



Lesson Plan: Recover, Grade 5 and 6 Science and Technology

Activity

Forms of Energy – Energy from Waste

Introduction

The energy we need to create electricity needs to be mined, harnessed, or collected from the earth. This includes natural gas, coal, water, solar energy, and wind. But did you know that garbage can also be used as a fuel source to generate electricity? These resources alone won't create the power that turns on our lights. A chemical or mechanical process is required to turn these energy sources into usable electricity. For the Region's garbage, that's where the Durham York Energy Centre (DYEC) comes into play. In this lesson, students will explore how household waste is used to generate electricity that can be used in our homes, schools, and businesses.

Curriculum Connections

Science and Technology, 2022 (revised)

Grade 5

- Strand A: STEM Skills and Connections
- Strand C: Energy and Matter
- Strand E: Earth and Space Systems

Grade 6

- Strand A: STEM Skills and Connections
- Strand C: Energy and Matter

Learning Objectives

1. Identify common household garbage
2. Investigate how garbage is managed in Durham Region
3. Describe various forms of energy and relate them to the energy from waste process
4. Identify ways they can reduce the garbage they create
5. Create a plan to reduce energy consumption at home and at school

Resources Provided (available in the resource file)

- Video: What happens to your garbage when it leaves the curb?

Materials Required

- Balloon
- Pinwheel

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Activity Instructions

1. As a class, make a list of household waste that would go into the garbage. This includes items like chip bags, single-use plastic bags, plastic utensils and straws, disposable coffee cups, and candy wrappers.
2. Explain that best way to manage our garbage is by not creating it in the first place. It takes a lot of resources to create the items we purchase and use every day. We can help protect natural resources and the health of the environment by only buying what we need and making decisions with waste reduction in mind.
3. From the list of household waste created by the students, ask students to identify how the use and disposal of these items could have been avoided. As an example, reusable metal utensils could replace disposable plastic utensils. This would eliminate the need to manage disposable plastic utensils through the garbage stream.
4. Explain that not all packaging and products have an alternative option to keep the material out of the garbage. This may be because the material is difficult to manage, there are no existing markets for the material (no one wants to buy it), markets are too far away, or the cost of an alternative program is too high.

Garbage within Durham Region is sent to the DYEC. Here, garbage is burned at high temperatures (making sure to protect the environment and the community) to reduce the volume of garbage being sent to landfill and to create electricity. The DYEC can safely process household garbage after waste diversion programs have been maximized.

5. Play the video What happens to your garbage when it leaves the curb?
6. Provide each student with an uninflated balloon and explain that garbage contains energy. Energy cannot be created or destroyed but can be transformed into other forms of energy.
7. Have the students recall the metal tubes filled with water surrounding the combustion chamber from the video and ask them to imagine their balloon is one of these water tubes.

The water within the tubes is heated at high temperatures by burning the garbage within the combustion chamber. **Thermal energy** is produced when the atoms and molecules in a substance vibrate faster due to a rise in temperature. As the water heats up, it begins to boil and creates steam. The air from your mouth will act as this high-pressure steam. Have students blow up their balloons and pinch the end to trap the 'steam'.

Mechanical energy (kinetic energy or potential energy) is the energy of either an object in motion or the energy that is stored in objects by their position. Explain that the balloon is filled with potential energy. **Potential energy** is energy that is stored in an object or substance – it has the 'potential' to do work.

8. We know that energy cannot be created or destroyed, it can only be converted from one form to another. Ask the students what will happen to the potential energy when we let go of the balloon?

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9. Now have the students let go of their balloon. What happened?

The balloon moved around the room. The potential energy has been released and converted to kinetic energy. **Kinetic energy** is the energy of motion. The kinetic energy moves the balloon around the room.

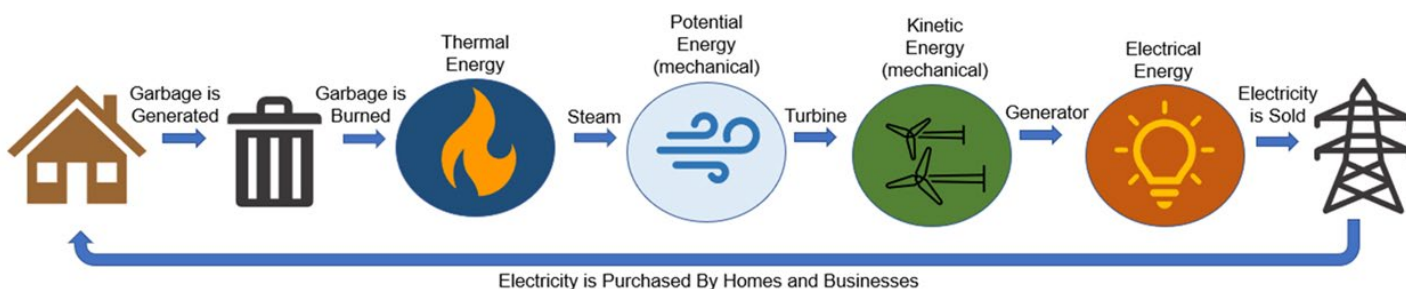
10. Blow up the balloon again and pinch the end to trap the 'steam'.

11. This time aim the end of the balloon at a pinwheel. Imagine the pinwheel is the turbine at the DYEC. What happens when you continue to hold the balloon and just release the end of the balloon?

The 'steam' from the balloon spins the 'turbine' blades. The potential energy was put to work to spin the turbine blades, converting the steam's potential energy into kinetic energy.

12. You can now imagine that the handle of the pinwheel is connected to a generator. The spinning action of the blades would then turn the handle connected to the generator to convert the kinetic energy into electrical energy. **Electrical energy** is caused by moving electric charges called electrons. The faster the charges move, the more electrical energy they carry.

13. The electricity generated by the DYEC can be used in our homes, schools, and businesses. Have your students look around their surroundings and point out items that rely on electricity.



Extension Activity

Now that the students have given some thought to what items in their surroundings rely on electricity, have your students create a plan to reduce their energy consumption at home and at school. Recommended actions can be shared with classmates and the school by creating an informative poster.

Summary

The best way to manage garbage is by not creating it in the first place. After maximizing our waste diversion, Recover can help take care of what is left. By adding Recover to the Region's waste hierarchy, we are recovering value from the waste that cannot be reused or recycled in our current diversion programs. The DYEC allows the Region to recover additional recyclable materials from the garbage and to convert non-recyclable waste materials into an energy source.

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Expanded Curriculum Connections

Grade 5, Science and Technology, 2022 (revised)

A: STEM Skills and Connections

A1. STEM Investigation and Communication Skills

- A1.1 use a scientific research process and associated skills to conduct investigations
- A1.2 use a scientific experimentation process and associated skills to conduct investigations
- A1.3 use an engineering design process and associated skills to design, build, and test devices, models, structures and/or systems
- A1.4 follow established health and safety procedures during science and technology investigations, including wearing appropriate protective equipment and clothing, and safely using tools, instruments and materials
- A1.5 communicate their findings using science and technology vocabulary, and formats that are appropriate for specific audiences and purposes

A3. Applications, Connections, and Contributions

- A3.1 describe practical applications of science and technology concepts in various occupations, including skilled trades, and how these applications address real-world problems
- A3.2 investigate how science and technology can be used with other subject areas to address real-world problems

C: Energy and Matter

C1. Relating Science and Technology to Our Changing World

- C1.1 assess the impacts on society and the environment of various processes used in the manufacture of common products
- C1.2 assess how the use of specific materials in the manufacturing of common products affects the environment, and identify actions that society and individuals can take to mitigate negative impacts

E: Earth and Space Systems

E.1. Relating Science and Technology to Our Changing World

- E1.1 analyse long-term impacts of human uses of energy and natural resources, on society and the environment, including climate change, and suggest ways to mitigate these impacts

E2. Exploring and Understanding Concepts

- E2.1 identify a variety of forms of energy, and describe how each form is used in everyday life
- E2.2 demonstrate an understanding of the law of conservation of energy, including how energy cannot be created or destroyed, but can only be transformed from one form to another
- E2.3 describe how energy is stored as potential energy and transformed in a given device or system
- E2.4 demonstrate an understanding that when energy is transformed from one form to another, some energy may dissipate into the environment in the form of heat, light, and/or sound energy

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C: Energy and Matter

C1. Relating Science and Technology to Our Changing World

- C1.2 assess choices that reduce personal use of electrical energy from both renewable and non-renewable sources, and advocate for the responsible use of electrical energy by the school community

C2. Exploring and Understanding Concepts

- C2.4 describe how technologies transform various forms of energy into electrical energy
- C2.5 describe ways in which electrical energy is transformed into other forms of energy