Title

River Trash Analysis

Overview

This service learning activity increases awareness of the garbage problem in our rivers, and instills a sense of environmental stewardship. After a safety briefing, students, teachers, chaperones and staff depart from the floating classroom to a pre-chosen, volunteer friendly spot along the riverbank. Garbage is collected and then analyzed. Guided by scientific methodology, students determine what type of material they found most of, and make predictions on what type of litter is most present in other waterways. Together, students come up with strategies to prevent garbage from entering our waterways, and develop an action plan on how they can make a more positive impact on their environment.

Objectives

- Students become more aware of the issue of litter in the natural environment by seeing it and collecting and analyzing it
- Students actively participate in a service learning project
- Students understand that their individual actions have an impact on the environment
- Students understand that reducing their waste makes more of an impact than recycling
- After seeing their cleanup results, students feel empowered and confident to take action

NGSS

HS-ESS3-4: Evaluate or refine a technological solution that reduces impacts of human activities on natural systems.

Key Terms

- Conscious consumerism- a social movement based on awareness of the impact of purchasing decisions on health, the environment, and overall community
- Sustainability- managing resources in such a way that they will not be degraded or depleted over time
- Service Learning- An educational approach enforcing learning objectives with an activity that has community impact

Background Information

Plastic is everywhere. It's most likely in every room in most homes in America. We brush our teeth with it, store and cook food in it, drink out of it, wear it, and even sleep on it. Most of our clothing and fabrics for bedding are made out of plastic. Because plastic is so prevalent in society, it's no wonder that it's showing up in places where it shouldn't be, like our rivers, lakes and oceans.

According to a study published by Geyer et al in the journal Science Advances, plastic production and disposal surpasses most other man-made materials, with exceptions being materials used in the construction sector. Geyer's research also shows that an estimated 8 trillion metric tons of plastic ends up in the oceans every year, which equates to five grocery bags of plastic trash for each foot of coastline around the planet. Scientists estimate that 80% of marine debris starts off on land, while the other 20% is from ocean based sources (National Geographic 2014).

Furthermore, Geyer and his team estimated approximately 8300 million metric tons of virgin plastics have been produced to date (see exponential increase of plastic production in Figure 1.). As of 2015, 9% has been recycled, 12% was incinerated, and 79% ended up in landfills or either carelessly or accidentally discarded into the natural environment. Even though plastic production started 6 decades ago, plastic pollution has caused severe impacts on water quality, as well as death and illness of birds, marine mammals, and fish. If allowed, synthetic chemicals as well as petroleum that plastic is made out of leach out into water over time. Combined with ultraviolet rays and wave action, plastic particles break down into smaller and smaller pieces, and become ingested by animals that mistake it for food. Once ingested, plastic builds up in the animal's stomach, giving it a false sense of fullness, which can lead to starvation and infections. These plastics act as sponges in the water by soaking up toxins which accumulate in the tissues of the animals that ingest it, and possibly ending up in the food we eat. Research on the toxicity of plastics is lacking, but the little that has been done shows that many plastic leachates are dangerous to human health.

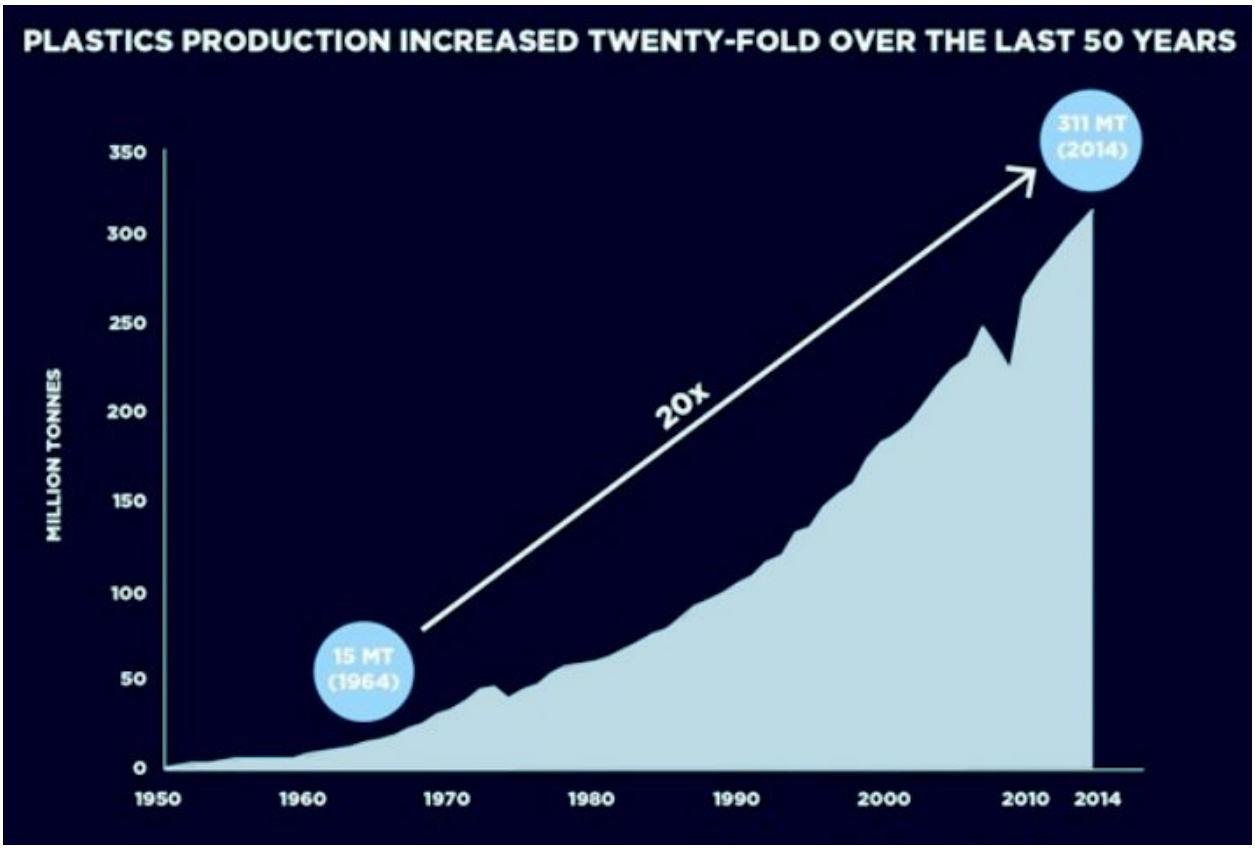

Figure 1. According to the World Economic Forum, plastic production has increased 20 fold in the past half century, and is expected to double again in the next 20 years.

According to a report from the World Economic Forum, plastic production has increased 20 fold in the past half century, and is expected to double again in the next 20 years. The report also states that "Even by 2025, the ratio of plastic to fish in the ocean is expected to be one to three, as plastic stocks in the ocean are forecast to grow to 250 million tonnes in 2025."

A study done by Sarah Dudas and students from the Vancouver Island University in Canada showed plastic particles in a majority of the oysters stomachs that were observed. Another study by the Vancouver Aquarium's Ocean Pollution Research Program found up to 9,200 particles of microplastic per cubic meter of seawater tested. Microplastics are plastic particles 5mm in size and smaller. Most of the microplastics found proven to have come from fibers from clothing like nylon and polyester. Since filters for microplastics in laundry is lacking, those fibers very likely may end up in waterways. These micro particles are confusing animals on the bottom of the food chain like zooplankton as food. Plastic particles and toxins can bioaccumulate in animals further up the food chain and cause damaging effects to individuals and populations. Humans are at the very top of the food chain and susceptible to these effects.

Plastic pollution gets into the river via flooding, storm drain runoff, littering, and natural disasters. By keeping communities clean, we can help prevent trash from flowing into storm drains and ending up in our rivers. Cleaning up is the proactive approach, whereas preventing waste from ending up in the waste stream is the best way to prevent litter from getting into the natural environment in the first place. Legislation for plastic reduction across the country is in effect in some cities and states, and it's important that constituents voice their concerns to the local and federal Government. Putting pressure on companies to adopt more sustainable practices in the production and distribution phases of a product starts with the consumer. On an individual level, one can look for eco-labels that identify environmental practices within the products creation. Being a conscious consumer involves a lot of practice and requires changing habits. Creating habits such as bringing reusable grocery bags to the store, and choosing aluminum over plastic bottles is a great start. A cultural mind shift towards conscious consumerism relies on effective communication, so educating oneself, setting a good example for others, and spreading awareness are one of the first steps one can make it to leave a more positive impact on the environment while shopping.

Materials

Clipboards-one for each group of 5

Gloves

Pens-one for each group of 5

River Findings sheet

Trash bags

White board with writing utensil (or chalkboard)

Activity

The framework of this activity follows the Next Generation Science Standards methodology of the 5E model of instruction in which through the learning experience, students build upon knowledge through exploration and investigation.

Engagement- Start by asking students, "What material will we find most of during our river cleanup and why?" Other questions to supplement discussion are: "What is the most common material that fruit and vegetables are packaged in? What material are most of the single use items are made out of? What are the items in your lunch packaged in?" This discussion engages students and allows them to share what they already know and relate it to the river cleanup activity and discussion later.

Exploration- After going over safety, students will go out along a predetermined, safe, shoreline, collect garbage, and place them in one large pile to be examined later. Please allow, at minimum, 30-45

minutes for this activity. Note that our safety procedures and guidelines are specific to each location and vary. Below are some general safety talking points that we go over at LL&W:

- Watch out for nails in boards-Watch where you walk, and lookout for dimensional lumber, as it sometimes holds nails. If you see a nail in a board, tilt it over, tilt it on a tree, or push it into the water so no one else can step on it.
- Do not put broken glass in bags-leave on ground
- Do not overfill bags (greater than 20 pounds is too full)
- Do not open bottles with liquid inside
- All participants must have their necessary medications at all times

By collecting trash and seeing the problem first-hand, students observe and develop their own explanations that they can use to make sense of the concept of why certain debris is more prevalent in the natural environment than others. After the river cleanup, students then get together in small groups and choose one bag to analyze and record its contents.

Explanation-Students share their findings and come up with explanations on how this common material might have gotten there in the first place. Instructors provide background information on the production, use, and disposal of plastics and other materials and how they can end up in waterways.

Elaboration-Students brainstorm ideas together and develop strategies on how to prevent garbage from entering the natural environment. Instructors can guide discussion by mentioning the Four R's: Refuse, Reduce, Reuse, Recycle and how it relates to their findings. In their small groups, students share their thoughts and ideas with whole group.

Evaluation- Instructor should ask if students have had any changes to their beliefs on what type of trash would be most common during the river cleanup. Students should be allowed a few minutes and reflect on the amount of plastic they consume in a day, and write down examples. After brainstorming, students choose at least one action they can take to change one habit related to plastic consumption in their daily lives. For example, "I will replace single-use bottles with a refillable water bottle at school." The goal is for students to confidently create a framework in which they can develop better habits towards conscious consumerism.

Extensions

1. Students are encouraged to start their own environmental groups, as well as recycling programs at their school. Living Lands & Waters is here for guidance and support for any student interested in doing so!
2. Recommended for grade levels 7-12 and above, Plastic Paradise is a documentary that sheds light on the effects of our plastic consumption.

Links and References

1. Geyer R, Jambeck J, Law KL. 2017. Production, use and fate of all plastics ever made. Science Advances. 3 (7).

2. Advancing sustainable materials management: facts and figures. United States Environmental Protection Agency. [Last updated 8/10/2017; Accessed 11/28/2017]. https://archive.epa.gov/epawaste/nonhaz/municipal/web/html/

3. Allsopp, M, Walters, A, Santillo, D, Johnson, P. (2006). Plastic debris in the world's oceans. Greenpeace International.

4. http://www.bluebirdelectric.net/oceanography/Global_Ocean_Commisioners/World_Economic_Forum_Fish_Plastic_Oceans.htm

River Findings

1. What was the most common material you found along the river?

2. Randomly choose one bag of trash to examine. What material makes up the highest percentage in the bag- plastic, glass, aluminum, or steel?

3. What are three ways to reduce your use of this material in your everyday life?