

Marine debris

Audience – High school environmental science

Time required – 15 minutes

Activity Investigate marine debris, the role of ocean gyres, and how humans impact trash accumulation.

Science Standards APES: IC. Global Water Resources and Use
APES: IV.A. Benchmark: Pollution Types
NGSS: HS-ESS3. Earth and Human Impacts

Learning Outcomes

- Students will investigate how marine debris becomes trapped by ocean gyres.
- Students will predict where marine trash will accumulate in oceans.

Map URL: <http://esriurl.com/enviroGeoInquiry9>



Engage

What are the major ocean currents?

- Click the map URL link above to open the map.
- Zoom and pan the map to see all the ocean currents.
- ? Why are some currents marked red and some marked blue? [*Temperature differences*]
- Equatorial waters are the warmest and, like air, warm water expands and rises. This results in about a 3-inch-higher water surface elevation in the tropical region than elsewhere.
- ? What impact does this have on direction of equatorial warm water currents? [*Water flows away from the equator.*]
- ? What is the cause of this pattern? [*Gravity*]



Explore

Will an ocean current trap marine debris?

- With the Details pane visible, click the button, Show Contents of Map.
- Click the Hawaii map marker and then click the link to enlarge it.
- Gyres are large circular ocean currents that redistribute heat and can trap marine debris.
- Zoom out and pan the map.
- ? Where are other gyres, potentially trapping debris? [*North & South Atlantic, South Pacific, Indian Ocean*]



Explain

Where does the trash come from?

- Researchers estimate 80 percent of trash comes from land and 20 percent comes from marine sources.
- ? What are the main sources of land-based trash? [*Litter; industrial discharges, such as microplastics; garbage transport; and landfills*]
- Click the button, Bookmarks. Select Spokane.
- From the Details pane, click the button, Show Contents Of Map.
- Click the checkbox to the left of the layer name, Spokane Downstream Trace.
- ? How can trash from inland areas, such as Spokane, reach the ocean? [*Trash and litter flow down rivers to the ocean.*]

Elaborate

Why are “garbage patches” filled with plastic?

- Pan the map to see the Pacific Ocean, and click the map marker near the Midway Atoll.
- In the popup window, click the animation of Trash Accumulation.
- Trash from the United States coastline may take six years to reach the Eastern Pacific Garbage Patch, while Japanese trash takes about one year.
- ? Why is plastic the main trash found in this area? [*Plastic floats; biodegradable material decomposes while plastic only breaks into smaller pieces but does not decompose.*]
- Click the Spokane map marker to see one common source of plastic pollution.

Evaluate

What is the impact of marine debris?

- Turn on the layer, Blue Whale Concentration.
- Click the Blue Whale area in the map for more information.
- ? How could the ingestion of microplastics, such as nurdles or older plastic trash, impact whales? [*It can cause malnutrition or intestinal blockage.*]
- ? How can you prevent additional marine debris? [*Recycle: Reduce plastic that ends up in the waste stream; educate others to prevent coastal pollution; and/or participate in beach cleanups.*]

ZOOM TO A BOOKMARK

- Click the button, Bookmarks.
- Select a bookmark name to zoom to its map location and scale.

TURN A MAP LAYER ON OR OFF

- Press the Details button to turn on the pane.
- Show the table of contents for the map by pressing the button, Show Map Contents.
- Show layers by checking the box next to layer names.
- If a map layer name is light gray, zoom in or out of the map until the layer name is black. The layer can now be turned on.

Next Steps

DID YOU KNOW? ArcGIS Online is a mapping platform freely available to U.S. public, private, and home schools as a part of the White House ConnectED Initiative. A school subscription provides additional security, privacy, and content features. Learn more about ArcGIS Online and how to get a school subscription at <http://connected.esri.com>.

THEN TRY THIS...

- Investigate the impact of marine trash on albatross in the story map, *Winged Ambassador*, at <http://esriurl.com/Geo551>.
- Using an ArcGIS Online organizational subscription for schools, create a cluster map analysis for point locations of garbage in the sea. Explore how the map scale of cluster data informs your data interpretation.

TEXT REFERENCES

This GIS map has been cross-referenced to material in sections of chapters from these texts.

- *Environmental Science: A Global Concern* by McGraw-Hill — Water Use and Management Chapter
- *Living in the Environment (16th)* by Brooks/Cole, Cengage Learning — Global Climate and Biomes Chapter