Abstract

For better or worse, litter is one form of pollution that everyone can impact through their daily behavior – even children. It is a pollutant that we see everyday, as opposed to other types of pollutants, like bacteria or fertilizers in rivers, which are best measured with scientific instruments. Once litter is transported into rivers via storm-drains, it becomes known as aquatic debris; when it reaches the ocean, it is known as marine debris. As a topic, litter offers teachers and students a rich opportunity to learn about the impacts of litter and trash on waterways and the ocean, and to reflect on their own actions related to recycling, picking up litter and the use of re-usable items including water bottles. Litter data can also help students explore watersheds, and understand how we are connected to the ocean through streams and rivers.

Tsunami of Debris

One of the consequences from the March 11, 2011 earthquake and tsunami that struck Japan was the movement of an estimated 20 million tons of debris into the ocean. According to the Japanese government, most of this debris has sunk or has been collected, but an estimated 1.5 million tons is floating across the Pacific Ocean (Government of Japan, 2013). Toys, bottles, household items, boats and other floatable debris items from the tsunami are now being found on the
shorelines of Alaska, British Columbia, Washington, Oregon, California, Hawaii, and are being monitored by the National Oceanic and Atmospheric Administration (NOAA), Environment Canada and their partners (NOAA, 2013 and Environment Canada, 2013). Much of this debris is expected to travel on the ocean’s surface currents until it reaches areas where marine debris concentrates in patches. According to NOAA, there are two garbage “patches” in the Pacific Ocean where currents spiral around a central point – such spiraling areas are known as gyres (Figure 1). These patches of debris are made up of mostly small bits of floating plastic – fragmented from still larger pieces of debris. Similar patches have been identified in other oceans where global surface currents and wind move to create gyres, vortexes that concentrate buoyant materials (Figure 2).

**Daily Tsunamis of Marine Debris**

NOAA refers to the tsunami as a severe marine debris event, and the 2011 Japanese tsunami debris has generated many headlines. But each day, there are tiny “mini tsunamis” when plastic waste enters storm-drains, streams, rivers and eventually coastal waters. While school children can do little about true tsunami related debris, they can do a great deal about the debris in their local waterways. Learning about litter in our communities can provide a launching pad to learn about the connections of watersheds to ocean health.

For better or worse, litter is a form of water pollution that everyone can reduce through changes in their daily behavior – even children. Litter is understandable to children since it is visible, and usually is made up of items they use daily including bottles, straws, and food wrappers.

Once litter is transported into rivers via storm-drains, it becomes known as aquatic debris; when it reaches coastal waters and the ocean, it is known as marine debris or marine litter. According to the United Nation’s Environmental Programme (2005), marine debris is “…any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment.” It includes items made from plastics, metal, glass, paper or wood, rubber and other biodegradable and non-biodegradable materials (UNEP, 2005). The U.S. Environmental Protection Agency (2012) estimates that 49 percent of marine debris items found on U.S. beaches are from inland sources including parking lots, roads and sidewalks. An estimated 18 per cent is from ocean-based sources (e.g., fishing gear, trash from boats, etc.), and 33 per cent is from sources that could be either land-based or ocean-based (US EPA, 2012).

**Impacts: Marine Debris and Wildlife**

In addition to the impact that marine debris has on human health and safety, more than 260 species of animals—including birds, turtles, marine mammals, crustaceans, and fish—have been reported to have become entangled in marine debris, or to have ingested it (Kershaw, et al., 2011). Often wildlife mistakenly consumes marine debris items (e.g., plastic bags, micro-plastics, and
Eating debris items can cause obstruction, damage to the gut, or result in malnutrition. Fishing line, plastic ribbons on balloons, and similar types of trash can entangle animals (see Figure 3). There are also concerns about the lethal and sub-lethal impacts of compounds used in the manufacturing of plastics, as well as persistent bio-accumulative toxic chemicals that adsorb (adhere) to the surfaces of plastic fragments (Kershaw, et al., 2011).

**Addressing the Daily Tsunamis**

In 2011, just nine days after the earthquake and tsunami in Japan, hundreds of marine debris experts gathered at the 5th International Marine Debris Conference to collaborate and create a global framework for prevention and management of marine debris. Education and the raising of awareness about the sources and impacts of marine debris were among the key strategies identified. Schools can play a vital role in introducing students to aquatic and marine debris issues, and in helping them explore actions they can take to be part of the solution.

**Lessons in Litter**

**Classroom Prep**

For children, litter cleanup events can be educational, meaningful experiences that deepen their understanding of geography, ecology, and the impacts humans have on aquatic and terrestrial ecosystems. These activities can be interdisciplinary, using science, math, writing, art, and civic engagement. Student-generated data about litter can become the basis for guided, inquiry-based learning and can build their confidence in science process skills. This topic also offers both teachers and students the opportunity to reflect on their own actions and behaviors related to recycling, litter, and their own use of single-use disposable items versus their use of re-usable items (e.g., water bottles and lunch bags). Activities that include picking up litter also provide students with direct personal involvement and a hands-on, real-world stewardship activity.

Prior to engaging students in a litter cleanup on the school grounds or in a nearby park, teachers should review field trip safety recommendations, and preview the site to anticipate safety and logistical issues. Careful planning will ensure that outdoor activities are successful, meaningful, and safe. Furthermore, students will need to increase their knowledge and awareness about litter. Students can explore sources of litter (“How does a soda bottle become litter?”), and impacts of litter (“How might this balloon be harmful to a fish, bird or turtle?”). Teachers can provide prompts to help students think about sources and impacts of litter in the environment.

- Where do you see litter?
- What impacts do you think litter could have on wildlife?
- How do you think litter gets into rivers and oceans?
- What do you know about plastic in the ocean?
- What do you predict we will find when we do a litter cleanup?

As an extension, students can research their watershed using local maps or the on-line tools offered by the US Environmental Protection Agency and the US Geological Survey. By observing how small watersheds are nestled inside larger ones, they can start to understand how a piece of trash that is littered in their town can make the journey to the ocean.
Students should develop a comparative question that they would be interested in investigating using litter as the context. Then, in small groups, students can discuss the questions and decide on one that they will explore as a team during an upcoming litter cleanup event. Depending on the age of the students, they can also write a hypothesis based on their question.

Examples of Comparative Questions

- Is there more litter found in one location vs. another?
- Of the litter we find, is most of it recyclable (or is most of it non-recyclable)?
- When comparing the composition of the litter, what type of litter makes up the largest group?
- Are most litter items, small items (smaller than 25 cm) or larger?
- Are the “top ten” littered items in our study area similar to the “top ten” items found in the US (see Table 1)?

Lessons in Litter: Conducting a Litter Cleanup and Data Collection

After the class is prepared, it is time for a hands-on activity, students pick up litter and collect data on the school grounds, in a nearby park, or at a local stream or beach. After collecting the litter, and while still in the field, have students record the types and quantities of the litter in their study area. They can analyze the data, and record findings on data sheets, portable white boards or in journals. Next, each group can give to the class, a brief (one to three minute) summary of their findings. Students can also compare the “top ten” most commonly found items from their local clean-up site with the “top ten” list produced annually by the Ocean Conservancy (see Table 1). This list is based on data collected by hundreds of thousands of volunteers who participate in the International Coastal Cleanup, the world’s largest volunteer effort to collect data on litter and trash found in streams, rivers and beaches.

Reflection and Communication

While a litter cleanup by itself has value, there is an opportunity for deeper learning when reflection and communication are included. Back in the classroom, there are opportunities for external sharing and communication. For example, students can write articles about their findings for the school paper, or letters to the editor of a local newspaper or to their congressman. Students could create a story or educational poster about a plastic bottle cap’s journey to the sea. Students can revisit their research on local watersheds, and explore how trash travels by way of storm drains, streams, and rivers.

Students can also discuss what actions they will likely take in the future to reduce litter pollution in our waterways and ocean. Included could be discussions of how our choices (e.g., what we buy, how we handle our waste, etc.) can impact the environment. Inquiry-based activities like these help in the formation of values that might impact future choices that the students make in regard to “reduce, re-use and recycle”. Depending on the grade level, further exploration can include ways a community or government can work to reduce this form of pollution through education, regulation and innovation.
Resources

Introduction to watersheds
A video by Clean Virginia Waterways explains how to explore your watershed and learn the names of local streams and rivers: http://www.longwood.edu/cleanva/videosbycvw.html

Learning names of local water-bodies

Planning safe field trips

References

About the Author
Katie Register is executive director of Clean Virginia Waterways at Longwood University in Farmville, Virginia. For 20 years, she has conducted research on marine debris and has organized river and beach cleanups. She has worked on marine debris issues on the state, national and international levels. She has a Master’s degree in environmental science and public policy from George Mason University in Fairfax, Virginia, and is currently the vice-chair of the Virginia Water Monitoring Council. Katie can be reached at registerkm@longwood.edu

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