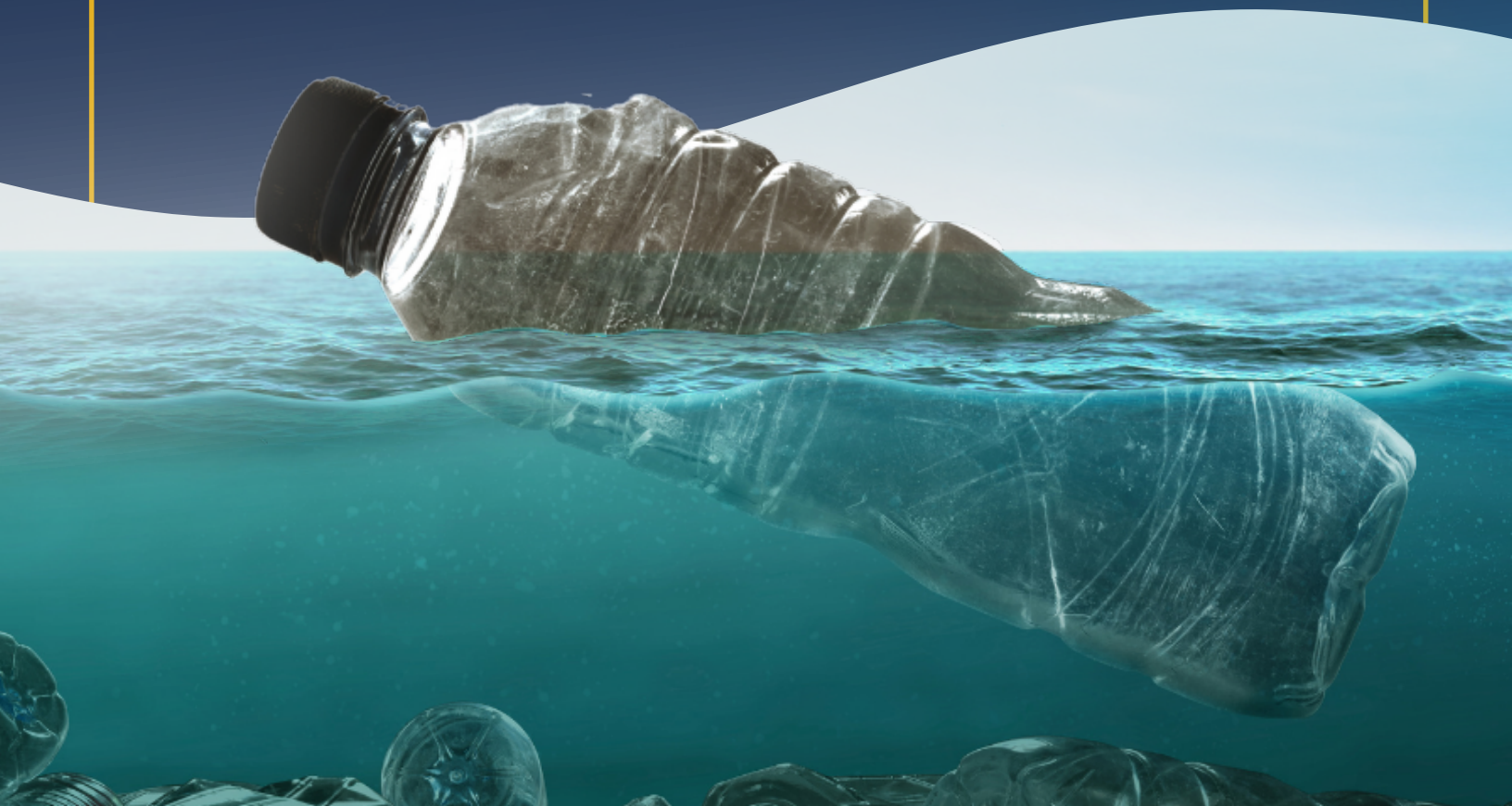
Ocean Week Canada

Museum, Science Centre & Aquarium Toolkit

Activity #1: RiverBot Garbage Gulper



Ocean Week Canada

Introduction

The health of the global ocean and freshwater ecosystems, as well as the biodiversity they each sustain, are critical for our community, cultural, and economic well-being. Pollution, climate change, habitat loss, and many other factors related to human activity pose a risk to our water systems and the species that live there. Action must be taken to not only protect these species, but to actively rebuild their populations. The issue of plastic pollution is a growing problem. Scientists have predicted that by the year 2050, there could be more plastic in the global ocean than fish (by weight). Plastic debris can lead to suffocation and entanglement for marine species. Its ingestion by wildlife can lead to starvation, stunted growth, and reproductive problems; plastics also pose a threat to human health as toxins and microplastics are introduced into our food web. Local waterways flow into watersheds that eventually lead to the ocean, acting as an avenue for any pollution or debris left to travel. Bottom line: we are all connected and our actions matter!

Dive into this hands-on toolkit developed by the Canadian Museum of Nature and Ingenium to promote the importance of aquatic health throughout Canada. A limited number of kits with materials are available to select museums, science centres, and aquariums across Canada; however, all the information and materials required to engage in the activities are detailed in the digital toolkit. You can do it yourself! The activities are targeted for general museum audiences of children, aged 6-12, and their families, and will help museum professionals interpret marine concepts in an encouraging and engaging way. Participants will have the opportunity to program their RiveBot (line tracking robot) to gobble up plastic garbage in a river; use handheld microscopes to investigate aquatic organisms and microplastics samples up close; and then test their knowledge with our water trivia game. By creating a memorable moment of discovery and investigation visitors will feel empowered to support ocean health.

Ingenium
Canada's Museums of Science and Innovation
Musées des sciences et de l'innovation du Canada

canadian museum of nature
musée canadien de la nature

Canadian Ocean Literacy Coalition
La coalition canadienne de la connaissance de l'océan

Canada

RiverBot Garbage Gulper

In this activity, visitors will program their RiverBot to mimic real life examples of pollution cleanup in aquatic ecosystems. Most local waterways eventually lead to the ocean, bringing any pollution or debris left on the ground along the way with them. We are all connected and our actions, wherever we live, matter. In order to effectively clean up ocean plastics, we need to help prevent new plastic from entering the ecosystem.

Learning Objectives

- We are connected to the ocean and the ocean connects us.
- There is only one big global ocean, and we have a responsibility to care for it.
- Life on land and life below water depend on a healthy ocean
- Our actions threaten ocean health, our health, and the health of future generations.
- Plastic pollution negatively affects aquatic ecosystems and can have an effect on biodiversity and species at risk.

Materials

- Charged Ozobots
- Markers
- Maps
- Instruction Sheets
- Colour Codes
- Line drawing examples
- Table, chairs, roll-up banner

Preparation

- Ensure Ozobots are charged (plug the mini USB charging cable into a computer or a multiport charger and plug the Ozobot into the other end. Ozobot blinks green when it is partially charged, and shows a solid green light when fully charged.)
- Make a demonstration path on a map to allow for an example of how the Ozobots work.
- Prepare a space with the maps, markers, instruction sheets, and colour codes laid out for visitors to create their own map.
- Keep the Ozobots near the facilitator, and hand them out for people to test their path as needed.

Try This

- Create a path for your Ozobot to leave the ship and return to the dock
- Collect 3 pieces of trash and take a photo of any aquatic animals you might see along the way

Accommodations

A lower working area, such as a short table, bench or clipboard, should be made available so that the activity is accessible for small children and people in wheelchairs.

Facilitator Guide

Guiding Questions

How do you think cleaning up the river can help the ocean?

- Small streams and rivers will join together and eventually all this water runs into a large body of water like a large lake or the ocean.
- It is easier to prevent pollution from entering at the source rather than try to clean it up once it is already in the aquatic environment.
- Rivers have been found to be the primary source of ocean plastic pollution as they are the arteries that carry waste from the land to the ocean.

Why is plastic bad for the aquatic environment?

- Plastic can be ingested by aquatic species, which for some, can lead to their starvation, as their stomachs fill with debris that provides no nutrition.
- Plastics can cause entanglements of marine species.
- Plastic in the ocean can break down into particles due to the constant motion and harsh conditions. Particles smaller than 5mm in diameter are called microplastics and become effectively impossible to retrieve as they travel farther and deeper.
- Floating plastic contains harmful chemicals and absorbs even more pollutants. These make their ingestion even more dangerous for aquatic animals and anything along their food chain. As animals eat the plastic, and are in turn eaten by other animals, these toxins (along with the plastics) can travel up the food chain in a process called biomagnification.

Why do you think some species in Canada are identified as at risk?

- A species at risk is any naturally-occurring type of plant or animal that is in danger of extinction or of disappearing.
- Habitat loss and degradation are the primary factors that influence the endangerment of species today. In Canada, about 60% of species identified as being at risk are affected by habitat loss or degradation.
- It is not necessary that a habitat be destroyed for it to become unsuitable for some species. Any disturbance can cause some species to abandon their habitat or prevent them from breeding successfully.
- Environmental contamination can have a great effect on wildlife and their habitats. Chemicals released from industry into air or water, or leached off lands into water bodies, can have a great effect on many organisms.
- Climate change affects species in many ways. Warming temperatures, effects on food sources, sudden climatic events like extreme storms, all have an impact.
- The introduction of invasive plants and animals takes its toll on native wildlife.
- Outbreaks of diseases can radically affect populations.
- Over harvesting and excessive trade (for food or pelts) has a great effect on species survival.

Dive Deeper

Ozobots are little robots that were designed to provide an introduction to coding. They use downward facing cameras to detect the color of the line under it. They will follow the lines using a back-and-forth motion. Different colors give different commands via different combinations.

Our RiverBots cleaned up our plastic pollution during this activity. Technologies are being developed in the real world that will help us find solutions to plastic pollution accumulating in our aquatic environments. For more information on these real-life projects refer to the **Background Information for Science Interpreters**.

RiverBot Garbage Gulper

Instruction Sheet

PLEASE BE CAREFUL WITH THE OZOBOTS; THEY ARE FRAGILE!

***All lines and codes must look EXACTLY like they do on the colour code sheet! ***

The Ozobot will follow a black line, read the code, and perform each action. Draw a black line from the boat (your starting point) to the first objective you pick. **Remember, you need to collect 1 plastic bag, 1 surgical mask, 1 plastic straw, and take a photograph of any aquatic species you go by!** You must leave the starting point and make it to the dock at the other end. Use the legend of codes to figure out which code to use for each action.

Tips

- Make your lines the same thickness as on the example sheet
- **Go one step at a time!** Your Ozobot might end up off the path after doing an action so draw your route one piece after the other.
- TEST AFTER EACH STEP/ACTION
- When you are drawing the lines make sure you don't run over any objects, go around or else your bot will get confused.

Colour Codes

Collect a plastic bag

Collect a surgical mask

Collect a plastic straw

Take a photo

Move quickly

Slow down

To run your Ozobot

1. Press the button on the side.
2. Make sure to calibrate your Ozobot by holding the side button until a white light blinks. Then place the Ozobot on the black dot and the Ozobot will read the code, flash blue, move forward, flash green, and stop. If it flashes red, then try again.

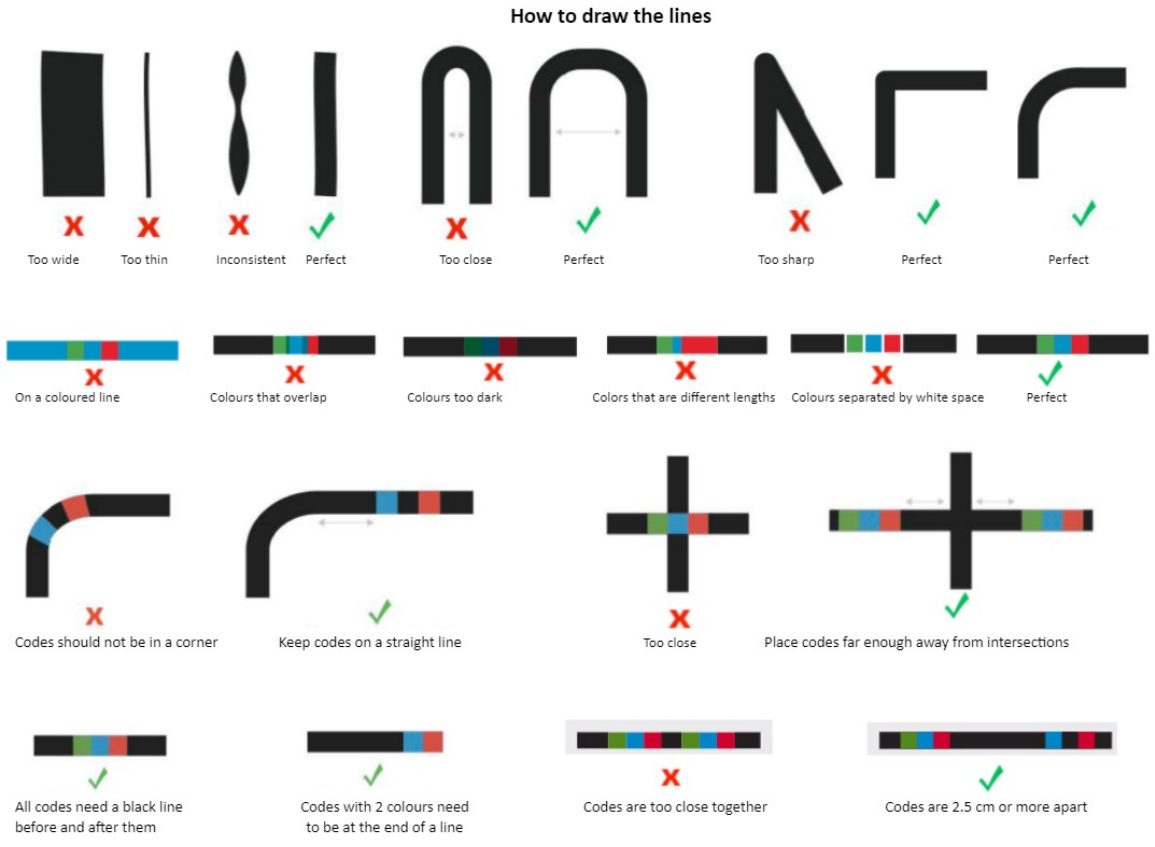
Colour Codes

OzoCodes

ozobot COLOR CODE REFERENCE CHART

ozobot.com

Tracking Lines



CODES COULEURS

VITESSE


Vitesse escargot


Vitesse lente


Vitesse de croisière

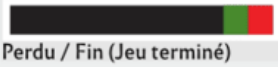

Vitesse rapide


Turbo


Boost

FIN DE JEU

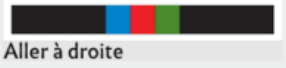

Gagné / Fin (Rejouer)


Perdu / Fin (Jeu terminé)

DIRECTION


Aller à gauche


Aller tout droit


Aller à droite


Sauter de ligne à gauche


Sauter de ligne tout droit


Sauter de ligne à droite


Demi-tour


Demi-tour (Fin de ligne)

COMPTEURS


Compteur X-ing enclenché


Compteur de virage enclenché


Compteur de chemin colorisé


Compteur de points enclenché


+1 point


-1 point

TEMPS


Chrono allumé, 30s puis STOP


Pause, 3s

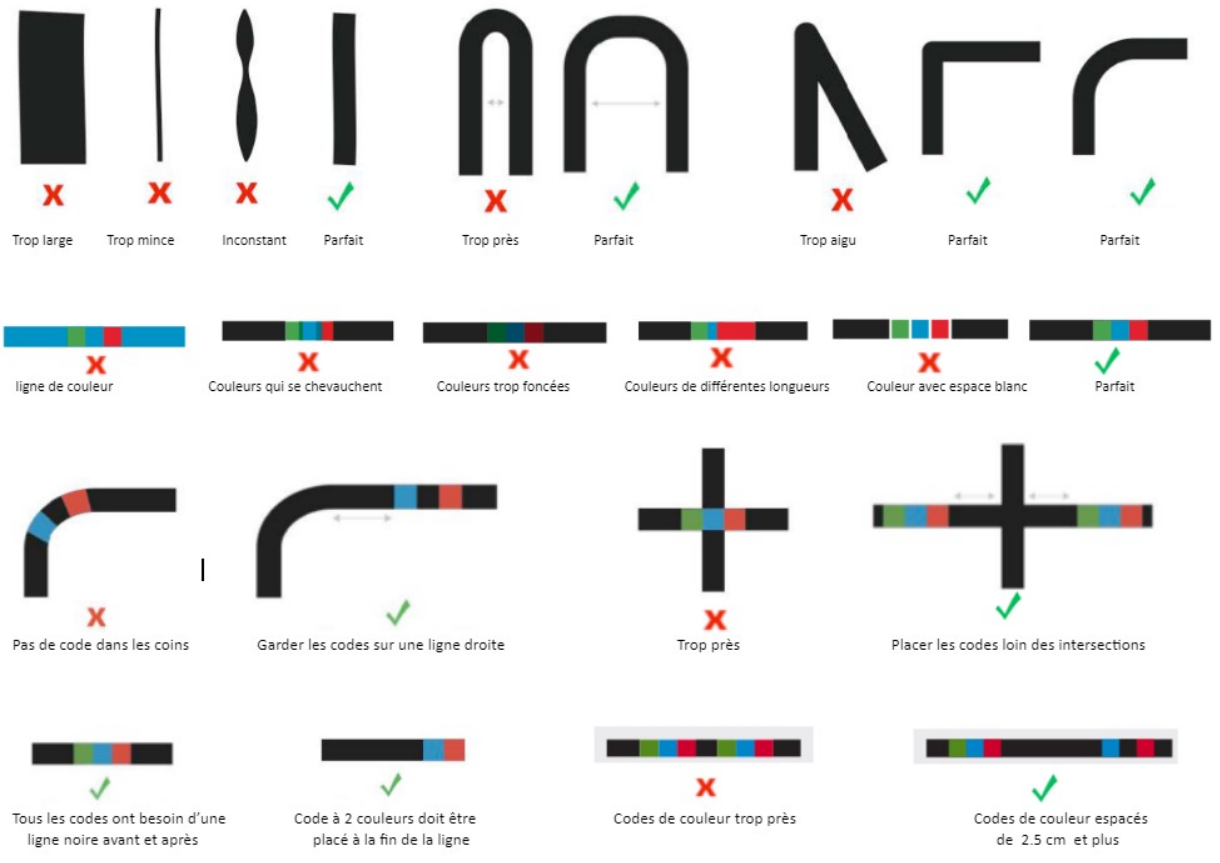
MOUVEMENTS SPECIAUX


Tornade

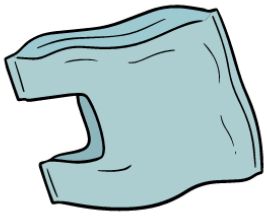

ZIGZAG

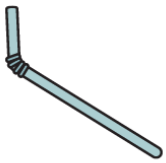

Tourner sur soi-même

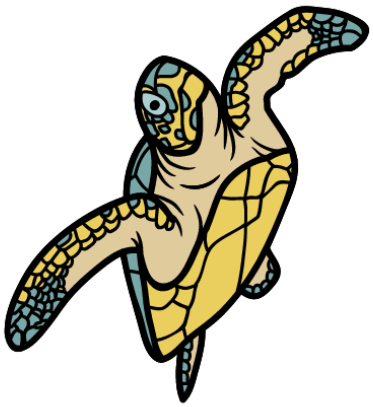
Comment dessiner les lignes

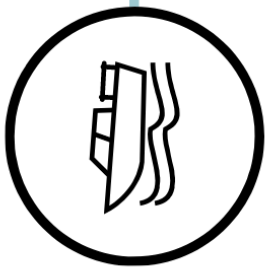


Map









Background Information for Science Interpreters

There is one big ocean global ocean

- Local waterways and watersheds eventually lead to the ocean and all the worlds' oceans are connected.
- Local activities can affect the global ocean.
- It is the responsibility of everyone to take care of the ocean.

Oceans play a crucial role in mitigating climate change

- The global ocean acts as a climate regulator and as a sink for atmospheric carbon dioxide (CO_2).
- Atmospheric carbon dioxide (CO_2) diffuses naturally with water (it mixes into the ocean). Here, it undergoes several chemical reactions with water and forms carbonate ions (CO_3^{2-}) and hydrogen ions (H^+). Microscopic planktonic organisms combine these carbonate ions with calcium ions (Ca^{2+}) (rocks dissolved by weathering are the main source of calcium in the ocean) to create calcium carbonate ($CaCO_3$) which they use to build shells and plates necessary for their survival. When these organisms die, they sink to the bottom of the ocean and are buried, taking the CO_2 with them. This is why the ocean is a sink for CO_2. These tiny marine organisms are the basis of the marine food chain. Many of these organisms are phytoplankton and, through photosynthesis, are responsible for producing 50-80% of the world's oxygen.
- With more carbon dioxide in the atmosphere, more is diffused into the ocean. Increased carbon dioxide increases the amount of H^+ ions in the ocean. These extra H^+ ions begin to react with the carbonate (CO_3^{2-}) and create bicarbonate (HCO^{3-}). This reduces the amount of carbonate available for marine organisms to use in building their shells. These extra H^+ ions reduce the pH of the ocean, making it more acidic - this is why the process is called ocean acidification. Normally, since the ocean is so big, it is very difficult to change the equilibrium of its chemistry. But human activities have added so much carbon dioxide to the atmosphere that the ocean cannot keep up. Between 1751 and 2021, the ocean's pH has dropped from 8.25 to 8.1. This represents a 30% increase in H^+ ions in that time (remember, pH is a logarithmic scale, so a change of unit of pH is equal to a tenfold change in H^+ ions). Freshwater environments also seem to be acidifying, but this is much more complex and less understood.
- Climate change has a negative impact on the ocean including: rise in ocean temperature, ocean acidification, deoxygenation, sea level rise, the decrease in polar ice coverage, coastal erosion, and extreme weather events.
- The ocean plays a crucial role in the water cycle.

Health of marine and freshwater ecosystems are critical for our country and they are at risk

- The health of our water systems (marine and freshwater) and the wildlife they sustain are critical to our community, cultural, and economic well-being.
- Climate change, habitat loss, pollution and many other factors related to human activity pose a risk to the species that find their homes in our water systems.
- Action must be taken to not only protect these species, but to actively rebuild their populations.

Human activities are harming Canadian water systems – plastics

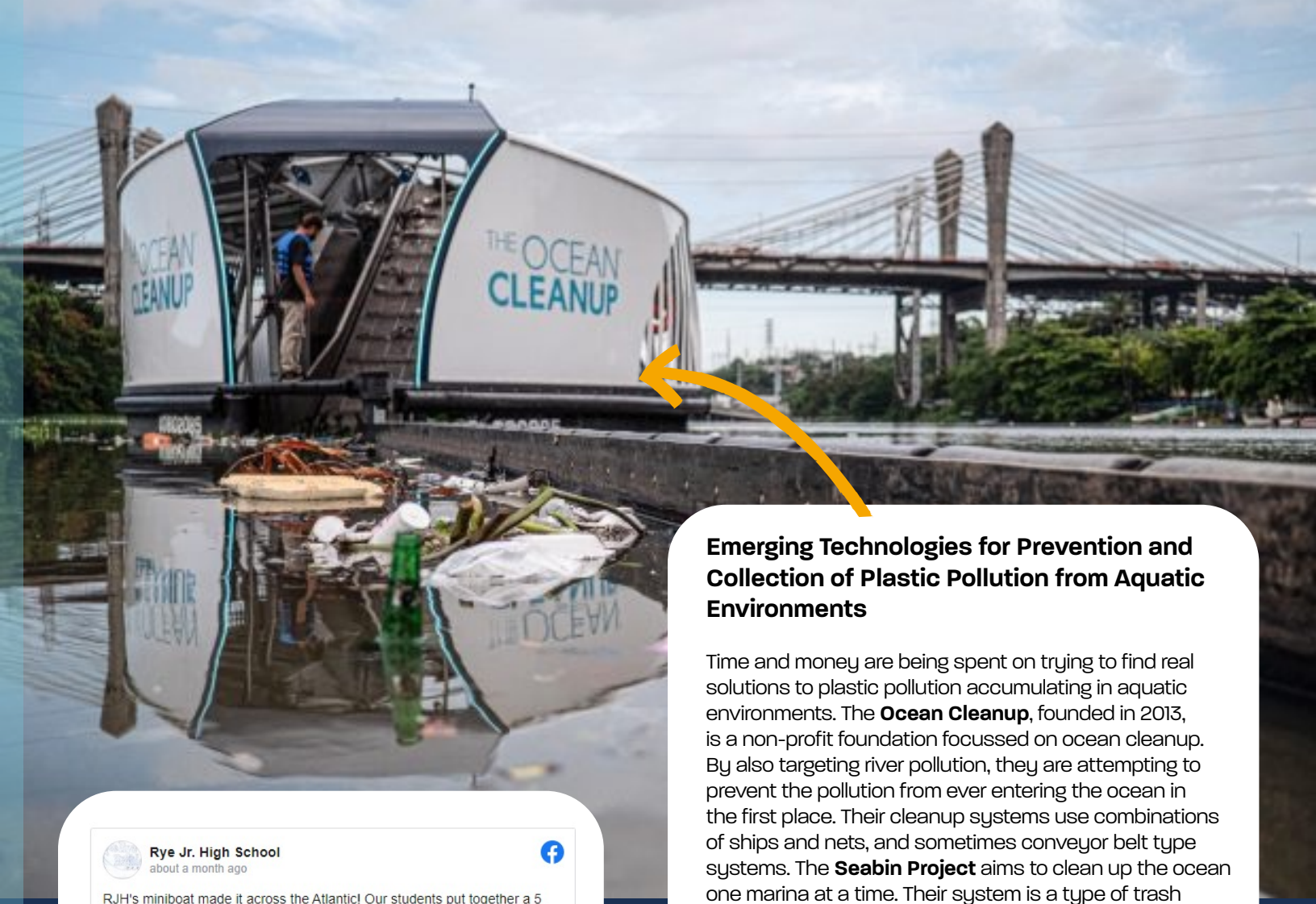
- Human activities can harm aquatic life and are degrading the ocean and waterways.
- This undermines coastal communities' livelihoods and has a negative impact on human health.
- Every year more than 8 million tonnes of plastic are dumped into the ocean.
- Oceanic pollution includes toxic chemicals from industries (including oil, lead, and mercury), land run-off (including fertilizers, petroleum, and pesticides), wastewater, oil spills, and littering.
- Pollution in the ocean has a negative impact on human health, through contaminated water supplies and food chains through affected marine life.
- Pollution has a negative effect on the economy as natural resources are destroyed by pollution.
- Pollution can reduce the ecological benefits of a recreational area and in some cases render it completely unusable, negatively impacting culture.

Where do plastics come from?

- Plastic pollution needs to be stopped at the source
- Alternatives need to be found to single-use plastics; not only are they killing aquatic animals, but they are made using fossil fuels which are affecting our climate.
- Plastic production is projected to quadruple in the next 30 years, and we cannot recycle our way out of that.
- Only 9% of every piece of plastic ever made has been recycled, and some of that is not even recycled – it's downcycled.
- Customers need to be provided a choice of plastic-free options.
- Pollution, including plastics, gets washed down from our streets, parks, and parking lots and into storm drains and small creeks which make their way to bigger waterways, and eventually the ocean.
- Microplastics are found in many of our cosmetic products and microfibers are released from synthetic fabrics. When synthetic plastics are laundered these microplastics find their way into our wastewater. To protect the health of the water systems we should limit our use of products that contain, or are made from, synthetic materials. Microplastic filters that you can attach to your washing machine are being developed. The performance of these filters is still being investigated. This work is important since scientists are saying that textiles may be responsible for up to 35% of microplastic pollution in the ocean.

Why are plastics a problem?

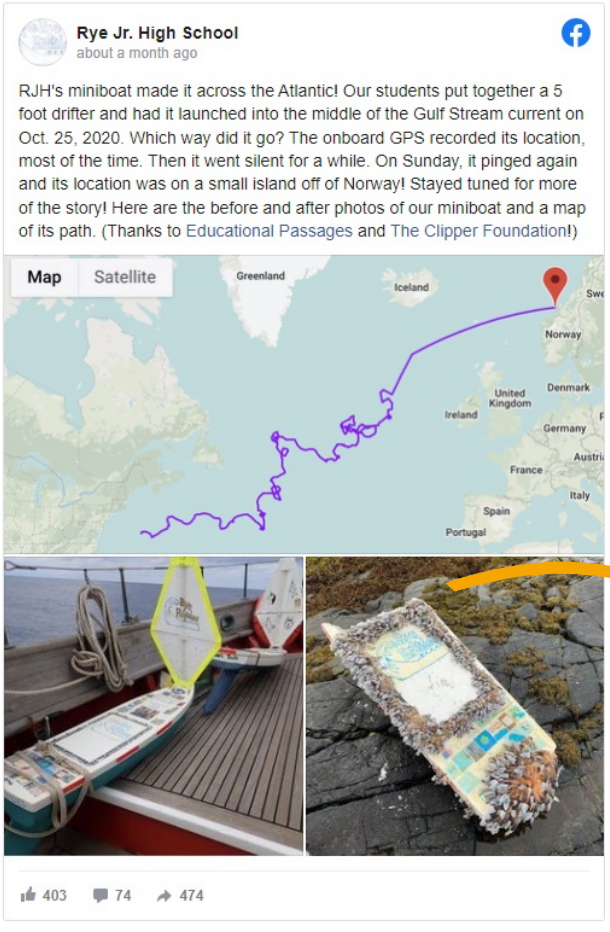
- In 2017, the World Economic Forum and Ellen MacArthur Foundation estimated that by the year 2050 there could be more plastic in the global ocean than fish (by weight).
- In the great garbage patches in the Pacific and Atlantic Ocean, plastic already outnumbers living organisms by 180:1.
- As plastics float around in the ocean, they are broken down into smaller pieces; pieces of plastic smaller than a quarter are called microplastics.
- Microplastics are easily ingested by marine life and produce a series of toxic effects and can lead to starvation as stomachs become filled with plastic.
- Toxins can adhere to plastics and biomagnify up the food chain.
- Plastic can release harmful chemicals into the water and into animals that ingest it.
- Microplastics have been found in Arctic ice, human blood, and even embedded in human lung tissue.



Emerging Technologies for Prevention and Collection of Plastic Pollution from Aquatic Environments

Time and money are being spent on trying to find real solutions to plastic pollution accumulating in aquatic environments. The **Ocean Cleanup**, founded in 2013, is a non-profit foundation focussed on ocean cleanup. By also targeting river pollution, they are attempting to prevent the pollution from ever entering the ocean in the first place. Their cleanup systems use combinations of ships and nets, and sometimes conveyor belt type systems. The **Seabin Project** aims to clean up the ocean one marina at a time. Their system is a type of trash skimmer that is designed to be installed in the water in areas with calm environments, such as marinas. The **Jellyfishbot** is a remote-controlled device that collects marine waste in areas that are inaccessible for cleaners that use nets. The **WasteShark** is an electric marine drone that scoops up floating debris. It can be used in rivers, lakes, and along coastlines. **FRED (Floating Robot for eliminating Debris)**, developed by Clear Blue Sea, runs on solar power, and collects marine debris using booms, belts, and bins.

Photo Credit - The Ocean Cleanup



A small boat made by middle schoolers in New Hampshire made its way to Norway!

In October 2020, a small boat fitted with a GPS tracking device aboard set sail from a small town in New Hampshire. Some 462 days and 13,400 km the boat made its way to the shores of the small Norwegian island of Smøla.

Photo Credit - @RyeJrHigh

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