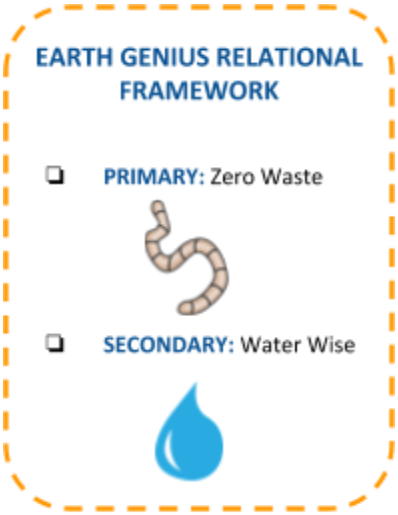
Pollution Solutions

Key Topics: [Point vs. Nonpoint Source] Pollution, Litter, Human Impact
Grade Levels: K, 3, 4-8
Inside and Outside

Lesson Overview:

How is litter created? What impact does it have on the environment, both humans and non humans? In this lesson students pose questions about the nature of the litter found around their school, make predictions, do a campus cleanup to cultivate environmental stewardship, and then brainstorm solutions to prevent litter.



Suggested Time Allowance:

Intro - PowerPoint and Cleanup Introduction (10 minutes)
Activity - Campus Cleanup Tour and Documentation (40 minutes)
Wrap Up (10 minutes)

Suggested Activities and Learning Objectives by Grade Level:

- K:
  - K-ESS-3 How can we prevent litter?
- 3:
  - 3-LS4-4 How can we prevent litter?
- 5:
  - 5-ESS3-1 Track the amount and kinds of litter collected and use it to inform a decision about how to prevent litter.
- MS:
  - MS-ESS-4 How does increased human consumption of natural resources impact the Earth's systems?

Essential Question(s) that Connect CCCs and SEPs:

- How does what I observe and note on campus about pollution, habits, and structures for humans change at different scales? Can I think of examples of what I am seeing as bigger or smaller? (Scale; Asking Questions & Defining Problems)
- What is already known about this cause and effect? How can I best communicate about this cause and effect relationship? (To my peers, campus, through a PSA, class presentation, etc) (Cause & Effect; Obtaining, Evaluating, and Communicating Information)

Materials:

- Beach box (a collection of natural items--could be from the beach or from any natural area)
- Jar with water and plastic soup

- Waste Bag (reused plastic or paper bags perhaps? Gather early)
- Hand Sanitizer
- Compostable or reusable gloves (supplied by OCE in bulk--one per student is sufficient)
- [Extension] art supplies: construction paper
- Campus map (found in the front office; ask for a copy)

EG Team Support Needed:

- None

Prep:

This lesson is to be done primarily outside. The preparation and introduction can be done inside with a projector. The tour is dependent on you being outside, but if raining and no solution for outside is formed, then have them look at campus maps and talk about possible areas of pollution from street/campus/community activities.

Multicultural Education for Resource Issues Threatening Oceans (MERITO) is a partner and has given us permission to use these as guides for your own briefing to do this lesson successfully. It is important to note that "marine debris" is not just litter found on the shore or in the ocean. Any items found on a school campus or anywhere in a watershed have the potential to travel, eventually, to our oceans! (Ex. via storm drain, rivers, streams, birds flying with plastic in mouth, etc)

Also, you may want to create your own tracking sheet for pollution you find on your campus cleanup. However, there is a sheet listed in the MERITO curriculum below AND ones found in curriculum cited at the bottom of this lesson plan.

Ask teacher ahead of time if this lesson could turn into an extension that she/he is willing to lead. It could tie in to campus cleanup announcements, PSAs written by students in the bulletin, or a project based learning component to human impact or science. If so, read on to the "Explain" section of activity procedure about documenting with photos. These will be helpful to the teacher.

Key the campus map and note Areas A, B, C etc you are going to take the students. Having a route, timing it, and pointing out specific things are an important thing to know in advance! Please at least identify the following zones 1) storm drain and talk about how that goes straight to creeks and then ocean, 2) lunch areas and litter that blows around and birds eat and fly away with littering somewhere else.

Lesson 6-4:
Trash Traits

Activity Summary

Through instruction and reading material, students will learn the two main characteristics of marine debris and how debris reaches the ocean. They will collect and pile various types of trash previously cleaned. Students will discover which items can easily be blown away by placing them on a table and using a fan as the wind. They will then experiment to find how easily certain types of debris float or sink, depending on their density, by using a bucket of water. Lastly, students will determine how certain objects can be blown away in the water by using a large shallow container and a fan.

Focus Questions

- What is marine debris?
- What characteristics make trash items likely to become marine debris?
- What are some sources of marine debris?

Learning Objectives

Students will be able to:

- Define marine debris
- Identify sources and physical properties of trash items that become marine debris
- Describe the impacts of marine debris on the ocean and marine ecosystems

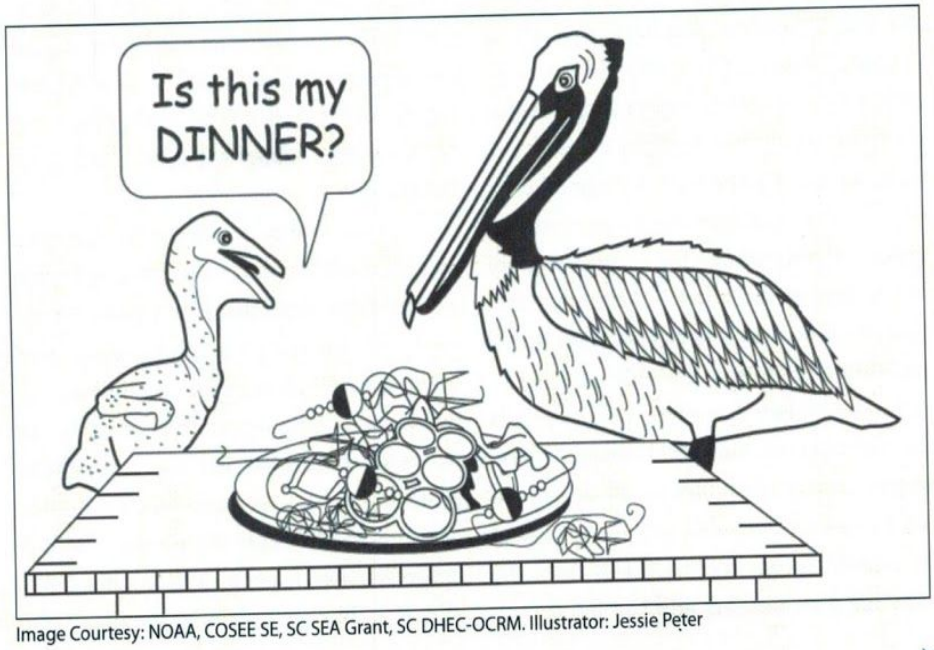


Image Courtesy: NOAA, COSEE SE, SC SEA Grant, SC DHEC-OCRM. Illustrator: Jessie Peter

Grades 4 – 12

Teaching Time

60-90 mins in class

Teacher Prep

1. Read activity background
2. Photocopy handouts
3. Clean and check all trash items before they are handled by students
4. Set up 3 or 4 demonstration stations:

Station 1:

- Position a fan at one end of a table where items can be placed in front of it to watch them blow.

Station 2:

- Fill a bucket with water.

Station 3:

- Fill a large, shallow container with water and place it in front of the fan.

Station 4:

- Find a sloped, outdoor area and fill a watering can.

Materials

- Students' MERITO® Academy logbook
- Plastic, glass, rubber, metal, paper, wood and food trash items (avoid any sharp objects or harmful chemicals)
- Bucket with water

...Continued

of being carried by the wind. During storms and other periods of high winds, almost any kind of trash (including glass, metal, and wood) can be blown into the ocean. The characteristics of buoyancy and the ability to be blown around are generally correlated. Lightweight objects tend to float and are also the items that are easily blown around.

In nature, materials are most commonly broken down through a process known as biodegradation. Biodegradation occurs when microorganisms (such as bacteria and fungi) **decompose** a material, causing it to be broken down into compounds (such as nutrients) that can be reused in the environment. Temperature and moisture levels affect the rate of biodegradation. Generally, the higher the temperature and the greater the moisture levels, the faster the rate of biodegradation. Natural materials tend to be more biodegradable than synthetic materials. Examples of biodegradable debris are food scraps, beverages, cotton fabric and wood.

Some materials are broken down by chemical interactions (for example, rust on steel) or by physical forces such as erosion and weathering. Debris that does not easily degrade remains in the environment for a long time and is labeled as "**persistent**." In general synthetic materials such as plastic, vinyl and rubber are the most persistent types of marine debris. **Non-degradable** debris does not decompose or chemically break down into smaller pieces and remains in the environment for a long time. Examples of non-degradable debris include plastic water and soda bottles, plastic bags, plastic food wrappers, nylon fishing line and nets, and car tires.

There are many places and activities that generate the debris that enters the marine environment. Any trash that is improperly disposed of, as well as any materials that are improperly transported or stored, have the potential to become marine debris. There are several sources of marine debris, including beachgoers, **litter** from people living inland, **storm drains**, combined sewer overflows, commercial and recreational vessels, industrial facilities, waste disposal activities, and offshore oil and gas platforms.

The United States generates significant quantities of trash- otherwise known as **municipal solid waste**, or garbage, every year. According to the U.S. Environmental Protection Agency (EPA), in 2005, U.S. residents, businesses, and institutions produced more than 245 million tons of municipal solid waste, which is approximately 4.5 pounds of waste per person per day. Although the U.S. represents roughly 5% of the world's population, we generate 40% of its waste. At 34%, paper and paperboard made up the largest component of generated solid waste.

Practicing the "3 Rs" (reduce, reuse, recycle) plus proper disposal of trash will go a long way towards reducing the amount of marine debris. Adopting pollution prevention strategies that produce less waste in the first place is an even better solution than recycling alone. Some methods to produce less waste include reusing materials, using reusable items rather than disposable ones, and reducing the amount of packaging that is used. For example, when shopping, use fabric bags instead of the plastic or paper bags provided by stores, and purchase items that have less packaging. Carry water in a reusable bottle rather than buying multiple bottles of water. Use cloth napkins and kitchen towels rather than disposable paper products.

Recycling is one way to reduce the amount of trash that must be disposed. Recycling is the collection and reprocessing of materials so they can be used again. Marine debris can only be truly managed by changing the behavior that causes it to enter the environment. Proper disposal of trash is the responsibility of every business, boater, and person.

Resources

1. www.vims.edu/bridge – Click on "Ocean Science Topics," then "Human Activities," then "Environmental Issues," then "Pollution."
2. NOAA's Marine Debris 101: www.marinedebris.noaa.gov
3. EPA's Marine Debris site: www.epa.gov/owow/oceans/debris
4. Ocean Conservancy Coastal Cleanup: www.oceanconservancy.org/our-work/marine-debris
5. "Addicted to Plastic," 2008 (documentary).

Sources of Marine Debris

Student Handout

Where Does Marine Debris Come From?

Marine debris comes from many different sources. Any trash that is improperly disposed of, as well as any materials that are improperly transported or stored, have the potential to become marine debris.

Main sources of marine debris:

- **Beachgoers** – Many beachgoers leave behind materials that can become marine debris, such as food packaging and beverage containers, cigarette butts, and toys like shovels, sand pails, and Frisbees. This trash can be blown into the ocean, picked up by waves, or washed into the water when it rains.
- **Improper disposal of trash on land** – Trash can be blown or washed directly into the oceans if it is littered or disposed of carelessly. Even if trash that is generated hundreds of miles inland can become marine debris if it is blown or washed into rivers or streams and carried to sea.
- **Storm drains and combined sewer overflow** – Storm water runoff (the water that flows along streets or along the ground as a result of a storm) can carry street litter into sewer pipes, which carry this water and debris to a nearby river or stream, or even directly to the ocean. Combined sewer pipes cause problems when heavy rainstorms cause too much water to enter the sewer system. When this happens, the amount of water in the sewer pipes exceeds the sewage treatment plant's handling capacity.
- **Ships and other vessels** – Although it is illegal in the United States to put any type of plastic trash into the navigable waters of the U.S. sometimes trash is thrown overboard on purpose.
- **Industrial facilities** – can contribute to the marine debris problem when waste items generated by industrial processes (i.e. production scraps, flawed products, and packaging material) when disposed of improperly.
- **Waste disposal activities** – can cause a problem when trash is lost during collection or transportation, or when trash blows or is washed away from disposal facilities.
- **Offshore oil and gas platforms** – Because offshore oil and gas platforms are surrounded by water, any items that are lost from these structures can become marine debris.

The Ocean Conservancy conducts an annual, international beach cleanup. Here's a top ten list of the most commonly found debris items over 25 years of beach cleanups.

Data originally published by Ocean Conservancy, "Tracking Trash, 25 Years of Action for the Ocean, 2011 Report.

Top Ten Items Over 25 Years

RANK	DEBRIS ITEM	NUMBER OF DEBRIS ITEMS	PERCENTAGE OF TOTAL DEBRIS ITEMS
1	CIGARETTES/CIGARETTE FILTERS	52,907,756	32%
2	FOOD WRAPPERS/CONTAINERS	14,766,533	9%
3	CAPS, LIDS	13,585,425	8%
4	CUPS, PLATES, FORKS, KNIVES, SPOONS	10,112,038	6%
5	BEVERAGE BOTTLES (PLASTIC)	9,549,156	6%
6	BAGS (PLASTIC)	7,825,319	5%
7	BEVERAGE BOTTLES (GLASS)	7,062,199	4%
8	BEVERAGE CANS	6,753,260	4%
9	STRAWS/STIRRERS	6,263,453	4%
10	ROPE	3,251,948	2%
	TOP TEN TOTAL DEBRIS ITEMS	**132,077,087**	**80%**
	TOTAL DEBRIS ITEMS WORLDWIDE	**166,144,420**	**100%**

SOURCE: OCEAN CONSERVANCY/INTERNATIONAL COASTAL CLEANUP

Student Handout

Name: _____ **Date:** _____

Trash Traits Results

Item	Material (plastic, paper, metal, etc.)	Does it float?	Could wind move it?	Could water move it?	How likely is it to become marine debris?	What is the likely source of the item, and how could you prevent it from becoming marine debris? Refer to "Sources of Marine Debris," *(See page 6-4.6)*
Objeto	*Material (plástico, papel, metal, etc.)*	*¿Puede flotar?*	*¿Lo puede mover el viento?*	*¿Lo puede mover el agua?*	*¿Qué tan probable es que se convierta en desecho marino?*	*¿De dónde podría venir el objeto, y como podrías evitar que se convierta en desecho marino? Revisar las "Sources of Marine Debris," (See page 6-4.6)*
1.						
2.						
3.						
4.						
5.						
6.						
7.						
8.						

Activity Procedure:

Engage:

Bring the beach box that is filled with different items. Also, fill a jar with water and ripped soft plastic and place in jar floating. Cut up some pieces of chip bags and place in there too! Make it look like a soupy mess. You want to go for the reaction and get them thinking about the topic of marine debris and plastics in our ocean and streams. It's easier to ignore a piece of litter on the ground on campus, but after this lesson, they may think twice!

Explore:

Action:

I am going to pass out a beach box of different artifacts found in the natural environment. I want you to share with your partner(s) around your table or buddy if you think it is marine debris or not. Just because I said "marine" and "beach" doesn't mean that it came from there. Some of these items are typically found on streets, schools, and any public space where humans are.

One thing you can stress is: Let's get the word "Trash" out of our vocabulary! Where does "trash" go? Nobody knows. We have landfill, recycle, compost, and reusing. Trash is just a word for things we don't care about.

Ask some students to raise their hands and tell the class what they discovered. Get a few different responses as to not single out a student and say they were the only one who got the answer right! Now, we are going to review a few things on the screen before we go out on our campus cleanup & documentation tour.

Review visuals provided to you and share about the animals, how it can affect species on and off campus, and ask students if they could think of ways it gets from us to them.

Leave the visual about school lunch for later after you get back from your tour on campus and return to class or meeting spot outside.

Explain:

Action:

Give each team a campus map where they can see their route and start understanding how maps to convey information. Pass out clip boards to teams and ask them to draw or write areas on their campus map what areas they determine as 'polluted'.

Does anyone know what I mean by polluted? When the water, air, or space is contaminated or "yucked up" by either synthetic or biological material(s). Examples can include: leaf litter build up in the gutters and storm drains, plastic baggies floating around, oil stains on the asphalt, etc.

Let's get ready to go on tour with the proper gear for cleaning up. We won't just look at waste, let's do something about it! Even if this is not our own litter, do you think it is still important to clean up? Why?

(Ex. look for these answers: it helps animals not eat it and get plastic in their gut, it shows good leadership/self-manager skills, lead by example, encourages others to keep a clean campus, shows you care, could help it not wind up in the ocean or local creeks/habitats where wildlife live, or it could attract wildlife from coming on campus to eat our garbage)

Elaborate:
Return to garden or classroom for handwashing and circling up. Discard of compostable gloves in an appropriate way. You may have to take off site to dispose of properly if there is not an organic recycling bin on campus. Give them each a squirt of hand sanitizer and ask that they wash their hands before eating anything.

Show the last picture of the two different lunches brought by students. After they answer and talk about other ways to pack a zero waste lunch, you might initiate a discussion of how we could make our cafeteria and events on campus zero waste. This will motivate them to imagine ways that they could empower their school as leaders. Tell them if they have a certain idea and want to talk more or need support, ask their teacher or come to Garden Club and talk to you about it!

Evaluation:

Let's review our clipboards. Can you circle items that you found often? Talk to your partners about anything that you noticed was causing something else to happen. I will ask each team to stand up and note certain findings. Use this structure to answer your question:

While we were on the campus clean up tour, we saw _____ and it causes _____ to happen. If _____ was done instead, then _____ would be the outcome.

For example: While we were on the campus clean up tour, we saw oil on the asphalt and it causes oil to leak off campus. If we had a catch area, like a patch of grass or something by the drainage area, then it would be better and not go down the drain to the creek.

Also, refer back to the Learning Objectives for your grade level and ensure that they have been met by asking the given learning objective question.

Extension Activities:

- Make colorful signs encouraging recycling and "zero waste" lunches with less packaging, and the connection of land-based litter to watershed/ocean pollution.
- Create mosaics by gluing found litter in the shape of marine life with sayings that will remind other students not to litter. Use the variety of colors, finishes, shapes, and textures of your found litter to creatively and artistically represent the sea-life you are portraying. Students can work in small groups to complete the project.

- Other Helpful Cleanup Worksheet https://fergusonfoundation.org/wp-content/uploads/2012/05/schoolyardcleanup_outline.pdf

Tips and Caveats:

- Noted throughout lesson plan

Cited Curriculum:

- Do the Rot Thing, Environmental Lunch (Page 8 has the template for documenting items found)
- MERITO Ocean Conservation & Education
    - One Cool Earth Directors were trained in the MERITO curriculum and have a partnership with this team in Southern California
- Ocean Conservancy Coastal Cleanup Data Card