5-8 Litter-free Land to Sea Activity

South Carolina Aquarium

Overview

Focus Questions
How does plastic litter affect ecosystems and watersheds? How do macroplastics lead to microplastics? What are some lifestyle changes that could be made to reduce our litter, waste and overall ecological footprint?

Activity Synopsis
Students will participate in a scientific investigation in which they read a case study about microplastics affecting coastal South Carolina. They will discuss the impact microplastics may have on our food, then differentiate between microplastics and macroplastics. Students will hypothesize what will be the most common macroplastic collected around their school, record data as they collect litter around the school, graph data to analyze, and generate solutions to litter pollution and their own ecological footprint.

Time Frame
1.5 hours-2 hours

Objectives
The learner will be able to:

- make a personal connection to microplastics impacting a South Carolina beach through a case study
- understand the impact microplastics may have on our seafood
- conceptualize how macroplastic litter leads to microplastics in our water sources
- hypothesize what is the most common macroplastic found on their school grounds
- collect litter as a team to investigate their hypothesizes
- sort and group litter to record their data quantitatively
- graph data collected
- generate solutions to litter pollution
- communicate ways to reduce their ecological footprint

Student Key Terms

- citizen science
- ecological footprint
- ecosystem
- hypothesis
- microplastic
- macroplastic
- watershed

Teacher Key Terms

- biomagnification
- exfoliants
- nurdles
- quantitative data

Standards

South Carolina College- and Career-Ready Science Standards 2021

5th Grade: 5-LS2-1, 5-ESS2-1, **5-ESS3-1**
6th Grade: 6-ESS2-4
7th Grade: **7-PS1-3**, 7-LS2-1, 7-LS2-2, **7-LS2-4, 7-ESS3-3**

8th Grade:

*** Bold standards are the main standards addressed in this activity**

2014 Academic Standards and Performance Indicators for Science

5th Grade: 5.S1A.1, 5.S.1A.2, 5.S1A.3, 5.S.1A.4, 5.S.1A.6, 5.S.1A.7, 5.S.1A.8, 5.E.3A.1, **5.E.3B.3,** 5.E.3B.4, 5.L.4B.3
6th Grade: 6.S1A.1, 6.S.1A.2, 6.S1A.3, 6.S.1A.4, 6.S.1A.6, 6.S.1A.7, 6.S.1A.8
7th Grade: 7.S1A.1, 7.S.1A.2, 7.S1A.3, 7.S.1A.4, 7.S.1A.6, 7.S.1A.7, 7.S.1A.8, 7.EC.5A.1, 7.EC.5B.2
8th Grade: 8.S1A.1, 8.S.1A.2, 8.S1A.3, 8.S.1A.4, 8.S.1A.6, 8.S.1A.7, 8.S.1A.8

*** Bold standards are the main standards addressed in this activity**

South Carolina College- and Career-Ready Science Standards 2021

5th Grade Performance Expectations
5-LS2-1. Develop a model to describe the movement of matter among plants, animals, decomposers, and the environment.
5-ESS2-1. Develop a model using an example to describe ways the geosphere, biosphere, hydrosphere, and/or atmosphere Interact.
5-ESS3-1. Evaluate potential solutions to problems that individual communities face in protecting the Earth's resources and environment.

6th Grade Performance Expectations
6-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity.

7th Grade Performance Expectations
7-PS1-3. Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
7-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
7-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
7-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
7-ESS3-3. Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.

2014 Academic Standards and Performance Indicators for Science

Fifth Grade Performance Indicators
5.S.1A.1 Ask questions used to (1) generate hypotheses for scientific investigations or (2) refine models, explanations, or designs.
5.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
5.S.1A.3 Plan and conduct scientific investigations to answer scientific questions, test hypotheses and predictions, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.

5.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation or graphing) to (1) reveal patterns and construct meaning or (2) support explanations, claims, or designs.
5.S.1A.6 Construct explanations of phenomena using (1) scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
5.S.1A.7 Construct scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
5.S.1A.8 Obtain and evaluate informational texts, observations, data collected, or discussions to (1) generate and answer questions, (2) understand phenomena (3) develop models, or (4) support hypotheses, explanations, claims, or designs. Communicate observations and explanations using conventions and expectations of oral and written language.
5.E.3A.1 Construct explanations of how different landforms and surface features result from the location and movement of water on Earth's surface through watersheds (drainage basins) and rivers.
5.E.3B.3 Construct scientific arguments to support claims that human activities (such as conservation efforts or pollution) affect the land and oceans of Earth.
5.E.3B.4 Define problems caused by natural processes or human activities and test possible solutions to reduce the impact on landforms and the ocean shore zone.
5.L.4B.3 Construct explanations for how organisms interact with each other in an ecosystem (including predators and prey, and parasites and hosts).

Sixth Grade Performance Indicators
6.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.
6.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
6.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
6.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.
6.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
6.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
6.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

Seventh Grade Performance Indicators
7.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.
7.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
7.S.1A.3 Plan and conduct controlled scientific investigation to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
7.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.

7.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
7.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
7.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.
7.EC.5A.1 Develop and use models to describe the characteristics of the levels of organization within ecosystems (including species, populations, communities, ecosystems, and biomes).
7.EC.5B.2 Develop and use models (food webs and energy pyramids) to exemplify how the transfer of energy in an ecosystem supports the concept that energy is conserved.

Eighth Grade Performance Indicators
8.S.1A.1 Ask questions to (1) generate hypotheses for scientific investigations, (2) refine models, explanations, or designs, or (3) extend the results of investigations or challenge claims.
8.S.1A.2 Develop, use, and refine models to (1) understand or represent phenomena, processes, and relationships, (2) test devices or solutions, or (3) communicate ideas to others.
8.S.1A.3 Plan and conduct controlled scientific investigations to answer questions, test hypotheses, and develop explanations: (1) formulate scientific questions and testable hypotheses, (2) identify materials, procedures, and variables, (3) select and use appropriate tools or instruments to collect qualitative and quantitative data, and (4) record and represent data in an appropriate form. Use appropriate safety procedures.
8.S.1A.4 Analyze and interpret data from informational texts, observations, measurements, or investigations using a range of methods (such as tabulation, graphing, or statistical analysis) to (1) reveal patterns and construct meaning or (2) support hypotheses, explanations, claims, or designs.
8.S.1A.6 Construct explanations of phenomena using (1) primary or secondary scientific evidence and models, (2) conclusions from scientific investigations, (3) predictions based on observations and measurements, or (4) data communicated in graphs, tables, or diagrams.
8.S.1A.7 Construct and analyze scientific arguments to support claims, explanations, or designs using evidence from observations, data, or informational texts.
8.S.1A.8 Obtain and evaluate scientific information to (1) answer questions, (2) explain or describe phenomena, (3) develop models, (4) evaluate hypotheses, explanations, claims, or designs or (5) identify and/or fill gaps in knowledge. Communicate using the conventions and expectations of scientific writing or oral presentations by (1) evaluating grade-appropriate primary or secondary scientific literature, or (2) reporting the results of student experimental investigations.

Cross Curricular Standards

South Carolina Social Studies Standards
6.5.CX, 7.5.1.PR, 7.5.2.ER

South Carolina College and Career Standards for Math
Measurement and Data Analysis (MDA) – 6.D3.4, 8.F.1, 8.F.2
South Carolina College and Career Standards for ELA
Inquiry-Based Literacy Standards (I)-5-1.1, 5-2.1, 5-3.2, 5-4.1, 5-4.2, 5-4.3, 5-5.1, 6-1.1, 6-2.1, 6-4.1, 7-1.1., 7-2.1, 7-4.1, 8-1.1, 8-2.1, 8-4.1
Meaning, Content, and Craft (MCC) – 5-2.1, 6-2.1, 7-2.1, 8-2.1
Communication-Meaning and Context (MC) – 5-1.1, 5-1.2, 5-1.4**,** 5-2.1, 6-1.1, 6-1.2, 6-1.4, 6-1.5, 6-2.1 7-1.1, 7-1.2, 7-1.4, 7-1.5, 7-2.1, 8-1.1, 8-1.2, 8-1.4, 8-1.5, 8-2.1

Background

5-8 Litter-free Land to Sea Activity

South Carolina Aquarium

Key Points
Key Points will give you the main information you need to teach the activity.

- **Litter** is trash, debris, and other items discarded in places they don't belong, such as roadsides, waterways or parks.
- **Macroplastics** are plastic pieces that are over five millimeters in size.
- **Microplastics** are small plastic pieces less than five millimeters in size.
- Microplastic litter comes from an assortment of sources including macroplastics, which degrade into smaller and smaller pieces. Another source is microbeads, very tiny pieces of manufactured polyethylene plastic that are added as exfoliants to health and beauty products. Nurdles, manufactured plastic pellets used to create plastic products, can also be found as a source of litter.
- Litter can easily travel from land to sea through watersheds. A **watershed** is an area of land where all of the water that collects in the area from precipitation will eventually drain into the same river, lake, wetland or other body of water.
- The South Carolina Aquarium is leading the way to empower citizens to make a positive impact while generating scientifically useful data available to the general community and scientific community though its **citizen science** project, Litter-free Digital Journal.
- The goal of the Litter-free Digital Journal is to promote collaborative solutions by removing and tracking litter, plastics specifically, from habitats throughout South Carolina. Students can clean up an environment and be part of the solution.
- An ecological footprint is the impact a person or a community has on the land around it. It is usually looked at in terms of how much land it would take to sustain their use of the land's natural resources.

Detailed Information
Detailed Information gives more in-depth background to increase your own knowledge, in case you want to expand upon the activity or you are asked detailed questions by students.

Litter is trash, debris, and other items discarded in places they don't belong, such as roadsides, waterways or parks. Deliberately throwing items on the ground or leaving items outside of a trash bin is littering. Sometimes it can be accidental, such as materials being blown out of a trash can or truck bed.

According to the 2009 KAB National Litter Survey Study, the most common roadside litter articles include tobacco products, unclassified trash, miscellaneous paper, packaging, miscellaneous plastic, and beverage containers. The study also found that the quantity of plastic litter observed has increased over the past 40 years. Plastic does not degrade or does so slowly with time. Also, being lightweight, plastics tend to be transported by wind and water to other locations, which adds to a growing marine debris issue (trash in the ocean).

Macroplastics are pieces of plastic that are larger than 5 mm. These include the plastic products such as water bottles, straws, bags, etc. However, because plastic does not degrade, or does so slowly, the large plastic waste that ends up in our water ways and oceans degrades into smaller and smaller pieces. If in the ocean or another body of water, macroplastics can eventually turn into **microplastics**, classified as plastics that are less than 5mm long**.** Most microplastics come from the degradation of plastic products into smaller fragments, however they also include tiny pieces of manufactured polyethylene plastic that are added as exfoliants to health and beauty products, known as microbeads. Microbeads can easily pass through water filtration systems and end up in our waterways and ocean. Nurdles are manufactured plastic pellets used to create plastic products. These can enter an ecosystem when there is an accident in transport (vehicle or boat).

Most plastic enters the ocean from the land, with more than half being single-use plastics. Plastic that is not disposed of properly as litter has the potential to making its way to the ocean. These contaminants pose a potential threat to aquatic life through entanglement or as mistaken food. However, as the plastic degrades into microplastics, they pose even more threats lower down on the food chain as smaller marine organisms mistake microplastics as food.

Despite research being conducted, there's still much we don't know about the potential negative impact microplastics pose on the oceans, wildlife and humans. One impact being studied is the impact microplastics may have on our saltwater food sources through **biomagnification.** Unfortunately, microplastics in the ocean are available for ingestion by a wide range of animals in the aquatic food

web, which humans have the potential to eat as apex consumers. It is estimated that approximately 90% of the plastics in the open ocean marine environment are microplastics, which is the home to many marine organisms large and small.

Solutions to plastic litter include citizen science, reducing and reusing waste as well as recycling when reducing and reusing is not an option.

Citizen Science

Defined by the Oxford Dictionary, **citizen science** is the collection and analysis of data relating to the natural world by members of the general public. Citizen science occurs when ordinary people help to conduct real scientific research. People can share and contribute to data monitoring and collection programs, usually as a volunteer. Participants have varying degrees of expertise. Modern technology makes citizen science accessible to anyone interested in participating, however, the success of the project depends on the creation of a well-devised monitoring program and participant dedication.

Many citizen-science projects have a national or local focus. Some projects are created by scientists, who need widespread data with the help of public observation. There are also projects community-based groups organized to generate ideas and involve scientists for advice and coordination. One of the oldest examples of citizen science in the National Audubon Society's Christmas Bird Count, which began in 1900. From December 14-January 5, birder groups collect information about local bird populations, which can be used for conservation efforts.

The South Carolina Aquarium has a citizen science application and an Anecdata website called the Litter-free Digital Journal for collecting trash data from the people of South Carolina. Community members are urged to collect trash from the environment and log the data on the app. Data is placed into categories and pictures can be downloaded as well as the location in South Carolina. This data is being used to change policy. Folly Beach and Mt. Pleasant, SC are two towns who have already had plastic bag bans put into effect. Aquarium staff have been a part of that change using the data from the app. It's an exciting time to see all people be able to make an impact to better the environment. Get your students involved as well through this activity!

Reduce and Reuse

The most effective way to prevent litter is to not create it in the first place. Reducing and reusing materials prevents new products from being made and transported. Americans generate over 4 pounds of trash every day, which mostly gets sorted into landfills. These landfills create the second largest source of human-related methane emissions in the country. Reducing and reusing also saves energy, saves money, prevents pollution caused by making new products and allows products to be used to their fullest purpose.

Approximate Time it takes for Garbage to Decompose in the Environment:

*This data is from *The Educator's Guide to Marine Debris* from SC Sea Grant, DHEC, COSEE and NOAA. The decomposition rates may change over time due to more research. Go here for a printable poster http://www.scdhec.gov/HomeAndEnvironment/Docs/SC_MARINE_DEBRIS_POSTER.pdf

Garbage Item	Decomposition Time
Glass Bottle	Undetermined
Monofilament Fishing Line	600 years
Plastic Beverage Bottle	450 years
Disposable Diapers	450 years
Aluminum can	200 years
Foam plastic cup	50 years
Plastic bag	1-20 years
Waxed milk carton	3 months
Apple core	2 months
Newspaper	6 weeks
Paper towel	2-4 weeks

Different ways to reduce and reuse:

- Do not use single-use plastics, which include plastic bags, plastic water bottles, take-out containers, take-out cups, eating utensils and straws.
- Use reusable products instead, such as a reusable shopping bag, thermos or reusable water bottle, reusable food containers, a personal cup, reusable eating utensils and just don't use a straw or use a stainless steel/reusable/paper straw.
- Buy products that use less packaging. Buying in bulk can also reduce packaging and save money.
- Borrow, rent, or share items used infrequently.
- Maintain and repair products so they aren't discarded frequently.
- Buy used things, which are often less expensive and just as good as new.

Recycle

When materials can't be reduced or reused, recycling is a great option. Recycling materials reduces the amount of waste sent to landfills. Natural resources are conserved by turning old products into new products, which prevents pollution by reducing the need to collect new raw materials. Recycling increases economic security by using a domestic source of resources, creating more jobs in manufacturing industries in the United States.

What can be recycled?

<u>Plastic</u>

- Water bottles
- Soda bottles
- Milk jugs
- Liquid containers
- Jars and tubs (yogurt, margarine tubs, etc.)
- Detergent and all-purpose cleaner bottles
- Soap and shampoo bottles
- Plastic cups
- Rigid plastic product packaging, such as clean rigid clamshell containers (Remove any plastic film or aluminum)

Approximately 300 million tons of plastic is produced globally each year and only 10 percent of it recycled. An estimated 7 million tons of plastic that is trashed ends up in the ocean each year, where it breaks down into microplastics. The smaller the pieces, the easier they are to be swallowed by fish. Plastics are derived from natural, organic materials such as cellulose, coal, natural gas, salt and crude oil.

What do the symbols mean on the bottom of plastic bottles and containers? These symbols were created by plastic manufacturers to help people identify the kind of plastic resin used to make the container. This can help you determine if the container can be accepted by your local recycling program. Plastics #1-7 can be recycled in Charleston County, however plastic bags cannot be included into mainstream recycling bins, but instead must be taken to a store. Check with your county to see which plastics can be recycled.

<u>Paper</u>

- Magazines
- Newspapers
- Catalogs
- Books/textbooks
- Coupons
- Office paper
- Envelopes
- Posters
- Sticky notes
- Paper bags
- Junk mail/envelopes
- Greeting cards
- Wrapping paper

Paperboard and cardboard

- Corrugated cardboard boxes (flattened)
- Soda/beverage boxes
- Shoe boxes
- Gift boxes
- Clean food boxes (cereal boxes, microwave meals, boxes of rice, etc.)
- Paper towel rolls
- Paper egg cartons

Paper typically makes up a third of the trash produced each year in the United States. Recycled paper is used to make new paper products, which saves trees and other natural resources.

Glass

- Jars and caps (labels can be left on containers)
- Bottles and bottle caps (labels can be left on containers)

Glass can be recycled again and again and again. Making new glass from recycled glass is cheaper than using raw materials. Glass is made from a mixture of sand, lime and soda heated together to form liquid glass. This liquid glass is made into sheets by cooling and flattening. To make objects like vases, craftsmen blow into a glob of liquid glass with the help of a long tube. Typically, at least a quarter of the glass discarded in the United States each year is recycled.

Aluminum and steel cans

- Aluminum cans and caps/lids
- Steel and tin cans
- Empty aerosol (spray) cans
- No foil or trays

Cans are made from aluminum and trace amounts of other metals, including magnesium, iron, and manganese. Aluminum, like glass, is one of the only materials that can be recycled over and over again! There is no limit to the number of times you can recycle it, making it one of the most valuable recyclables.

Batteries

Look for in-store recycling bins or community collection events to dispose of batteries. According to the EPA, in 2014, about 258 million tons of municipal solid waste (MSW) was generated in the United States. Over 89 million tons of MSW were recycled and composted, equivalent to a 34.6 percent recycling rate.

Other: Plastic bags, ink cartridges, old phones, corks, etc.

There is some waste that can be recycled, but not through mainstream recycling. Materials in this category take more time and effort to be recycled. Lots of grocery stores have plastic bag recycling. Cell phone carriers and electronic stores typically recycle or even buy old phones and tablets. Ink cartridges can be recycled at office supply stores. Lots of health food stores recycle corks. Just looking up an alternative to throwing waste away can make a difference.

Composting

Compost is organic material, including food scrapes and yard waste, which can be added to soil to help plants grow. Making compost keeps these materials out of landfills where they take up space and release methane.

How to do Backyard Composting:

- Select a dry, shady spot near a water source for your compost pile or bin.
- Add brown and green materials as they are collected, making sure larger pieces are chopped or shredded.
- Moisten dry materials as they are added.

- Once your compost pile is established, mix grass clippings and green waste into the pile and bury fruit and vegetable waste under 10 inches of compost material.
- When the material at the bottom is dark and rich in color, your compost is ready to use. This usually takes anywhere between two months to two years.

How to do Indoor Composting:
If you do not have space for an outdoor compost pile, you can compost materials indoors using a special type of bin, which you can buy at a local hardware store, gardening supplies store, or make yourself. A properly managed compost bin will not attract pests or rodents and will not smell bad. Your compost should be ready in two to five weeks.

How to make a Worm Bin: https://www.epa.gov/recycle/how-create-and-maintain-indoor-worm-composting-bin

More information: https://www.epa.gov/recycle/composting-home

Ecological Footprint
One way to look at how a person or community affects the earth is to look at its ecological footprint. An ecological footprint is the impact a person or a community has on the land around it. It can be looked at in terms of how much land it would take to sustain their use of the land's natural resources. Or, how many earths would it take if everyone lived their life like you. Things that are taken into consideration are the foods you eat (how much meat, how much is processed), your house (type, size, materials used to build), electricity (solar, low energy), trash produced (recycling, compost), vehicle use (how many per family, gas mileage, carpooling), travel (how much flying) and shopping (online, in store, products packaging).

It's important to remember that the life style choices we make effect the earth and we can make choice to help if we make a few changes to how we live. For example, we could carpool to work or school, eat less meat, buy local products and recycle. Visit this site to see how many earths it will take to sustain your ecological footprint https://www.footprintcalculator.org/

Procedure

Teacher preparation: Here are the instructions for how to use the Litter-free Digital Journal app and website in order to input your student's data. Either and both data entries can be used depending on if you want to use your smart device or a computer. The website will allow for more options when looking at the data (graphing, lists, downloads,…). The app seems to work easiest for data entry.

To download the Litter-free Digital Journal app on your smart device:
- Search for South Carolina Aquarium in your App store on your smart device
- Open the SC Aquarium Citizen Science App in your App store and download it for free
- Create an account with your email and a password
- Click on the Litter-free Digital Journal
- Add a picture to your profile and include information about yourself if desired
- You are ready to input your student's data!

To use the Litter-free Digital Journal anecdata website:
- Go to: www.anecdata.org
- Set up an account (or use the same information if you set up an account on your smart device)
- You can use either the website or the app to input data.

Materials

- Litter Case Study
- Litter Report
- IPad or smart phone to input data into Litter-free Digital Journal or Litter Datasheet

- Gloves
- 2 Trash bags per group (1 for trash and 1 for recycling – label these)
- Pencil
- Clipboard or hard surface to write on

Procedure

1. Introduce the terms macroplastics and microplastics. Read the Case Study aloud or have the students read it silently. Have a discussion about the impact microplastics and macroplastics in the ocean may have on animals, the environment and even humans.

2. Introduce the concept of biomagnification, which refers to the accumulation of toxic substances an organism ingests, accumulates, and passes along the food chain because the substances are not digested. Because biomagnification of plastics in sea organisms has an impact on the marine food chain, it may have an impact on the seafood humans eat.

3. Inform the students they will be making an impact and cleaning up the oceans today. No matter where your school is, all litter has the potential to make it downstream through the watershed to the ocean. Today they will be taking part in a citizen science project. Cleaning up litter anywhere not only helps the local ecosystem, but also the potential to impact other ecosystems downstream.

4. Communicate that while the class conducts an investigation finding out how much (quantitative data) of certain types of plastic litter is on their school ground, scientists from the South Carolina Aquarium are conducting similar experiments in ecosystems around the state. You can explain that their data will sent to Aquarium scientists to analyze through a special Litter-Free Digital Journal app. The information is then used to make positive changes in the community. The information has been used to ban plastic bags in parts on Folly Beach and Mt. Pleasant, SC, and can be used to make more positive change. If desired, display pictures and graphs from the Litter-free Project through the Anecdata website (https://www.anecdata.org/projects/view/122/about) to get the students excited.

5. Discuss what is considered trash and what can be recycled. Although the focus is plastic litter, the goal is to pick up all of the litter that is found! Anything paper, most plastics, glass, or aluminum can be recycled. Food waste, snacks and lunch food left outside, will be put in the trash, however, could be composted. Personal belongings, such as jackets, hats, water bottles, lunchboxes, will go in the trash or the school's lost and found if salvageable. Trash, such as rope, wrappers, and straws will go into the trash bag. Explain which bag is trash and which is recycling so they sort correctly.

6. Assign students to groups of 4. Give each group a Litter Report, Litter Datasheet and trash/recycle bags. Designate the role each student will perform or allow the students to decide who will be in charge of:

Recording: inputs data into the Litter-free Digital Journal or the hardcopy litter list
Materials: holds the trash bag and recycling bag with gloves on, helps sort litter
Litter Gathering: picks up the litter and puts litter in the appropriate bag with gloves on, helps sort
Seeking: on the lookout for litter and decides where to look, helps sort

7. Have each group review the materials and the procedure written on the Litter Report.

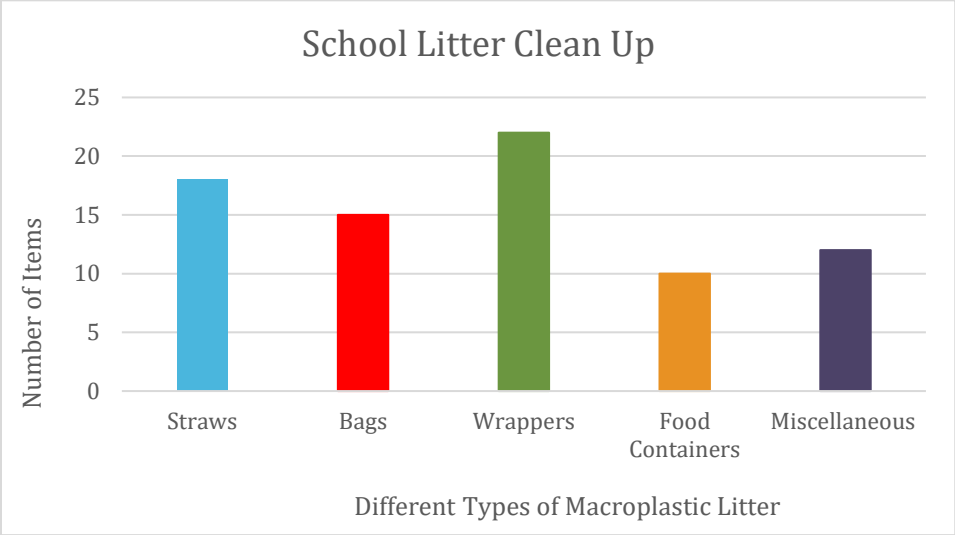
8. Provide a few minutes for each group to formulate their hypothesis in the Litter Report. As a group, they should discuss which macroplastic will be the most common.

9. GO FOR IT!!! Collect litter on the schoolyard for 15-30 minutes or whatever time is allowed. Help the recorders to input data into the Digital Journal or on their Litter Datasheet. If manageable, take some pictures to upload with your data. Or, have students take pictures.

*Note- If classroom management is challenging outside, students can just pick up litter and put it into one bag. Sorting can be done in a more confined place together outside or inside, with gloves. Data can be put into the Digital Journal inside of the classroom if that is more manageable for your class.

10. Find a place to discard the litter and recycling and invite the students back inside to discuss their findings.

11. Ask the students to analyze the data. Discuss their findings as a group. They can graph the macroplastics collected to help analyze their data. Example:



Note: You could make a class graph first to model how bar graphs are created before individual groups make theirs on their Litter Report.

12. Discuss their findings and conclusions using these questions.

- **Results with Evidence:** Discuss their results with evidence from their data.
- **Potential Error:** What are some potential errors that could have affected the results? What ways could the errors be prevented if the experiment was conducted again?
- **Potential Application**: Why are the results of their experiment important? How can the results be applied to actions to help with the problem? How can reducing macroplastics reduce microplastics?
- **Reflection:** Why is it important to have a litter free schoolyard? How could this affect the watershed?

13**.** Tie this activity to a discussion on their ecological footprint, calculated by the everyday choices we make in how we live our lives. Have them finish the Litter Report by calculating their ecological footprint. Once done, students should turn in their Litter Report and letter.

Follow-up questions

- Will you have a bigger ecological footprint as an adult?
- What areas of your life are the hardest to change in terms of your ecological footprint? Why?
- How do you think the United States does with our ecological footprint compared to other countries? How about South Carolina compared to other states?
- Which state do you think has the smallest ecological footprint? Which has the largest?

Assessment

Grade the Litter Report and ecological footprint letter. Instructions from Solutions section on Litter Report says to:

Take the ecological footprint calculator quiz found at: https://www.footprintcalculator.org/

Write a letter to your future grandson and/or granddaughter describing how many earths your current lifestyle requires. Using the solutions found on the website, describe 10 changes you will make to reduce your ecological footprint (You can play around with the calculator using the solutions suggestions to see ways you can reduce your footprint and use fewer earths). Turn in your letter to your teacher for a grade. You can also email your letter to the South Carolina Aquarium at education@scaquarium.org

Scoring rubric out of 100 points

Litter Report complete (use scale grading):	0-25 points
For a well written letter (use scale grading):	0-25 points
Each change suggested in letter (10 changes total):	5 points (50 pts total)

Cross Curricular Extensions

STEM Extension
Begin a discussion about ways to reduce food waste. Make a worm bin for the class to collect food scraps for a month and see the transformation of waste to vermicompost!

Directions on making a worm bin: https://www.epa.gov/recycle/how-create-and-maintain-indoor-worm-composting-bin

STEAM Extension
Create recycled art collages using litter collected outside or "trash" collected in the classroom.

ELA Extension
Write an editorial to the local newspaper describing the amount of macroplastics your class collected. Describe how these plastic items can degrade to become microplastics, which have the potential to contaminate our food chain. Submit it to the newspaper!

Math Extension
Repeat the litter investigation 3-5 more times during the school year. Have the students create a line graph of the data throughout the school year and interpret the trends.

Field Trip Extension
Take your class to the recycling center or waste management facility. Most centers have tours available for students to visit.

Resources

Teacher Reference Books
Appelhof, Mary Arlene (2003). *Worms Eat My Garbage.* Flower Press.

Humes, Edward (2013). *Garbology: Our Dirty Love Affair with Trash.* New York, New York. Penguin Group.

Johnson, Bea (2013). *Zero Waste Home: The Ultimate Guide to Simplifying Your Life by Reducing Your Waste*. New York, New York. Scribner.

Teacher Reference Websites

South Carolina Aquarium – Anedata website
This site is where trash data can be inputted as well as all data can be accessed. Shows pictures and has the ability to graph data. Data can also be inputted on the South Carolina Aquarium's Litter-free Digital Journal app by searching South Carolina Aquarium in your smart phones app store.
https://www.anecdata.org/projects/view/122/about

5-8 Litter Free: Land to Sea Activity

South Carolina Aquarium

5 GYRES: Science to Solutions
This site offers information about plastic pollution and solutions to the problem.
https://www.5gyres.org/

Citizen Science Center
Learn how you can make a difference by doing real science to help solve our planet's most pressing problems.
http://www.citizensciencecenter.com

NOAA's Marine Debris Program
This site has information about marine debris, as well as activities and curricula.
https://marinedebris.noaa.gov

NOAA's microplastic site:
This site provides a description of microplastics.
https://oceanservice.noaa.gov/facts/microplastics.html

South Carolina DHEC – Marine Debris
This site has information on marine debris in South Carolina.
http://www.scdhec.gov/HomeAndEnvironment/docs/marine_debris.pdf
http://www.scdhec.gov/HomeAndEnvironment/Docs/SC_MARINE_DEBRIS_POSTER.pdf

Keep America Beautiful
Keep America Beautiful inspires and educates people to take action every day to improve and beautify their community environment.
https://www.kab.org

National Geographic
This National Geographic site offers beautiful pictures and captions of citizen science projects, as well as projects to get involved in.
https://www.nationalgeographic.org/encyclopedia/citizen-science/

United Stares Environmental Protection Agency
These government sites provide basic information on ways to reduce and reuse materials, as well as information about microplastics.
https://www.epa.gov/recycle/reducing-and-reusing-basics
https://www.epa.gov/trash-free-waters/toxicological-threats-plastic

Global Footprint Network
This site goes through the demand on and supply of nature.
https://www.footprintnetwork.org/our-work/ecological-footprint/