Educator's Guide

Eco 360

Activity 3: Different Types of Plastics
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Backgrounder: Different Types of Plastics

We see plastic everywhere. It has many qualities such as durability, flexibility, being light-weight and not reacting with other chemicals has made it a popular material choice for many products. Many people assume all plastics have the same composition, however there are many different kinds of plastics, and their application is chosen based on the unique strength, flexibility and weight of each kind. Although there are many types of plastics – known as polymers – Polyethylene is the most common type of plastic used in the world. There are three common types of polyethylene plastic used in our economy – high-density, low-density, and linear low-density. Below are the common and popular types of plastics that we interact with on a daily basis (Plastics Industry Association, 2021).

Polyethylene Terephthalate (PETE or PET)  (Plastics Industry Association, 2021).	PET is a widely used plastic material. It is lightweight, strong and often transparent. The common application of PET is food packaging, such as water bottles, and fabrics in the form of polyester (Plastics Industry Association, 2021).

High-Density Polyethylene (HDPE)  (Plastics Industry Association, 2021).	High density Polyethylene HDPE is the strongest kind of polyethylene. Its strength and resistance to moisture make is an effective material to use for food packaging – most commonly used for beverage containers, such as storing milk as the gallon milk jugs are usually created from HDPE. Other applications include making pipes and plastic lumber to withstand extreme weather conditions and changing temperatures (Plastics Industry Association, 2021).
Low-Density Polyethylene (LDPE)  (Plastics Industry Association, 2021).	Low-Density Polyethylene (LDPE) "is a softer, clearer, more flexible version of HDPE—and it has its own strengths as well. It's often used as a liner inside juice and milk cartons, and it's used in corrosion-resistant work surfaces and other products, such as six-pack rings and plastic wrap" (Plastics Industry Association, 2021).

Linear Low-Density Polyethylene (LLDPE)  (Plastics Industry Association, 2021).	LLDPE is created by changing the chemistry of LDPE. LLDPE is most commonly used in plastic bags as they are tear and puncture resistant. Other common applications include using them for toys, pouches, and cable applications as they also hold well against chemical solvents (Plastics Industry Association, 2021).
Polyvinyl Chloride (PVC/vinyl)  (Plastics Industry Association, 2021).	"PVC is an incredibly durable material that's resistant to weathering, which is why it's so often used in building and construction applications. Common uses include flooring; siding; and indoor and outdoor plumbing, which uses PVC pipe. It's also resistant to chemicals and doesn't conduct electricity, making it crucial for use in high-tech applications, such as wire and cable. It's widely used in medical applications today because it's impermeable to germs, is easily cleaned and provides single-use applications that reduce infections in healthcare" (Plastics Industry Association, 2021).

Polypropylene (PP)  (Plastics Industry Association, 2021).	"PP is more heat resistant than some other plastics, making it ideal for use in food packaging and food storage that's made to hold hot items or be heated itself. It's another plastic that's chemically inert and durable, particularly when a product needs to be opened, closed or bent—like a hinge repeatedly (think of a DVD box). PP stretches to allow a consumer access to a product inside but retains its shape and strength for a long time" (Plastics Industry Association, 2021).
Polystyrene or Styrofoam (PS)  (Plastics Industry Association, 2021).	"Polystyrene is among the most diverse plastic materials, able to be processed in a way that produces packing peanuts, home insulation and even red party cups. It's also one of the only materials that can be recycled or chemically processed to return back to its original state. All of these materials are recyclable, but often the process of recycling can cause some of them to lose important characteristics. In certain processes, used PS can be returned to its original state, losing none of the properties that made it so useful and diverse in the first place" (Plastics Industry Association, 2021).

Polylactic Acid (PLA)  (Plastics Industry Association, 2021).	"More and more items, such as takeaway storage containers, cups and utensils, are being made with polylactic acid, a biodegradable bioplastic. Its biodegradability makes it ideal for sensitive medical applications, including implants, rods, and screws. It's also one of the most popular plastics used in at-home 3D-printing applications" (Plastics Industry Association, 2021).

Recycling Plastics

Plastics often include a triangle or a recycling symbol on them with a number inside it. This is called the *Resin Identification Code (RIC)* – which is a universal code that indicates what the plastic is made from (i.e., its chemical composition) and indicates how it should be recycled. In the case of apparel, the items may indicate the composition, like this 100% Acrylic winter scarf.

As we look at different plastics around us, we may notice that some plastics do not have a symbol on them or a label indicating the chemical composition of the plastic product at hand. This is usually the case with apparel. This is an important consideration to note that not all plastic is labeled with the RIC code or its composition. This poses a challenge for recycling as it is not easy to find out what they are made from and therefore, cannot be easily recycled. Canadians throw away almost 3 million tonnes of plastic waste annually. Out of which only 9% of plastic is recycled in Canada—which means 91% of the plastic ends up in landfills and worse, the environment (Government of Canada, 2020). This shows we need to do a lot of work to move to an economy that does not generate plastic waste.

Bibliography

Government of Canada. (2020). *Canada one-step closer to zero plastic waste by 2030* . Retrieved from Government of Canada: https://www.canada.ca/en/environment-climate-change/news/2020/10/canada-one-step-closer-to-zero-plastic-waste-by-2030.html

Plastics Industry Association. (2021). *What Are the Different Types of Plastic?* . Retrieved from This is Plastics: https://thisisplastics.com/plastics-101/different-types-plastic/

Curriculum Connections

Activity 3: Different Types of Plastics

Alberta ❖ Science 20 Unit A: Chemical Changes ➢ 20-A3.1k identify materials used in daily life that are based upon Alberta's petrochemical industry and that involve changes in energy ❖ Grade 9 Unit C: Environmental Chemistry ➢ 3 - Analyze and evaluate mechanisms affecting the distribution of potentially harmful substances within an environment
Ontario ❖ Grade 9 Geography ➢ E1. The Sustainability of Human Systems: analyze issues relating to the sustainability of human systems in Canada (FOCUS ON: Interrelationships; Geographic Perspective)

Activity 3: Different Types of Plastics

Overall Objective

Learners will explore the different kinds of plastics found in our economy. Learners will learn how to distinguish what kind of plastic they are dealing with by looking at the labels on plastic products.

Materials

- Internet-enabled device
- Eco 360 notebook (we recommend asking learners to maintain a notebook for this program to write down reflections as they go through the program)
- Plastic by Number Worksheet
- Information of Plastics Handout

Time Required

45 minutes - 60 minutes

Learning Outcomes

By the end of this activity, learners will:

- describe the different kinds of plastics found in our economy
- be able to differentiate the different kinds of plastics by reading the labels on the plastic products
- identify which kind of plastic is easily recyclable and those that are harder to recycle

Grade Level

Suitable for Grades 9 to 12

Activity Outline

Step One

Introduce learners to the different kinds of plastics found in our economy by watching the videos below. It is important to know the difference between different kinds of plastics as it indicates whether the plastic can be successfully recycled or not.

a. Brief history of plastic: https://www.youtube.com/watch?v=9GMbRG9CZJw (6 minutes
b. Know Your Plastics: https://www.youtube.com/watch?v=_qTelxi3MjU (watch 1 - 1:36 minutes)

Step Two

Distribute the "Plastic by Numbers Worksheet". Using the resource below, go through the different kinds of plastics found in our economy with your learners:

a. Plastic by the Numbers, article: https://plasticactioncentre.ca/directory/plastic-by-the-numbers/#:~:text=Plastics%20that%20have%20%231%20

Step Three

Identifying common plastic items:

a. Have each learner bring 2-3 plastic items to class. Ask them to look for plastic items around the house, such as:
    i. Bathroom: They can find empty plastic items in their bathroom such as shampoo bottles, toothpaste tubes etc.
    ii. Kitchen: Empty plastic containers, grocery bags, bottles, jars, milk jars, etc.
    iii. Apparel Closet: They can bring a pair of socks, shoes or sandals, shirts, jackets etc.
    iv. Or any other places they could find plastic!
b. Have each learner read the label of the plastic items they brought with them and see if the plastic item has a recycling symbol ♻ with a

number on it. Explain to learners that the *Resin Identification Code (RIC)* is a universal code that indicates what the plastic is made from (i.e, it's chemical composition) and indicates how it should be recycled. In the case of apparel, the items may indicate the composition, like this 100% Acrylic winter scarf.

Learners may notice that some plastics do not have a symbol on them or a label indicating their composition (as is usually the case in apparel) - for instance the chairs they are sitting on or the pen they are holding may not have labels or PRS symbols. Explain to learners that we find many plastic items in our economy that are not labeled. This poses a challenge for recycling as it is not easy to find out what they are made from and therefore, cannot be easily recycled. This may also be a good place to highlight how Canada recycles only 9% of its plastic waste at the moment, as mentioned in the backgrounder.

c. Allow learners to reference the 'Information of Plastics Handout' as they are finding various plastic products in their house. It gives learners examples of each type of plastic as well as their associated formulas and structures.

d. Have each learner record their findings in the Worksheet in columns A and B. They can find the chemical formula and composition of the plastic by looking at the PRS and finding the information about that plastic in the resource linked here (provided in step 2).
e. After each learner has gone through the items, have each learner share the common plastic number they found on their list with the rest of the class.
f. As a class, regroup to discuss which is the most common type of plastic that was recorded most often by the learners in their individual exercise.
g. Ask learners if all the plastic items that they brought to the class are recyclable in their municipality? They can find that by the instructions usually provided on the recycling bin or by visiting the local municipality's waste management website. If this information is not easily available to the learners, ask them what should the local municipal authorities do about it to make this information more accessible and understandable for masses? Emphasize on the importance of the role of municipalities in making recycling bylaws easily accessible to masses.
h. This activity can be done in a distanced learning environment by asking learners to bring the plastic items to their virtual class.
i. Educators may also go through the recycling bin in the classroom to find the common items found in there. This can be done over a number of weeks (sorting through the recycling bin and recording findings in the worksheet) to find the common plastic items consistently ending up in the classroom recycling bin.

Learner Assessment

Consolidation: After having gone through the activity, ask learners to reflect on the questions below by having a discussion in groups or answering them individually in their ECO 360 notebooks:

a. What was the most common type of plastic found in the classroom activity?
b. Did they find a particular plastic item that is consumed frequently but not recycled in the municipality?
c. Was the information on what can be recycled in their municipality easily accessible to them (i.e., the recycling bin had information printed on it showing what can be put in there)? If not, what

can the learners do about it as informed citizens now to make this information easily accessible to their peers and families?

d. Can they use alternative eco-friendly materials for the plastic items that were most commonly found in the class exercise?
e. Can they eliminate the use of plastic items that were found in the exercise but not recyclable in their municipality?

Associated Worksheets

Eco 360

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Plastics by Numbers Worksheet

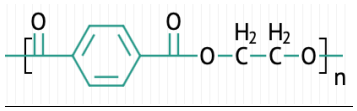
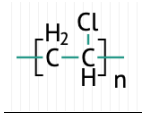
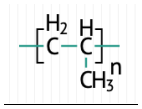
Activity 3 - Different Types of Plastics

Learner Name:

Date:

A: Plastic Label	B: Description and Chemical Composition	C: Are They Recyclable in Your Community?	D: Examples of Products Made From Them?

Information of Plastics Handout

Plastic Type & Symbol	Plastic Examples	Chemical Formula	Chemical Structure
PET (Polyethylene Terephthalate)	Beverage bottles, plastic cans, fabric fibres, and carpets, some bottles for hygiene products	$(C_{10}H_8O_4)_n$	
HDPE (High-Density Polyethylene)	Bottles for household chemicals, milk jugs, juice containers, medicine bottles	$(C_2H_4)_n$	More linear compared to LDPE: 
PVC (Polyvinyl Chloride)	Toys, blister wrap, cling wrap, detergent bottles, loose-leaf binders, blood bags, medical tubing	$(C_2H_3Cl)_n$	
LDPE (Low-Density Polyethylene)	Bags (grocery, dry cleaning, bread, frozen food bags, newspapers, garbage), plastic wraps; coatings for paper milk cartons and hot & cold beverage cups; some squeezable bottles (honey, mustard), food storage containers	$(C_2H_4)_n$	More "branches" compared to HDPE: 
PP (Polypropylene)	Thermal vests, car parts (bumpers), disposable diapers, sanitary pad liners, furniture	$(C_3H_6)_n$	
PS (Polystyrene)	Food containers, egg cartons, disposable cups and bowls, packaging, cosmetic bags	$(C_8H_8)_n$