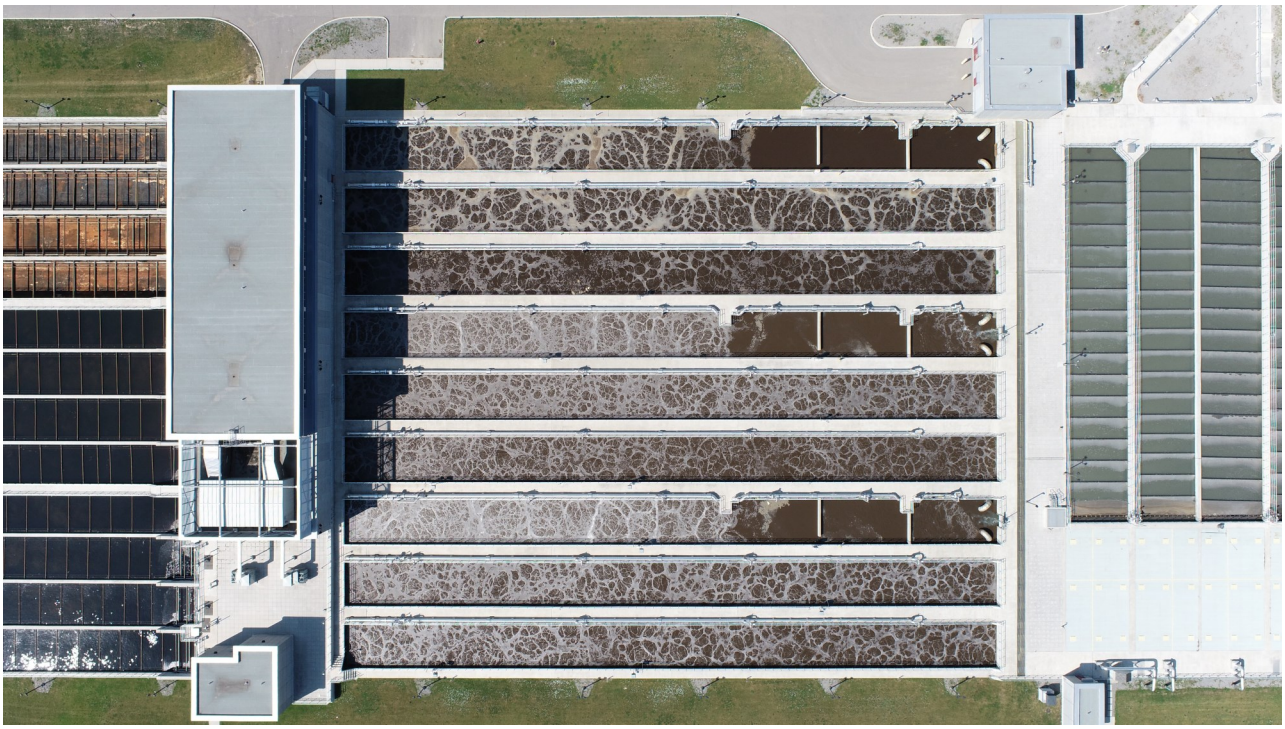
Wastewater Treatment Plant Virtual Tour

Fill in the table below as you complete the wastewater treatment plant tour.

	Describe the importance of this stage to wastewater treatment	What did you find interesting about this tour stop?
1. Introduction	• Wastewater is water that has been used in homes, schools, facilities, and businesses • Flushing your toilet, doing laundry, or washing hands produces wastewater • Wastewater goes down the drain and travels through underground pipes to a wastewater treatment plant	
2. Process Map	• This map outlines the wastewater treatment process at Region of Peel facilities	
3. Control Room	• This is where the treatment process is monitored • In here, operators make sure that everything is working properly and that the treated water is meeting the standards required to ensure the health of the public and the environment • Teamwork is important at the treatment facilities as many people are responsible for different parts of the treatment process	
4. Headworks	• Mechanical screens remove large items in the wastewater that can clog or damage the equipment • Items that are screened away include dental floss, wood, and personal hygiene products • Odour control equipment helps keep the bad smell from escaping from the facility	

	Describe the importance of this stage to wastewater treatment	What did you find interesting about this tour stop?
5. Primary Clarifying Tanks	• The wastewater flows here from the headworks • Here, heavier solid materials—called "sludge" - settle to the bottom, while lighter material called "scum" float to the top • The sludge and scum are pumped to the digester for treatment, while the remaining effluent flows to aeration tanks	
6. Aeration Tanks	• Diffusers at the bottom of the tanks bubble oxygen through the wastewater • The oxygen breaks down remaining nutrients, organic matter, and bacteria • There are areas in the tanks that do not have oxygen. They are called the "anoxic zones". This is where nitrogen is removed during "denitrification" when bacteria break down the nitrate into nitrogen gas	
7. Secondary Clarifying Tanks	• The wastewater is again given time to let the sludge settle • Some of the sludge is sent to the anaerobic digesters • Some of the sludge is returned to the aeration tanks to increase the microorganism population	
8. Disinfection	• Sodium Hypochlorite (bleach) is added to the water as a disinfectant • Sodium Bisulphite is added to remove the chlorine so the water is safe to return back to Lake Ontario • The water is sampled 60 times a day	
9. Outfall	• The water is discharged back into the lake through the outfall • The pipe goes 2.2 km into the lake, 70 m below the surface	

	Describe the importance of this stage to wastewater treatment	What did you find interesting about this tour stop?
10. Anaerobic Digestion & Biogas	• The anaerobic digesters are large enclosed tanks without oxygen • Microorganisms breakdown the sludge and scum that are sent here • The sludge stays at a temperature of 38°C • The gas collected from the digesters is used for heat and electricity	
11. Centrifuge	• After the digesters, the biosolids are 98% liquid and 2% solid • They are sent to the centrifuge to remove even more of the water • The biosolids are spun very fast to reduce the volume of water	
12. Incineration	• The incinerators heat up to 840°C to burn the remaining biosolids • Only inorganic material such as phosphorus and iron are left behind, the rest is ash • Ash is stored in ash lagoons	
13. Lab	• Wastewater samples are sent to the lab for analysis • Operators wear safety equipment for protection, which includes a safety vest, a hard hat, steel-toed boots, gloves, and eye protection	



Region of Peel
working with you