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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

Marine Debris Timeline	Styrofoam Cup	Fishing Line
Paper Towel	Milk Carton	Tin can
Plastic Water Bottle	Baby Diaper	Cardboard box
Plastic Grocery Bag	Aluminum Soda Can	Newspaper
Plastic fruit (apple)	6-pack plastic holder	Cigarette butt photo

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 micro-organisms (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

http://www.scdhec.gov/HomeAndEnvironment/Docs/SC_MARINE_DEBRIS_POSTER.pdf

https://marinedebris.noaa.gov/.../marine-debris-monitoring-and-assessment-project

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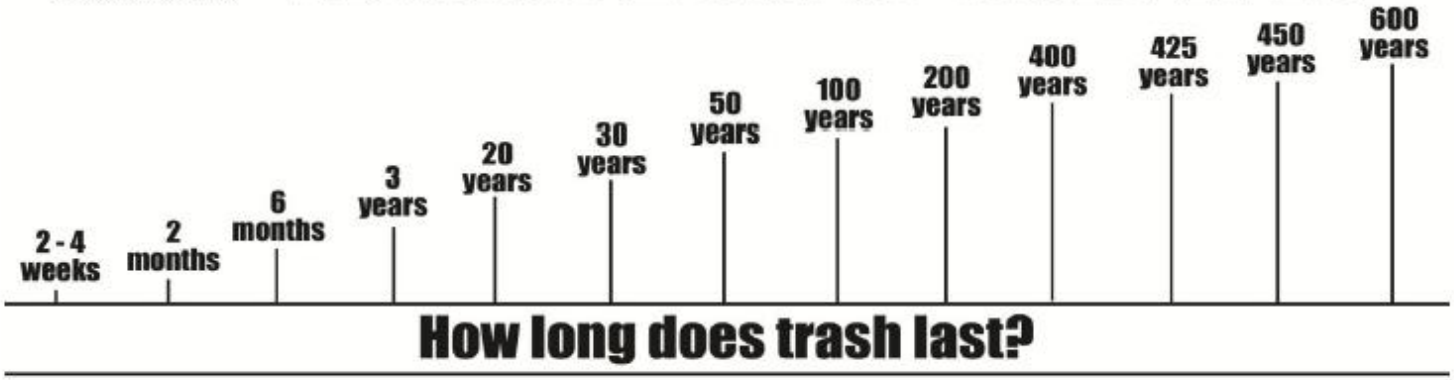
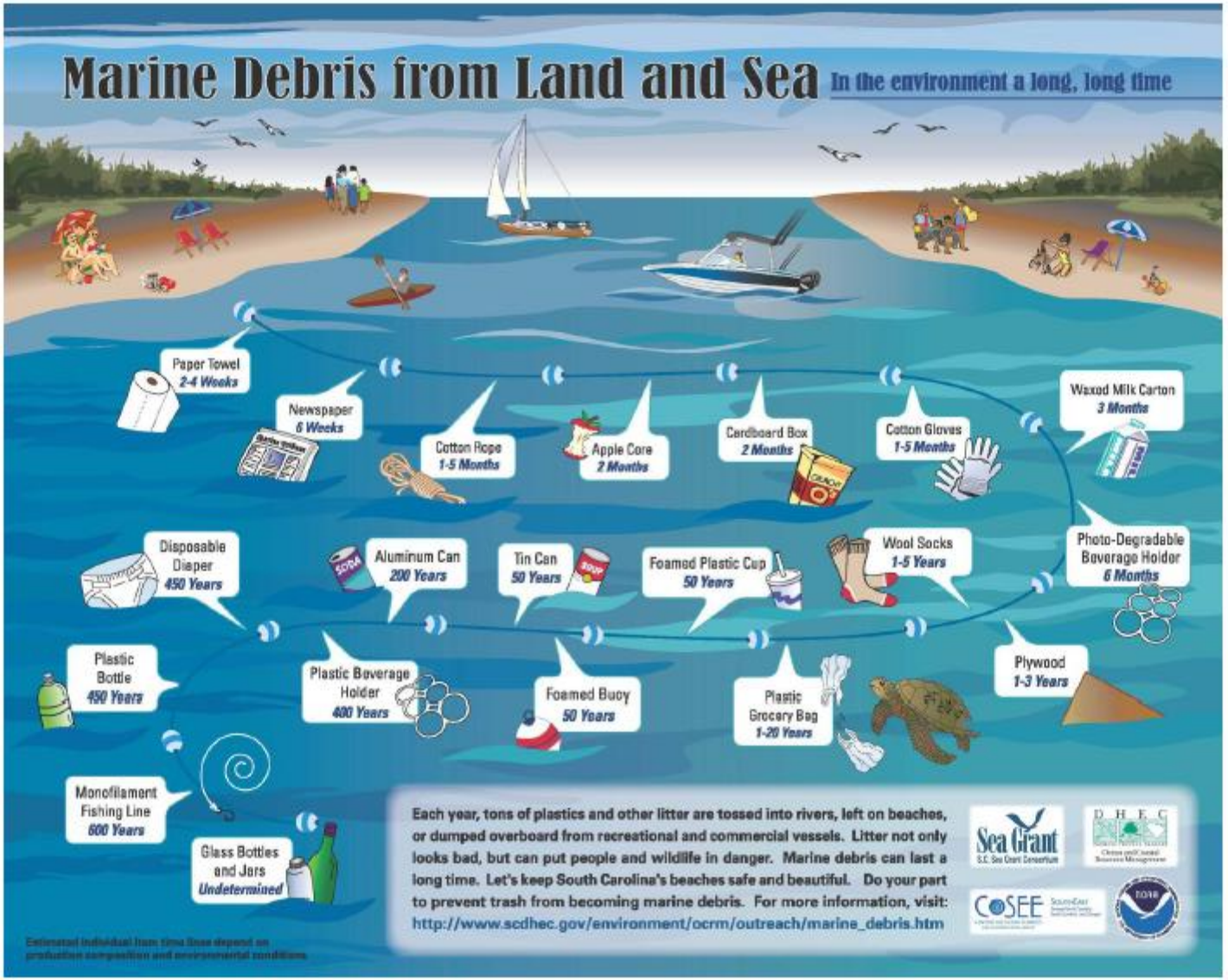
Marine Debris Time Line




Marine Debris from Land and Sea
In the environment a long, long time
Paper Towel
2-4 Weeks
Newspaper
6 Weeks
Cotton Rope
1-5 Months
Apple Core
2 Months
Cardboard Box
2 Months
Cotton Gloves
1-5 Months
Waxed Milk Carton
3 Months
Disposable Diaper
450 Years
Aluminum Can
200 Years
Tin Can
50 Years
Foamed Plastic Cup
50 Years
Wool Socks
1-5 Years
Photo-Degradable Beverage Holder
6 Months
Plastic Bottle
450 Years
Plastic Beverage Holder
400 Years
Foamed Buoy
50 Years
Plastic Grocery Bag
1-20 Years
Plywood
1-3 Years
Monofilament Fishing Line
600 Years
Glass Bottles and Jars
Undetermined
Each year, tons of plastics and other litter are tossed into rivers, left on beaches, or dumped overboard from recreational and commercial vessels. Litter not only looks bad, but can put people and wildlife in danger. Marine debris can last a long time. Let's keep South Carolina's beaches safe and beautiful. Do your part to prevent trash from becoming marine debris. For more information, visit: http://www.scdhec.gov/environment/ocrm/outreach/marine_debris.htm
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Match Marine Debris with Decay Time

 Plastice 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.

Top 10 Marine Debris Items Collected Globally of 2016		
Item	**# of Debris Items**	**% of Total Debris Items**
1. Cigarettes/cigarette filters	1,863,838	25%
2. Beverage Bottles (Plastic)	1,578,834	21%
3. Plastic Bottle Caps	822,227	11%
4. Food Wrappers (Candy, etc.)	762,353	10%
5. Bags (Plastic Grocery)	520,900	7%
6. Plastic Lids	419,380	6%
7. Straws, Stirrers	409,087	6%
8. Beverage Bottles (Glass)	390,468	5%
9. Other Plastic Bags	368,655	5%
10. Foam Take-Away Containers	365,584	4%
Top 10 Total Debris Items	7,511,325	64%
Total Debris Items Worldwide	11,794,314	100%