



Lesson Plan: Energy from Waste, Grade 10 Science (SNC2D and SN2P)

Introduction

The Durham York Energy Centre (DYEC) relies on numerous chemical reactions to process waste safely and effectively throughout the Energy-from-Waste (EFW) facility. The DYEC uses air pollution control equipment to cool, collect, and clean combustion gases. This equipment operates under stringent regulatory standards. In this lesson, students will explore the DYEC through a virtual tour and investigate safety and environmental issues associated with chemical reactions.

Learning Objectives

1. Investigate EFW and Air Pollution Control Equipment
2. Demonstrate an understanding of how garbage is processed to recover energy
3. Investigate safety and environmental issues associated with chemical reactions
4. Investigate if EFW impacts climate change and global warming

Resources Provided

- [Durham York Energy Centre Website](#)
- [Energy from Waste Process Overview](#)
- [Durham York Energy Centre Virtual Tour](#)

Questions

1. What is Energy-from-Waste?
2. Where is the DYEC facility located?
3. Where does the waste processed at the DYEC come from?
4. How much waste can the DYEC process per year?

Activity

1. Students will use take the DYEC Virtual Tour provided in the course materials and resources section to learn how garbage is processed to manage waste and to make energy.
2. The DYEC utilizes specialized air pollution control equipment to cool, collect and clean the combustion gases before they are released into the atmosphere. This equipment operates under stringent environmental regulatory standards. As a class, students will explore the table below which shows the pollutant control devices used for flue gas treatment at the DYEC and obtain additional information regarding these pollutant control devices on the DYEC website.

Target Pollutant(s)	Pollutant Control Devices
Nitrogen Oxides (NO _x)	<p>Selective Non-Catalytic Reduction (SNCR) aqueous ammonia injection and Covanta Very Low NO_x (VLN™) System</p> <p>SNRC - An air pollution control method that converts nitrogen oxide into elemental nitrogen and water by injecting a chemical reagent, typically urea, or another ammonia-based solution into the flue gas.</p> <p>VLN™ - The Durham York Energy Centre is equipped with a patented technology to reduce Nitrogen Oxides (NO_x) referred to as the VLN™ process.</p>
Carbon Monoxide	Martin Integrated Combustion Control System
Hydrogen Chloride, Sulfur Dioxide	LUHR Dry hydrated lime injection with fly ash recirculation - Lime is used to neutralize acidic chemicals compounds from flue gas before they reach the atmosphere.
Particulate Matter, Lead, Cadmium	LUHR Six compartment fabric filter baghouse - A component of the air pollution control equipment consisting of a series of fabric filters through which flue gases are passed to remove particulates prior to release to the atmosphere.
Mercury, Dioxins/Furans	Powder activated carbon (PAC) injection is used in air pollution control systems to control heavy metals and dioxins/furans. PAC has a large surface area which allows the contaminants to adsorb (e.g., stick to) the carbon.
Dioxins/Furans	Furnace temperatures >1,000 degrees Celsius for 1 second

- Students will then investigate and report on why treatment of the above target pollutants is important - how does these target pollutants affect the environment and/or human health?

The Regional Municipality of Durham - Waste Management Services

If this document is required in an accessible format, please contact schoolprograms@durham.ca

4. Using the website, students will answer the following questions in their own words:
 - a. What is the difference between and EFW facility and an incinerator?
 - b. What is the processing capacity of the DYEC?
 - c. Is the DYEC safe?
 - d. How are emissions monitored at the DYEC?
 - e. How can residents access emissions data for the facility?
 - f. Does the DYEC impact climate change?

Summary

The DYEC operates under some of the most stringent air emission guidelines in the world. Human health and the environment are primary concerns for both Durham Region and York Region. The Regions have undertaken a series of detailed studies on air emissions, health, traffic, noise, ground and surface water to assess any potential effects from the DYEC to ensure that residents and the environment are protected. Results of the Human Health and Ecological Risk Assessment studies in the Environmental Assessment concluded that the DYEC would not lead to any adverse health risks to the public or environment.

Curriculum Connections Expanded

The Ontario Curriculum, Grades 9 and 10: Science, 2008 (revised)

Science, Grade 10, Academic (SNC2D)

A. Scientific Investigation Skills and Career Exploration

- A1. Science Investigation Skills: demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating)

C. Chemistry: Chemical Reactions

- C1. Relating Science to Technology, Society, and the Environment: analyse a variety of safety and environmental issues associated with chemical reactions, including the ways in which chemical reactions can be applied to address environmental challenges
- C2. Developing Skills of Investigation and Communication: investigate, through inquiry, the characteristics of chemical reactions
- C3. Understanding Basic Concepts: demonstrate an understanding of the general principles of chemical reactions, and various ways to represent them.

D. Earth and Space Science: Climate Change

- D1. Relating Science to Technology, Society, and the Environment: analyse some of the effects of climate change around the world, and assess the effectiveness of initiatives that attempt to address the issue of climate change
- D2. Developing Skills of Investigation and Communication: investigate various natural and human factors that influence Earth's climate and climate change

The Regional Municipality of Durham - Waste Management Services

If this document is required in an accessible format, please contact schoolprograms@durham.ca

- D3. Understanding Basic Concepts: demonstrate an understanding of natural and human factors, including the greenhouse effect, that influence Earth's climate and contribute to climate change

Science, Grade 10, Academic (SNC2P)

A. Scientific Investigation Skills and Career Exploration

- A1. Science Investigation Skills: demonstrate scientific investigation skills (related to both inquiry and research) in the four areas of skills (initiating and planning, performing and recording, analysing and interpreting, and communicating)
- A2. Career Exploration: identify and describe a variety of careers related to the fields of science under study, and identify scientists, including Canadians, who have made contributions to those fields

C. Chemistry: Chemical Reactions

- C1. Relating Science to Technology, Society, and the Environment: analyse how chemical reactions are employed in common products and processes, and assess the safety and environmental hazards associated with them
- C2. Developing Skills of Investigation and Communication: investigate, through inquiry, the characteristics of chemical reactions
- C3. Understanding Basic Concepts: demonstrate an understanding of simple chemical reactions and the language and ways to represent them

D. Earth and Space Science: Climate Change

- D1. Relating Science to Technology, Society, and the Environment: analyse effects of human activity on climate change, and effects of climate change on living things and natural systems
- D2. Developing Skills of Investigation and Communication: investigate various natural and human factors that have an impact on climate change and global warming
- D3. Understanding Basic Concepts: demonstrate an understanding of various natural and human factors that contribute to climate change and global warming