STEAM Subject: Earth (Ocean) Science
Lab: Water Pollution

Grades: 3-8

Learning objective:
Students will be able to
- o identify natural and human-based pollution sources.
- o discuss pollution effects on marine and human life.
- o model ocean pollution and ocean cleanup
- o discuss solutions to minimize negative impacts.

ENGAGE:
Ask students the following questions:
- How important do you think water is to marine life?
  - ○ *Very important, of course! The ocean is one of the most biodiverse places in the planet Earth, from microscopic bacteria and algae to the largest marine mammal in the world. All life depends on water!*
- What humans' activities impact the ocean?
  - ○ *Pollution, commercial fishing, recreation, ships/boats, hunting, etc.*
- What does the term water pollution mean?
  - ○ *Water pollution is when waste, chemicals, or other particles cause a body of water (i.e. oceans, lakes) to become harmful to the organisms that live there. Pollution can occur through both natural and unnatural causes, and there are a variety of sources of pollution.*
- Ask students to mention some types of water pollution. Where do you think most of the pollution comes from?

EXPLORE:
Pollution Activity
Question: Can we clean the water after pollution happens?

MATERIALS:
- 1 medium to large plastic bin/tub (represent ocean)
- Water
- 1 smaller bowl (to mix "oil spill" ingredients cocoa+oil)
- Cocoa powder
- Vegetable oil
- Plastic bag (cut or shredded into smaller pieces)
- Small plastic trash (bottle caps, cut-up straws, cut-up candy wrappers, etc.)
- Coffee grounds
- Sponges or cotton balls
- Dish soap

- Spoons or other tools to remove "trash"

SET UP:
Fill the plastic tub halfway with water. Mix cocoa powder with vegetable oil to represent petroleum oil in a separate bowl. Set "pollutants" (oil, coffee grounds, plastics) off to the side to be added later.

DIRECTIONS:
1. Have students slowly add small amounts of oil into the clean water. Discuss how the water has changed and what happens when oil spills into our oceans.
2. Then, have students drop a few spoonsful of coffee grounds (representing soil or dog poop) into the water and pieces of shredded plastic bags (marine debris). Ask students what do they think will happen when an animal gets stuck in plastic or if an animal drinks contaminated water?
3. Lastly, students will use sponges/cotton balls to try and absorb the oil that has spilled, and spoons to try and remove any plastic from the water. Students can also try to use dish soap to clean the oil.

Discuss students' observations:
What happened to the water after you pick up the trash or use the cotton balls/sponges, and dish soap? Which cleanup method was most effective?

While the water does LOOK a bit cleaner, there may still be very small pieces of pollution in the water. Water pollution is much easier to create than it is to clean up, as we just experienced. If it was this difficult to clean up just these tubs, imagine how difficult it would be to try to clean up the ocean!

EXPLAIN:

Water pollution is a serious problem, but if every person does their part we can find solutions to prevent pollution! The first thing we are going to do is to learn more about the problem.

Types of water pollution:
- Sometimes water pollution can be caused by natural events such as volcanoes, algae blooms, and sedimentation from storms and floods.

- Most water pollution comes from human activity. Around 40% of the rivers and lakes in the United States are too polluted for fishing or swimming.

- Pollution from human activities:

    - Animal waste (farm animals or pets)
    - Pesticides
    - motor oil from cars and even soap from washing your car can run down the street and into storm drains.
    - Marine debris, trash that reaches the ocean from land
    - Fertilizers from agriculture
    - Sediments from construction sites
    - Sewage (human waste). Sometimes due to sewage spills San Diego needs to close its beaches, check out more updates at https://www.sdcoastkeeper.org/beach-advisories
    - Oil spills (NOAA Photo 2010 Deepwater Horizon Oil Spill. Image from: https://www.worldwildlife.org/stories/five-years-after-deepwater-horizon-spill)

Oil Spills
Water pollution from major events like oil spills can completely destroy marine ecosystems, let's take a closer look to oil spills in our history.

What happens to the habitats and wildlife after an oil spill?
Read and find out:

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- NPR article "Where the Land Used To Be, Photos Show Louisiana Coast 10 Years After BP Oil Spill" https://www.npr.org/sections/pictureshow/2020/04/20/835829123/where-the-land-used-to-be-photos-show-louisiana-coast-10-years-after-bp-oil-spil
- NOAA Deepwater Horizon: Another Year Gone By, What's Changed? https://blog.response.restoration.noaa.gov/index.php/deepwater-horizon-another-year-gone-whats-changed

Water pollution effects in wildlife and human health.

- Pollution in the water can reach a point where there isn't enough oxygen in the water for the fish to breathe. The fish can eventually suffocate! This is caused by **eutrophication** (excess of nutrients from runoff, then algae overgrowth really fast and suck up the oxygen). Areas in the ocean with low oxygen are known as **dead zones**.
- Sometimes pollution affects the entire food chain. Small fishes absorb pollutants, such as chemicals, into their bodies. Then bigger fishes eat the smaller fishes and get the pollutants too. Birds or other animals may eat the bigger fishes and be harmed by the pollutants. This process is known as **biomagnification**.

- Plastic pollution affects wildlife in two ways: entanglement and ingestion. We will share more information in a lesson about Marine Debris and Ocean Currents.

- Show students some marine debris pictures at:
  https://www.arcgis.com/apps/MapJournal/index.html?appid=f933af6745ea4672aa3264bd157df414
- One of the most precious and important commodities for life on planet Earth is clean water. More than 1 billion people do not have access to clean water. Dirty, polluted water can make them sick and is especially tough on young children. Some bacteria and pathogens in water can make people so sick that they can die.
- Only around 2.5% of the Earth's water is fresh water. The rest is saltwater, which we cannot drink. Of the 2.5% that is fresh water, only 0.02% is available drinking water, the rest is trapped in glaciers/ice caps or stuck in the soil as groundwater.
- Between 5-10 million people worldwide die each year from illnesses related to water pollution.

Review STEAM Vocabulary:

- **Water pollution:** Chemicals, particles, industrial, agricultural, and residential waste, noise, or the spread of invasive organisms in Earth's oceans and waterways
- **Algae blooms:** Rapid increase or accumulation in the population of algae in freshwater or marine water systems, and is often recognized by the discoloration in the water from their pigments
- **Pesticides:** Substances used for destroying insects or other organisms harmful to cultivated plants or to animals
- **Sewage:** Wastewater from sinks, showers, and toilets that typically gets cleaned and treated before being released back into Earth's waterways
- **Storm drain runoff:** trash, pesticides, fertilizers, pet waste, oil, dirt, soap, and other chemicals that does not get cleaned or treated and enter the storm drains after it rains. All these pollutants go straight to the ocean.
- **Oil spill:** Release of a liquid petroleum oil into the environment, especially the marine ecosystem, due to human activity

EXTENSION:
Read the book Silent Spring by Rachel Carson. In this book you will learn about the history of a pesticide (DDT) and how it affected wildlife.
What marine bird was greatly affected by DDT? What humans did to help?
For younger students we recommend "Who was Rachel Carson" by By Sarah Fabiny.

EVALUATE:
Students will make a list of things that they can do to help prevent pollution (i.e. save water, pick up your trash, avoid plastic use, reduce, reuse, recycle, don't put grease down the sink, attend a beach cleanup, and more).

RESOURCES:

https://parentingchaos.com/ocean-pollution-clean-up-science-activity/
http://jdaniel4smom.com/2017/01/water-pollution-experiments-kids.html
https://www.ducksters.com/science/environment/water_pollution.php
http://ejcj.orfaleacenter.ucsb.edu/wp-content/uploads/2017/06/1962.-Rachel-Carson-Silent-Spring.pdf
https://www.sdcoastkeeper.org/community-engagement