NGSS Lesson Plan – Algalita Plastic Ocean Investigation Toolkit

Grade/ Grade Band: 5-12	**Topic:** Oceanic Plastic Pollution	**Lesson #** __1___ **in a series of** __3_ **lessons**

Brief Lesson Description: Investigate the impacts of microplastics on our oceans.
The Plastic Ocean kit free for public school educators in the US, and is available for request at https://algalita.org/wayfinder-society/toolkit/plastic-ocean-teaching-kit/ Webpage also includes instructions and downloadable worksheets. All referenced handouts are linked below on last page. They can be edited by the educator if they download their own copy.



Photo credit: Algalita

Performance Expectation(s):

- MS-PS 1-3 Gather and make sense of information to describe that synthetic materials come from natural resources and impact society.
- HS-ESS3-4. Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.
- HS-ETS 1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.

Specific Learning Outcomes: Plastics are synthetic material that are made from fossil fuels and negatively impact the health of our ocean environment.

Narrative / Background Information

Prior Student Knowledge: Basic understanding of density, Geographical Coordinates (x,y graphs)

Science & Engineering Practices:	**Disciplinary Core Ideas:**	**Crosscutting Concepts:**
Analyzing and interpreting data ● Students collect their own data, and analyze real world samples of plastic pollution (real sample and photos) to draw conclusions about the impacts of plastic pollution on our oceans. Constructing Explanations and designing solutions ● Students design a solution to plastic pollution after completing the activities to educate their school community about plastic pollution and how to take action. Obtaining, Evaluating, and Communicating Information ● Students complete investigative activities to obtain information about plastic pollution in our oceans and then use what they learned to communicate with their school community about the issue.	Human Impacts on Earth Students investigate primary source data about the impacts of plastic pollution on the oceans and ocean ecosystems. **High School Extension Activity** ESS3.C: Human Impacts on Earth Systems ● Scientists and engineers can make major contributions by developing technologies that produce less pollution and waste and that preclude ecosystem degradation. ETS1.B: Developing Possible Solutions When evaluating solutions, it is important to take into account a range of constraints, including cost, safety, reliability, and aesthetics, and to consider social, cultural, and environmental impacts. *(secondary)*	Influence of Engineering, Technology, and Science on Society and the Natural World ● Students evaluate a solution to microfiber pollution using 4 separate sources and a set of critique prompts. (High School Extension Activity)

LESSON PLAN – 5-E Model

ENGAGE: Opening Activity – Access Prior Learning / Stimulate Interest / Generate Questions:
Begin with screening the introductory video. The video introduces the many ways we use plastic in our lives. It then highlights the ways that it enters the environment, impacts organisms, and what humans can do to address the problem.

EXPLORE: Lesson Description – Materials Needed / Probing or Clarifying Questions:
Students rotate through 3 hands-on activities. All materials except 3 watertight containers are provided in the Plastic Ocean Teaching Kit.

Station 1: Sink or Float. Students are investigating the question: “How does plastic impact different depths of the ocean?” Students are provided with a station card, worksheet, 6 pieces of common single use plastic items, hemostats, and a towel. Teacher needs to procure a container such as a wide-mouth pint mason jar, beaker, or any tub to hold water at least 3 inches deep. Students use the station card to learn about how some types of plastics float and others sink in water, and how that causes them to pollute all parts of marine environments and impact different types of animals. Students are instructed to use a worksheet and chart to determine what type of product the plastic piece might be from, what type of plastic resin it is made of, and use the density of the plastic to predict whether it will sink or float. They then test their prediction by testing the piece in the water container.

Station 2: Plastic Soup. Students investigate the question: “How do microplastics impact the oceanic food web?” Students are provided with a station card, worksheet, magnifying glass and a vial containing real ocean surface water samples that include preserved plankton and microplastics. Educators need to fill sample vials with 70% isopropyl alcohol (rubbing alcohol), prior to activity. Students use the station card to learn about how the sample was collected, how microplastics form, and how they impact the oceanic food web. They then observe the sample using the magnifying glass, and they draw scientific sketches of a plankton, a microplastic fragment, and a nurdle (plastic pellet) using descriptive clues provided on the worksheet.

Station 3: Tracking Trash. Students investigate the question: “Why does plastic pollution accumulate in the middle of our oceans?” Students are provided with a station card, worksheet, and 5 clue cards. Students read the station card to learn about the phenomenon of ocean gyres, spiraling ocean currents. They learn how these currents carry pollution from land to the centers of our oceans. They also learn how scientists collect ocean water samples to study plastic pollution. Students then use the clue cards showing ocean water samples from each ocean basin, and their geographical coordinates to map where those samples were collected on a world map.

EXPLAIN: Concepts Explained and Vocabulary Defined:

Plastic polymers
Plastic polymers are human-made materials built from long chains of repeating chemical units called monomers. Plastics can be flexible or rigid, but most are very durable, which is why they stay in the environment for a long time instead of breaking down quickly.

Plankton
Plankton are tiny organisms that drift with the water instead of swimming strongly against currents. They include both plant-like plankton (that do photosynthesis) and animal-like plankton, and they form the base of most ocean food webs.

Density
Density is how much “stuff” (mass) is packed into a certain amount of space (volume). A material with higher density than water tends to sink, while a material with lower density than water tends to float.

Buoyancy
Buoyancy is the upward force a fluid (like water) exerts on objects placed in it. If the buoyant force is stronger than an object’s weight, the object floats; if it is weaker, the object sinks.

Plastic photo-degradation
Plastic photo-degradation is the process where sunlight, especially ultraviolet (UV) light, breaks large plastic items into smaller and smaller pieces. The plastic usually does not turn into harmless natural materials; instead it becomes many tiny plastic fragments.

Microplastics
Microplastics are very small plastic pieces, usually defined as less than 5 millimeters across. They can come from larger plastics breaking apart or from products that were made small to begin with, like some microbeads and synthetic fibers.

Surface ocean currents
Surface ocean currents are large, continuous flows of water at or near the ocean’s surface, mainly driven by wind and the rotation of the Earth. These currents transport heat, nutrients, organisms, and floating materials such as plastic across long distances.

Gyres
Gyres are huge, rotating systems of surface ocean currents that form in each major ocean basin. Floating debris, including plastics, can get trapped in the center regions of gyres, creating areas of high plastic concentration often called “garbage patches.”

Ocean zones
Ocean zones are layers of the ocean defined by depth, light, temperature, and sometimes distance from shore. Examples include the sunlit surface zone where photosynthesis happens, deeper dim zones with less light, and dark deep-sea zones where no sunlight reaches.

Vocabulary definitions
Water column
The water column is the whole vertical section of water from the surface down to the seafloor at a given location. Scientists use this term when they talk about where, at what depth, something is found in the ocean.

Density
Density is the amount of mass in a given volume of a substance, often stated as “how heavy something is for its size.” Comparing densities helps explain whether an object will float, sink, or stay suspended in water.

Buoyancy
Buoyancy is the force that pushes up on objects in a fluid, opposing gravity. When buoyancy and weight balance, an object can be neutrally buoyant and stay at the same depth without rising or sinking.

Polymers
Polymers are substances made of long chains of repeating small molecules called monomers. Many things are polymers, including natural ones like DNA and cellulose, and synthetic ones like most plastics.

Biodegrade
To biodegrade means to be broken down by living organisms, such as bacteria and fungi, into simpler natural substances like water, carbon dioxide, and nutrients. Materials that biodegrade can be returned to natural cycles relatively quickly.

Photo-degrade
To photo-degrade means to break down when exposed to light, especially sunlight’s ultraviolet rays. For plastics, photo-degradation usually means they crack and fragment into smaller pieces rather than fully turning into natural materials.

Plankton
Plankton are drifting organisms, both microscopic and somewhat larger, that cannot swim strongly against currents. They include phytoplankton (plant-like, doing photosynthesis) and zooplankton (animal-like, that eat other organisms).

Manta trawl
A manta trawl is a sampling device that looks a bit like a small, winged sled with a net attached, towed at the surface behind a boat. It skims the top layer of the ocean to collect floating debris and organisms, including microplastics, for study.

ELABORATE: Applications and Extensions:
The student workbook includes an extension activity. Students are tasked with creating a public outreach message to teach their school or community about plastic pollution and ask them to take action. Students are guided through identifying their message, audience, and a strategy for communicating their ideas. They are also provided with a worksheet to develop a SMART (specific, measurable, attainable, relevant, timely) goal for their action plan.

High School Extension Activity: Solution Critique
Students use the provided prompts to evaluate and refine a tech solution to microfiber pollution using at least four sources.
Link to activity worksheet here.

EVALUATE:

Formative Monitoring (Questioning / Discussion): Engage students as they work through the three stations to determine level of student understanding.

Summative Assessment (Quiz / Project / Report): The student worksheets for each station include 3 questions to gauge student comprehension. Also, see student extension project (Public Outreach Message) explained above.

Elaborate Further / Reflect:
Enrichment:

Provided Lesson Plan on Resource Webpage:

Plastic Ocean Investigation Toolkit (https://algalita.org/wayfinder-society/toolkit/plastic-ocean-teaching-kit/)

Overview

Investigate the impacts of microplastics on our oceans with this hands-on, out-of-the-box teaching kit.
Grades 5, Middle School, High School
Time Needed 50 minutes in class
FREE for public school educators in the USA

Toolkit Details

What standards does this resource address?

- NGSS MS-PS 1-3 Gather and make sense of info to describe that synthetic materials come from natural resources and impact society.
- AP Environmental Science Unit 8 Water Pollution

What subjects does this resource connect with? General Science, Life Science, Physical Science, Biology, Geography, Environmental Science, AP Environmental Science

What topics does this resource explore? Ocean Pollution, Human Impact on the Environment, Plastic Pollution, Student Action Projects on Waste Reduction, Plankton, Ocean Ecosystems, Density, Gyres, Ocean Currents, Coordinates and Latitude / Longitude

What is in the Plastic Ocean Teaching Kit?
– link to shared Google Drive folder with all printable materials for class copies and replacements
– 1 copy of the Educator Guide
– 1 copy of the Student Workbook and Answer Key
– 3 sets of 3 Station Cards
– Sink or Float Station Materials: 3 sets of plastic item samples, 3 towels, and 3 hemostats
– Plastic Soup Station Materials: 3 North Pacific Ocean water samples containing plastic and plankton
– Tracking Trash Station Materials: 3 sets of microplastic sample image cards

Materials you'll need to procure
– isopropyl alcohol to fill the water sample vials which have been drained for shipping
– 3 wide mouth, clear containers for the Sink or Float station

Preview a sample of the Plastic Ocean Kit Student Workbook – PDF

Format Serves up to 9 groups of students simultaneously. This kit is designed for schools and is fully **reusable and shareable.**

Purpose and Context

This easy-to-use kit will give your students a look at real-world ocean and environmental science!

The Plastic Ocean Kit (a.k.a. the Debris Science Investigation Kit) is an all-included, prepared activity for educators to use in the classroom. Students rotate through three hands-on activities, including studying microplastics in an ocean gyre sample, investigating the densities of various plastics and their effects on ecosystems, and mapping out where we find plastics in our oceans. Each activity includes a station card with background information, a student worksheet with investigation instructions, and 3 sets of materials for that station.

Algalita Marine Research and Education have been investigating and educating about ocean plastic pollution for over 25 years. This teaching kit is our most popular teaching resource and has been distributed to over 2,500 classrooms across the US.

Instructions

Prepare
Order a kit with the link above. Once you have your kit, just follow the Educator Guide to set up the lesson!

In class
Screen the 6-minute introductory video.

Group your students into 9 groups that will rotate through 3 stations. At each station, students read the station card aloud, then follow their workbook instructions for each activity. Each activity should take about 10-15 minutes.



Station: Sink or Float includes common single use plastic items and a jar and hemostats to test their buoyancies.



Station: Plastic Soup contains a real ocean sample collected on an Algalita expedition.



Station: Tracking Trash includes clue cards of samples collected around the world's ocean to locate on the world map.

Discussion Ideas
The student workbook includes a follow-up reflection and action activity: creating a Public Service Announcement about the issue of plastic pollution.

Tips and Suggestions

This kit is designed to be completely reusable so you can share it with the other teachers in your school or department!

Associated Standards

NGSS
MS-PS 1-3 Gather and make sense of info to describe that synthetic materials come from natural resources and impact society.

Additional Handouts
The printable Educator Guide, Student Worksheet, Student Worksheet Grading Key, Station Guide Printout PDFs are all provided in a Google Share Folder that educators can access through the toolkit (found on the notice pasted on the inside of the box lid) once they have the kit.

Materials Required for This Lesson/Activity

Quantity	Description	Potential Supplier (item #)	Estimated Price
1	Algalita's Plastic Soup Toolkit (includes link to Educator Guide, Introductory Video, Student Worksheets, Station Guides, 3 Water Sample Sets, 3 Sink or Float Activity Sets, 3 Sets of Tracking Trash Clue Cards)	Algalita (https://algalita.org/wayfinder-society/toolkit/plastic-ocean-teaching-kit/)	$50 value (free for public school educators while supplies last)
3	Water containers (pint mason jar, 200 ml beaker, cup/tub)	Repurpose what you have	$0
1	Bottle of 70% isopropyl alcohol	Any grocery store	$4