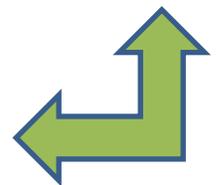


# **Snack Time!**

The Evolution and Disposability  
of Snack Food Packaging



## **When Snack Time is Over...**

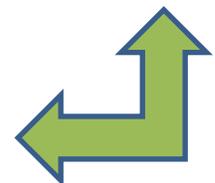
When you finish your snack, what do you do with the leftover packaging? More than likely, you either throw it in a trash can or put it in the recycling bin. You may think that this is the end for the snack packaging, but it is actually the beginning of a long disposal process.

This lesson examines the four possible options for disposal. It also looks at each type of snack packaging material to see what happens after the consumer disposes of it.

In doing so, the lesson demonstrates the environmental impact of each of these methods of disposal and materials. To do our best to help our environment, we have to understand the effects of the choices we make.

### **In this section:**

- 1. Disposal Options**
  - a. Reduce-Reuse-Recycle**
  - b. Composting**
  - c. Combustion**
  - d. Landfills**
  
- 2. Disposal Methods by Material**
  - a. Glass**
  - b. Metals: Steel and Aluminum**
  - c. Paper and Cardboard**
  - d. Plastics**
  - e. Biodegradable Materials**
  
- 3. Review Questions**
  
- 4. “How Much Food Packaging Waste does your Classroom Produce?” Activity**



## Disposal Methods

In 2014, Americans generated 258 million tons of *municipal solid waste*, meaning everyday waste [Slide 7]. There are four ways of disposing of this waste:

1. Reduce-Reuse-Recycle
2. Composting
3. Combustion
4. Landfills

### **Reduce, Reuse, Recycle**

#### Reduce

Reducing consumption decreases the amount of waste generated. With food packaging, consumers can avoid buying more food than they need to reduce waste. Businesses can also help by designing packaging that uses less material. For example, the cereal box may contain the same amount, but the box is smaller.

#### Reuse

Consumers can use items more than once to make the most of materials. Food packaging presents creative opportunities for people to reuse materials. One recent trend is the bottle garden, which reuses beverage bottles to grow herbs. [Video: Bottle Gardens]



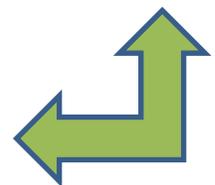
## Waste Prevention

“Waste prevention” combines reduction and reuse. It means cutting down on how much you throw away, consuming less, and using what you consume more than once. This stops waste before it is created.

Strategies for waste prevention include:

- Buy used or borrow, rent, or share items that you do not use often
- Look for products that use less packaging
- Buy reusable over disposable
- Maintain and repair products so that they last longer
- Donate items you no longer need

Benefits of Waste Prevention	Drawbacks
Conserves energy and resources	Requires a reduction in consumption, which can be difficult to implement
Reduces water pollution	
Reduces greenhouse gases	
Saves consumers and business money	

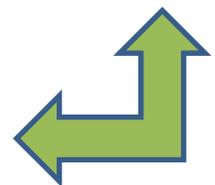


# Recycling

## The Recycling Process



Benefits	Drawbacks
Conserves resources and energy	May require that trash is sorted
Reduces water pollution	Excludes some items that cannot be recycled
Reduces greenhouse gases	
Supplies raw materials to industry	
Stimulates the development of green technologies	



**FACT CHECK:**

According to the EPA, recycling rates have increased dramatically over the past fifty years [Slide 8]. In 1960, only 5.6 million tons (6.4%) of municipal solid waste was recycled/composted. In 2014, that number reached 89.4 million tons (34.6%).

Single-Stream Recycling

“Single-stream recycling” refers to a recent recycling system where all recyclables can be placed in a single bin and are collected together. More and more people are gaining access single-stream recycling in the United States, with 25% of recycling communities using it in 2005 and 64% in 2010.

In single-stream recycling, materials are then taken to a “materials recovery facility,” where they are sorted by type and then dealt with accordingly. [Video: Single-Stream Recycling]

Benefits	Drawbacks
Provides convenience, which increases recycling volume	Items that cannot be recycled end up in the stream, so about 25% of items in the single stream end up in landfills
Lowers recycling collection costs	Mixing materials can cause contamination by leading to materials that can't be sorted, like broken glass



## Composting

“Compost” refers to organic material that can be added to soil to help plants grow [Slide 9]. Sometimes considered a form of recycling, composting requires 3 ingredients that work together to break down waste:

Greens	Browns	Water
Grass clippings, vegetable waste, fruit scraps, coffee grounds	Dead leaves, branches, twigs	
Provide nitrogen	Provide carbon	Provides moisture

### Benefits and Drawbacks of Composting

In addition to breaking down waste, composting helps the environment by enriching the soil and benefitting the plants it helps to grow.

Successful composting can be hard, however, because it only works for certain types of waste. Many materials used in snack packaging, like plastic and aluminum, will not break down and cannot be disposed of this way.

Recent efforts in food packaging have shifted to trying to use biodegradable materials, which can be composted instead of sent to landfills.

Benefits	Drawbacks
Breaks down waste completely	Only works for certain materials
Enriches soil	



## **Combustion**

Combustion is the controlled burning of waste in a designated facility. Combustion can dispose of waste that cannot be recycled or composted.

### Waste-to-Energy Combustion

A special kind of combustion, called “waste-to-energy combustion,” harnesses the energy generated by combustion to create electricity [Slide 10]. Materials are burned in a combustion chamber that filters fumes to prevent dangerous gases from seeping into the environment. This releases heat that converts water to steam. The steam goes to a turbine generator to produce electricity. The remaining ash is then transported to a landfill that has a protective lining.

#### **FACT CHECK:**

**The EPA claims that combusted municipal solid waste is converted to ash representing 15-25% of the original waste by weight and 5-15% by volume.**

### Benefits and Drawbacks of Waste-to-Energy Combustion

In positive terms, the EPA claims that waste-to-energy combustion offers a “greener” solution to waste disposal by reducing the municipal solid waste that ends up in landfills by 70-90% while creating energy.

Other environmental experts reject waste-to-energy combustion, including those who advocate for zero waste reject combustion. “Zero waste” refers to the belief that all materials should be reused so that nothing is sent to incinerators or landfills.



Some environmentalists claim that filtration does not eliminate all pollution from the combustion process. Other experts, however, claim that the gases released from these processes has less of an environmental impact than American fireplaces and barbecues.

Waste-to-energy facilities also require a large investment and take a significant amount of time to become profitable.

Benefits	Drawbacks
Reduces municipal solid waste by 70-90%	Despite filtration, still generates some pollution
Generates electricity	Undermines “zero waste” efforts
Reduces reliance on oil and gas	Expensive to build proper facilities

**FACT CHECK:**  
 According to the EPA, 12.9% of municipal solid waste in the United States was combusted for energy in 86 facilities in 2013. These facilities process 28 million tons of waste per year, generating 2,720 megawatts of power. *Scientific American* claims that this is enough to power 2 million average American homes for one year!



## Landfills

A Landfill is a carefully engineered depression in the ground (or built on top of the ground, resembling a sports stadium) into which waste is put [Slide 11]. Landfills are lined to avoid leakage into the local environment and groundwater. When full, landfills are capped with a layer of plastic or clay and then dirt and grass to create a hill.

### Types of Landfills

- Municipal Solid Waste (MSW): Specifically designed to receive household waste, as well as other types of nonhazardous wastes.
- Industrial Waste Landfill: Designed to collect commercial and institutional (i.e. industrial waste), which is often a significant portion of solid waste, even in small cities and suburbs.
- Hazardous Waste Landfills: Facilities used specifically for the disposal of hazardous waste. These landfills are not used for the disposal of solid waste.

#### FACT CHECK:

*The Washington Post* counted 1,098 landfills in the United States in 2009, down from 7,683 in 1986. Experts caution, however, that this decrease is somewhat misleading because today's landfills are larger than those from the past.



## Landfill Contents

Landfills are sites of disposal for any municipal solid waste that is not recycled, composted, or combusted. It is also where the residues of recycling and combustion operations are disposed.

Benefits	Drawbacks
After they are filled and sealed, they can be used for land reclamation. Some become parks.	Waste placed there may never degrade
Modern landfills include liners and other protective measures to limit harmful environmental impacts	Toxic chemicals can seep into groundwater
	Landfills smell



## Disposing of Specific Materials

### **Glass**

Glass is made by melting silica sand, limestone, soda ash, and *cullet* (crushed, recycled glass) [Slide 12]. It is 100% recyclable and can be melted into new bottles, jars, and other food containers without losing quality or purity [Slide 13]. To be recycled, however, cullet must be free of contaminants like metals, ceramics, gravel, and stone. Glass must also be sorted by color before melting.

#### **FACT CHECK:**

**The weight of glass bottles has been reduced by an average of 40% since the 1980s. In 2000, Coca-Cola introduced its new “Ultra Glass” bottle. The company has reported that this new bottle has prevented the use of 52,000 metric tons of glass from 2000-2012. This has reduced carbon dioxide emissions by 26,000 tons, which is equivalent to planting 8,000 trees!**

Glass that cannot be recycled is sent to the landfill, where it takes up space because it does not compress or degrade over time. Glass is *inert*, however, which means it does not release harmful chemicals into the soil.



## **Metals: Steel and Aluminum**

The majority of metal food containers are made out of steel or aluminum. Both are easily recyclable [Slide 14].

### **FACT CHECK:**

**According to the Steel Recycling Institute, more than 80% of steel in the American domestic industry is recycled each year. All new steel produced includes a minimum of 25% recycled material.**

Metals that are not recycled, however, make their way to the landfill, where they biodegrade over 50-100 years.

### **FACT CHECK:**

**According to the Aluminum Association, the United States recycled 66.7% of aluminum beverage cans used in 2013. Recycling this many cans saves enough energy to fuel 1,000,000 cars on the road for a full year! On the other hand, the Association of Plastic Recyclers and the American Chemistry Council report only a 30.9% recycling rate for plastic bottles in 2013.**



## Paper and Cardboard

Today, almost all paper and cardboard is made from wood pulp. Paper can be recycled, but there are benefits and drawbacks to doing so [Slide 15].

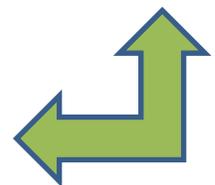
Unlike some materials, paper can only be recycled a finite number of times. The long wood fibers used in making paper are chopped shorter each time they are made into paper. When they become too short, they are useless. That is why some paper products contain only a percentage of recycled paper.

Secondly, many recyclable papers and cardboards are covered in ink, which has to be removed before recycling. The ink removal process involves bleaching fibers, which releases toxic waste into the environment.

Finally, recycling paper has relatively low energy savings compared to recycling other materials such as steel or glass.

**FACT CHECK:**  
The American Forest & Paper Association reports that 66.8% of paper was recycled in 2015. This is a dramatic increase from only 33.5% in 1990.

While many paper and cardboard products are recyclable, those that come in contact with grease and food waste have to be sent to the incinerator or landfill. Paper that ends up in a landfill can leach toxic chemicals like inks and dyes into the soil and water as it breaks down.



**FACT CHECK:**

**In 2015, the American Forest & Paper Association reported that 21.7 million tons of paper was sent to landfills.**

Paper made from wood pulp can contribute to compost. If it contains harmful inks, dyes, and other chemicals, however, it can release dangerous toxins and should not be composted.

**Plastics**

Most plastics are made from petrochemicals derived from crude oil, gas, or coal. Food packaging is typically made out of thermoplastics, virtually all of which are recyclable. They can be melted and reused as raw materials for production of new products.

However, plastic is very difficult to recycle because there are many different kinds of plastic and each has to be recycled in a different way [Slide 16].

**FACT CHECK:**

**Only 6.5% of plastics are recycled in the U.S. each year, and only 7.7% are combusted in waste-to-energy facilities.**



The majority of plastic food packaging ends up in landfills where it may take up to 1,000 years to decompose and can leak pollutants. Harmful chemicals are used in the plastic manufacturing process. These substances have been shown to negatively affect human health. (For more information on the health consequences of plastics, visit <https://www.scientificamerican.com/article/plastic-not-so-fantastic>.)

**FACT CHECK:**

**According to a 2015 report by the Natural Resources Defense Council, less than 14% of plastic packaging is recycled.**

### **Biodegradable Materials**

Biodegradable materials can be broken down into raw materials by biological agents, like bacteria and fungi. Biodegradable packaging can be made from natural materials like corn and potato starches, wood, and sugarcane. Although some companies are experimenting with biodegradable packaging, it is mostly found in takeout containers.

**FACT CHECK:**

**The Food and Drug Administration (FDA) classifies a material as biodegradable if it breaks down within 5 years.**



In 2010, SunChips introduced a biodegradable bag made from *polylactic acid* (PLA), a corn-based polymer [Slide 17]. The product failed, however, because consumers complained that the crinkling sound from the packaging was too loud.

When treated as compost, biodegradable materials can break down safely, naturally, and relatively quickly, “disappearing” into nature. At the same time, biodegradable materials are not universally embraced.

**FACT CHECK:**  
**Bagasse, packaging made from sugarcane pulp, degrades in 60-90 days when composted.**

Not all materials deemed biodegradable break down in all conditions. Biodegradable materials will not break down in a landfill because the environment there is *anaerobic*, meaning oxygen-lacking. Biodegradable materials could also encourage consumers to buy more and generate more overall waste because they think they are making an environmentally-friendly purchase.



## **Questions:**

- 1) How can you reduce your amount of food packaging waste?
  - a) Avoid buying more food than you will consume
  - b) Buy foods with less packaging
  
- 2) Name two of the positive effects of recycling.
  - a) Conserve resources and energy
  - b) Reduce water pollution
  - c) Reduce greenhouse gases
  - d) Supply raw materials to industry
  - e) Stimulate the development of greener technologies
  
- 3) Why do some people criticize waste-to-energy combustion?
  - a) Undermines zero waste efforts
  - b) Filters may not remove all pollutants, releasing dangerous gases
  
- 4) Why can't all paper be recycled safely?
  - a) It may have been recycled so many times already that the fibers are too short to make new paper
  - b) It may include ink, dyes, or other chemicals which must be separated from the paper first. This requires a bleaching process that can release dangerous chemicals into the environment.
  
- 5) What type of plastic is most food packaging made from? Can it be recycled?
  - a) Thermoplastics
  - b) Yes, virtually all thermoplastics used for food packaging can be recycled

**Food for thought: All packaging materials have environmental impacts. What do you think are some solutions for reducing the amount of packaging that Americans discard every year?**



**TEACHER SHEET**  
**How Much Food Packaging Waste Does Your Classroom Produce?**

Day 1: Have your students save every piece of food related packaging that they would normally dispose of. Make a place in your classroom where these items can be stored for use in the activity the following day.

Day 2: Find out how much food packaging waste your class produces in 1 day, 1 week, 1 month, and 1 year.

*Step 1:* Have students sort all packaging waste into two piles, one for recyclables and one for trash.

*Step 2:* Weigh each pile and record the data for use in the next step. How many pounds of trash and how many pounds of recycling did you generate?

	Recyclables	Trash	Total
Weight	Lbs.	Lbs.	Lbs.

*Step 3:* Calculate how much waste your class produces in 1 day, 1 week, 1 month, and 1 year.

	Recyclables	Trash	Total
Day	Lbs.	Lbs.	Lbs.
Week (Day Total x 7)	Lbs.	Lbs.	Lbs.
Month (Day Total x 30)	Lbs.	Lbs.	Lbs.
Year (Day Total x 365)	Lbs.	Lbs.	Lbs.



*Step 4:* Knowing how much waste your class produces, how long would it take for you to produce one ton of trash? (Hint: 1 ton = 2,000 lbs.)

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*Step 5:* Calculate the volume of your classroom's trash can using the formula *length x width x height*. Count how many times (approximately) you have to fill/empty the trash can with your class's waste. Multiple this number by the volume you calculated to estimate the total volume of waste that your class produced.

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### Questions

1. Were you surprised by how much waste your class generates?
2. Does your school have a recycling program?
3. After completing this activity, can you think of any ways that you could reduce the amount of waste you generate?

### Additional Activity

*Step 1:* Separate all aluminum cans, glass bottles, and plastic bottles from your recycling pile.

*Step 2:* Count how many of each item you collected.

	Aluminum Cans	Glass Bottles	Plastic Bottles
Total			

*Step 3:* Use the recycling converter from the EPA to see what your recyclables can do:

<https://www3.epa.gov/epawaste/conservation/tools/iwarm/widgets/3rwidget.htm#>



## STUDENT WORKSHEET

### How Much Food Packaging Waste Does Your Classroom Produce?

Yesterday you saved all of your food packaging. Now it is time to find out just how much food packaging waste you generate as a class.

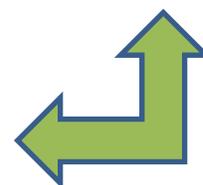
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*Step 2:* Weigh each pile and record the data for use in the next step. How many pounds of trash and how many pounds of recycling did you generate?

	Recyclables	Trash	Total
Weight	Lbs.	Lbs.	Lbs.

*Step 3:* Calculate how much waste your class produces in 1 week, 1 month, 1 year

	Recyclables	Trash	Total
Week (Day Total x 7)	Lbs.	Lbs.	Lbs.
Month (Day Total x 30)	Lbs.	Lbs.	Lbs.
Year (Day Total x 365)	Lbs.	Lbs.	Lbs.





Additional Activity

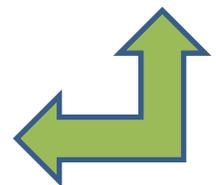
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*Step 2:* Count how many of each item you collected.

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Total			

*Step 3:* Use the recycling converter from the EPA to see what your recyclables can do:

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## **Trash- It's an International Issue**

Did You Know?

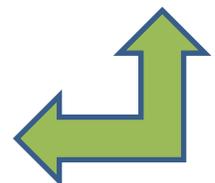
The Great Pacific Gyre (Garbage Patch) is found between Hawaii and California. Some reports have estimated it to be twice the size of the continental United States, but no one can accurately measure the boundaries of trash gyres because they are vast, remote and always shifting with ocean conditions. In any case, plastic marine debris is now found on the surface of every ocean on Earth. In addition to the harmful impact of debris on marine life, gyres can act as floating transportation, allowing non-native species to hitchhike to unfamiliar parts of the world, threatening biodiversity.

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Read the attached article “Great Pacific Garbage Patch” and answer the following questions. Answer questions 1-3 on your own then discuss your answers and answer question 4 as a group. (Use full sentences in your answers.)

1. What is the Great Pacific Garbage Patch and how did it form?

2. What are the two main reasons plastic makes up the majority of debris in the Great Pacific Garbage Patch?



3. What impact does the Great Pacific Garbage Patch have on marine life?

4. Pretend you are in charge of an international commission tasked with cleaning up the Great Pacific Garbage Patch. Create a proposal for shrinking the size of the garbage patch. Explain your thinking.



## TEACHER SHEET

### Trash- It's an International Issue [Slide 18]

Did You Know?

The Great Pacific Gyre is a floating island of garbage formed by ocean currents and found between Hawaii and California. Some reports have estimated it to be twice the size of the continental United States, but no one can accurately measure the boundaries of trash gyres because they are vast, remote and always shifting with ocean conditions. In any case, plastic marine debris is now found on the surface of every ocean on Earth. In addition to the harmful impact of debris on marine life, gyres can act as floating transportation, allowing non-native species to hitchhike to unfamiliar parts of the world, threatening biodiversity.

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Read the attached article “Great Pacific Garbage Patch” and answer the following questions. Answer questions 1-3 on your own then discuss your answers and answer question 4 as a group. (Use full sentences in your answers.)

Article

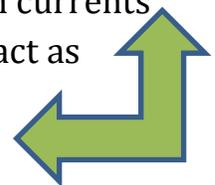
<http://nationalgeographic.org/encyclopedia/great-pacific-garbage-patch/>

Video

<https://www.youtube.com/watch?v=Co43TXJXryI>

#### **1. What is the Great Pacific Garbage Patch and how did it form?**

The Great Pacific Garbage Patch is a collection of marine debris, or litter, in the North Pacific Ocean. It was formed by the North Pacific Subtropical Gyre and covers about 7.7 square miles. A Gyre is a system of circular ocean currents formed by wind patterns and the rotation of the planet. Currents act as



highways that transport trash to the center of a gyre that tends to be very calm and stable.

## **2. Why does plastic make up the majority of debris in the Great Pacific Garbage Patch?**

(1) Plastic's durability, low cost, and malleability means that it is increasingly used in both consumer and industrial products.

(2) Plastic goods do not biodegrade but instead break up into smaller and smaller pieces. Some microplastics are so small that they cannot be detected by satellites or even the naked human eye.

## **3. What impact does the Great Pacific Garbage Patch have on marine life?**

Marine mammals can get entangled in abandoned plastic fishing nets where they can drown in a phenomenon called 'ghost fishing.' Trash can also block sunlight thus threatening the entire marine food web because algae and plankton, an important food source for fish and turtles, is unable to grow. Additionally trash leaches out harmful chemicals and pollutants that impact the health of marine animals.

## **4. Pretend you are in charge of an international commission tasked with cleaning up the Great Pacific Garbage Patch. Create a proposal for shrinking the size of the garbage patch. Explain your thinking.**

This is a critical thinking question. Break students into groups of 4-6 and have them brainstorm ideas. After they have developed a plan have students share their plans with the class and have a discussion about why they chose to do things and what the advantages and disadvantages of their plan might be. (Economic Cost, Damage to Marine Life, International Collaboration Issues, etc.)



## Vocabulary Sheet

**Anaerobic:** an environment that lacks oxygen

**Bagasse:** crushed sugar cane or beet refuse, can be used to make paper or bioplastics

**Biodegradable:** a material capable of decaying through the action of living organism such as fungus and bacteria

**Bioplastic:** plastic suitable for use as biomaterial

**Climate change:** shifts in climate and weather; recent climate change is the result of global warming

**Cullet:** recycled broken or waste glass used in glassmaking.

**Composting:** the process of mixing various decaying organic substances (dead leaves, fabric, etc) to use as fertilizer

**Global warming:** recent rise in Earth's global average temperature caused by greenhouse gases

**Greenhouse gases:** gases that trap heat in the atmosphere and warm the earth's temperature, resulting in global warming and, ultimately, climate change

**Incineration:** a waste treatment process that involves the combustion, or burning, of organic substances contained in waste materials

**Landfill:** a place to dispose of refuse and other waste material by burying it and covering it over with soil

**Municipal Solid Waste:** the everyday items that are discarded, thrown in the trash, by the public

**Petrochemicals:** a chemical substance obtained from petroleum or natural gas



**PLA (Polylactic Acid):** a biodegradable thermoplastic derived from cornstarch or sugarcane

**Polyethylene Terephthalate (PET):** clear, lightweight, non-toxic, and flexible thermoplastic, used to make soda bottles

**Recycling:** the process of converting waste into reusable material

**Thermoplastics:** a plastic that is soft and pliable when heated without any change to its inherent properties.

**Trash Gyre:** a naturally occurring ocean current vortex where trash collects to form large floating islands

