MARINE DEBRIS TIMELINE: How Long Does Trash Last?

OVERVIEW
In this activity you will use a marine debris decomposing timeline and some everyday household products, to predict how long the products take to completely decay.

OBJECTIVES
Following completion of this lesson, students will recognize that trash takes a long time to decompose, and ordinary household objects may take centuries to decay. The long life of marine debris means it can continue to harmfully impact our oceans for many years, a fact that can be modified by positive human behavior.

GRADE LEVEL 3rd-12th grades

BACKGROUND
What is marine debris? Marine debris is defined as large amounts of paper, plastic, rubber, metals, textiles, derelict fishing gear and/or vessels or other lost or discarded items that enter the marine environment every day. It is one of the most widespread pollution problems facing our oceans and waterways and is an issue on a global level. Not only is marine debris a threat to the natural environment, it is a hazard to navigation, can negatively impact our economy, and can be detrimental to human health.

Where does marine debris come from? It is not just litter that we deposit in or near the ocean. Marine debris can come from sources far inland. Marine debris can come from any number of sources including littering, illegal dumping, careless or poor waste management, storm water discharges (especially after a significant rain event) and extreme natural events including hurricanes and nor’easters. In the ocean, marine debris can come from lost or improperly discarded fishing vessels and gear, stationary platforms, cargo ships and other vessels, and rivers that connect to the sea that carry litter, debris and storm drain waste from the land to the ocean.

In nature, debris and waste break down through a natural mechanical, chemical and bacterial process into simpler matter. This process is known as decomposition. When plastic is exposed to sunlight, air and water, a combination of mechanical and chemical processes take place that
break down plastic into smaller pieces. **Decomposers** such as bacteria, fungi and scavengers, break down dead organisms and natural waste products, ultimately, returning the waste to the environment as **nutrients**. The speed at which waste decomposes depends on a variety of factors, such as temperature, humidity, size and available oxygen. Organic substances such as food or paper products decay fairly quickly. Their decomposition is often called **biodegradation** because they break down safely and disappear into the environment. Inorganic products such as plastics and glass take much longer to decompose. We do not even know the time it may take some objects to decompose, possibly centuries, if ever.

The most prevalent type of marine debris is made of plastic such as disposable water bottles and grocery bags. The enormous Pacific Ocean trash vortexes, known as “garbage gyres,” are notorious for their immense collection of hundreds of square miles of plastic waste trapped within currents. Larger pieces of plastic waste break down into smaller pieces, and eventually become so small they are known as **microplastics** (5 mm or less in length). As plastic degrades, it also releases chemicals that are toxic that **contaminate** the water. While plastic disintegration into toxic **polystyrene** chemicals tends to occur in warmer waters (86 degrees or more), the resulting chemicals can spread, causing widespread contamination to the ocean’s ecosystems.

All plastics are **detrimental** to marine life. Large items, such as 6-pack rings, grocery bags, or fishing monofilament, may be inadvertently ingested or tangled around marine life, impairing mobility and health. When sea creatures consume plastics, toxic chemicals are ingested or absorbed which can impact hormones, digestion, and reproduction. Microplastics also pass through the food chain, starting at the bottom where they are ingested by microscopic zooplankton and become increasingly concentrated as they move up the food chain, including all the way up to humans.

What can you do to help? The problem will only get worse unless we change the way we consume and dispose of products. Reduce, reuse, recycle and dispose of trash properly to keep debris out of the ocean in the first place. Bring your own shopping bag, drink out of a reusable bottle, and join a group cleaning up the beach. Be more conscious of how many disposable plastic items you are using and be sure to use the **recycle** bin. Share your knowledge and educate others.

**MATERIALS**

<table>
<thead>
<tr>
<th>Marine Debris Timeline</th>
<th>Styrofoam Cup</th>
<th>Fishing Line</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paper Towel</td>
<td>Milk Carton</td>
<td>Tin can</td>
</tr>
<tr>
<td>Plastic Water Bottle</td>
<td>Baby Diaper</td>
<td>Cardboard box</td>
</tr>
<tr>
<td>Plastic Grocery Bag</td>
<td>Aluminum Soda Can</td>
<td>Newspaper</td>
</tr>
<tr>
<td>Plastic fruit (apple)</td>
<td>6-pack plastic holder</td>
<td>Cigarette butt photo</td>
</tr>
</tbody>
</table>
PROCEDURE
Two ways to conduct this lesson will be described, both of which use the same materials. The first is a Supervised Group Study, in which the teacher explains the lesson and leads the interactive activity. The second format is Self-Guided Independent Study, which works well when there are several interactive stations which the students can rotate through, or if the teacher prefers, encourage individual educational exploration. In this second format, the teacher introduces the lesson, but students work independently or in small groups on the interactive portion of the activity.

*Supervised Group Study:* The teacher explains the concept of marine debris, identifying where it typically originates and why it is persistent in the environment. The concept of decomposition is also introduced, and general examples provided for organic vs. inorganic decay.

Each person in the group selects a waste product to make a prediction. The student places the item on the Marine Debris Timeline according to how long they believe it will take to decompose completely. For example, if the student believes it will only take 3 months to decay, they physically place the item on that spot on the Timeline. They can guess a decay time that is not specifically shown on the Timeline by putting the waste product approximately where that time designation would be.

After all students have placed their waste products on the Timeline, the teacher gives each student the Trash Decay Times handout. Students compare the actual decomposition times to their guesses, and may wish to then move their product to the correct decay time on the Timeline, observing what types of wastes actually decay fastest (and thus impacting the marine life less) and which are more persistent and damaging. The class can also use the *Marine Debris from Land and Sea* poster to check their answers. Teachers can explain why organic items decay much faster than inorganic ones, as well as why packaging can be more harmful than the product inside.

*Self-Guided Independent Study:* The teacher explains the concept of marine debris, identifying where it typically originates and why it is persistent in the environment. The concept of decomposition is also introduced, with examples provided for organic vs inorganic decay.

Working independently or in groups of two, the students place all of the waste products from the bin onto the Marine Debris Timeline according to how long they believe it will take to decompose completely. For example, if the student believes it will only take 3 months to decay, they physically place the item on that spot on the Timeline. They can guess a decay time that is not specifically shown on the Timeline by putting the waste product approximately where that time designation would be.

When all the items have been placed on the Timeline, the student checks their answer themselves by reviewing the Trash Decay Times answer sheet, which is hidden in a large manila envelope near the Timeline. Students may then wish to re-align their waste products on the Timeline to reflect correct decomposition rates, observing what types of wastes actually decay fastest (and thus impacting the marine life less) and which are more persistent and damaging.
An alternate format, after students have had a chance to physically place waste products on the Timeline and consider their relative stability, is to have students match up the waste products with the decay times on the *Match Marine Debris with Decay Time* handout. Using pencils, students draw lines connecting the item with the amount of time the student estimates it will take to completely decompose. Once completed, students can visually check their answer themselves by reviewing the *Match Marine Debris with Decay Time* answer sheet (prepared ahead of time by the teacher) which is hidden in a large manila envelope near the Timeline. Students may then wish to re-align their waste products on the Timeline to reflect correct decomposition rates.

**VOCABULARY**

**Marine Debris** is any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes.

**Decomposition** is the state or process of rotting decay.

** Decomposers** is an organism especially a soil bacterium, fungus, or invertebrate, that decomposes organic material.

**Nutrients** is a substance that provides nourishment essential for growth and the maintenance of life.

**Organic** is relating to or derived from living matter.

**Biodegradation** is the process by which organic substances are decomposed by microorganisms (mainly aerobic bacteria) into simpler substances such as carbon dioxide, water and ammonia.

**Inorganic** not consisting of or deriving from living matter.

**Microplastics** extremely small pieces of plastic debris in the environment resulting from the disposal and breakdown of consumer products and industrial waste.

**Contaminate** make (something) impure by exposure to or addition of a poisonous or polluting substance.

**Polystyrene** a synthetic resin that is a polymer of styrene, used chiefly as lightweight rigid foams and films.

**Detrimental** tending to cause harm.

**REFERENCES**

[https://www.nps.gov/teachers/classrooms/things_stick_around.htm](https://www.nps.gov/teachers/classrooms/things_stick_around.htm)


Marine Debris Time Line

How long does trash last?

- 2 - 4 weeks
- 2 months
- 6 months
- 3 years
- 20 years
- 30 years
- 50 years
- 100 years
- 200 years
- 400 years
- 425 years
- 450 years
- 600 years
Match Marine Debris with Decay Time

- Plastic Grocery Bag: 6 weeks
- Paper Towel: 2 months
- Plastic Bottle: 1-20 years
- Cardboard Box: 2-4 weeks
- Newspaper: 400 years
- Apple Core: 50 years
- Plastic Beverage Holder: 450 years
- Disposable Diaper: 7 weeks
- Aluminum Can: 425 years
- Tin Can: 200 years
- Foam Cup: 50 years
Time it takes for garbage to decompose in the environment:

Glass Bottle....................... 1 million years
Monofilament Fishing Line... 600 years
Plastic Beverage Bottles...... 450 years
Disposable Diapers............ 450 years
Aluminum Can..................... 80-200 years
Foamed Plastic Buoy.......... 80 years
Foamed Plastic Cups.......... 50 years
Rubber-Boot Sole............... 50-80 years
Tin Cans.......................... 50 years
Leather............................ 50 years
Nylon Fabric..................... 30-40 years
Plastic Film Container...... 20-30 years
Plastic Bag....................... 10-20 years
Cigarette Butt.................... 1-5 years
Wool Sock........................ 1-5 years
Plywood.......................... 1-3 years
Waxed Milk Carton............. 3 months
Apple Core....................... 2 months
Newspaper......................... 6 weeks
Orange or Banana Peel........ 2-5 weeks
Paper Towel....................... 2-4 weeks

Information Source: U.S. National Park Service; Mote Marine Lab, Sarasota, FL.
<table>
<thead>
<tr>
<th>Item</th>
<th># of Debris Items</th>
<th>% of Total Debris Items</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Cigarettes/cigarette filters</td>
<td>1,863,838</td>
<td>25%</td>
</tr>
<tr>
<td>2. Beverage Bottles (Plastic)</td>
<td>1,578,834</td>
<td>21%</td>
</tr>
<tr>
<td>3. Plastic Bottle Caps</td>
<td>822,227</td>
<td>11%</td>
</tr>
<tr>
<td>4. Food Wrappers (Candy, etc.)</td>
<td>762,353</td>
<td>10%</td>
</tr>
<tr>
<td>5. Bags (Plastic Grocery)</td>
<td>520,900</td>
<td>7%</td>
</tr>
<tr>
<td>6. Plastic Lids</td>
<td>419,380</td>
<td>6%</td>
</tr>
<tr>
<td>7. Straws, Stirrers</td>
<td>409,087</td>
<td>6%</td>
</tr>
<tr>
<td>8. Beverage Bottles (Glass)</td>
<td>390,468</td>
<td>5%</td>
</tr>
<tr>
<td>9. Other Plastic Bags</td>
<td>368,655</td>
<td>5%</td>
</tr>
<tr>
<td>10. Foam Take-Away Containers</td>
<td>365,584</td>
<td>4%</td>
</tr>
<tr>
<td>Top 10 Total Debris Items</td>
<td>7,511,325</td>
<td>64%</td>
</tr>
<tr>
<td>Total Debris Items Worldwide</td>
<td>11,794,314</td>
<td>100%</td>
</tr>
</tbody>
</table>