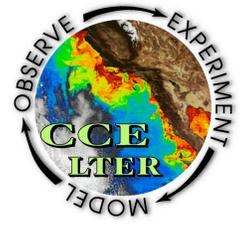


PLASTIC MICRO-DEBRIS

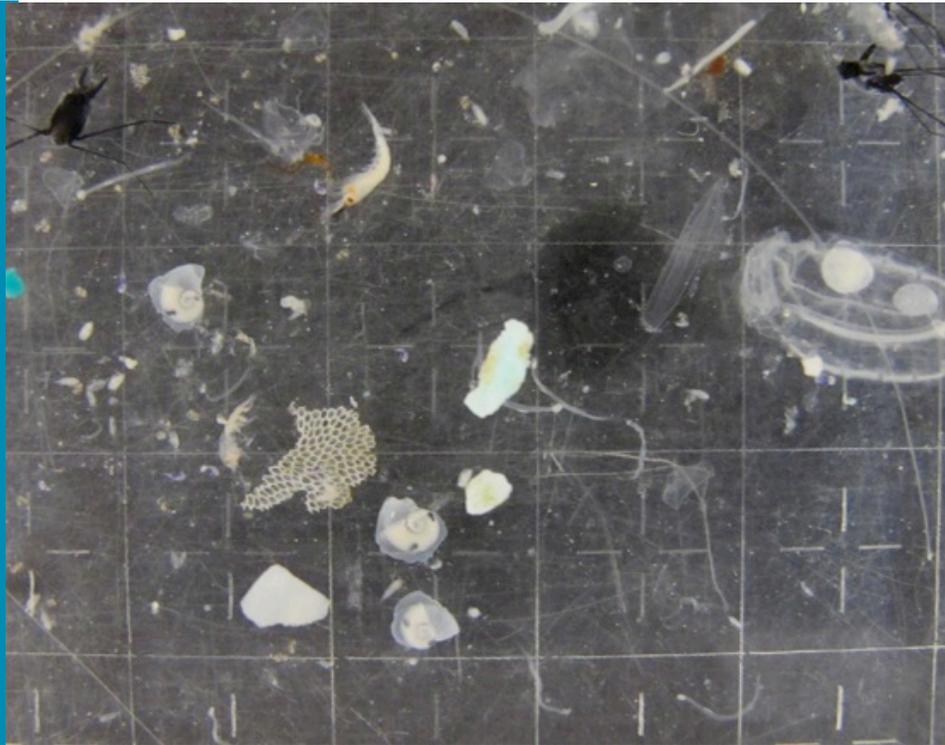
Scripps Environmental Accumulation of Plastic Expedition (SEAPLEX)



STUDENT PAGES

The distribution of plastic debris is accumulating thousands of miles off the California coast at the center of the Central North Pacific Gyre. SEAPLEX researchers are focusing their studies on answering some critical questions.

Figure 1: Digital image of zooplankton and plastic micro-debris (Courtesy Linsey Sala, UCSD/SIO, 2010.)



Investigating Plastic Micro-Debris in the Central North Pacific Gyre

By Beth Simmons (CCE LTER Education & Outreach) and William Miller (Patrick Henry High School)

Plastic debris in the Central North Pacific Gyre is a concern at many levels. The introduction and distribution of plastic debris, from both terrestrial and oceanic sources, has recently become of interest to many studies and research expeditions.

Gregory and Ryan (1997) reported that plastics comprise 60-80% of marine debris. It is typically composed of fragments of manufactured plastic products and pre-production plastic pellets that comprise other objects. (McDermid & McMullen 2004).

Most plastics do not biodegrade. Unless they are removed, they remain in the sea for hundreds of years, breaking up into ever-smaller particles (Leahy 2004). The possibility of plastic accumulating in the ocean from countless sources raises many questions; notably because of the lack of effective methods to remove it.

Information about the abundance and occurrence of plastic micro-debris particles, as well as quantitative information on how plastic particles change over time is limited (Gilfillan, 2009). Those scientists that have begun to investigate removal methods have divided marine debris plastic into two class sizes. Those pieces greater than 5mm are

characterized as macro debris, and those smaller than 5 mm classified as micro debris (Arthur et al. 2009).

In 2009, the [SEAPLEX](#) research expedition set out on a 3,000 mile cruise track to survey plastic distribution in the Central North Pacific Gyre. They utilized numerous methods from visual observations, manta nets, and trawl nets to pumps and bottles. This lesson is designed to introduce students to the environmental issue of plastic micro-debris in the ocean. It emphasizes that plastic does not just disappear when it enters the ocean, but rather is broken down through processes such as mechanical degradation and photodegradation. Mechanical degradation occurs when plastic breaks down into smaller pieces due to the movement of the ocean waves.

Photodegradation is thought to be one of the driving forces behind plastic breakdown, and occurs when ultraviolet waves of light from the sun break apart the bonds that hold plastic together, causing it to be brittle and more vulnerable to mechanical degradation. Both types of degradation creates microscopic pieces, difficult to see with the naked eye, but continually traveling throughout the Central North Pacific Gyre and having possible long lasting effects.

PLASTIC MICRO-DEBRIS

NAME: _____

DATE: _____

STUDENT WORKSHEET Page 1

Essential Questions (E.Q.): Record your answers to the following questions:

1. Do scientists know what type of plastic exists in the ocean and how long it has been there?

2. Hypothesize how plastic breaks down in the ocean over a period of time.

3. Consider three different plastic products you might find floating in the ocean. List them on the table. Over the course of floating for 1, 5, and 10 years in the ocean, estimate how the different kinds of plastics will change over time. You may sketch or describe the changes but you must **include a scale of change over time** (ex. 1 inch equals 1 cm over X time.)

	Plastic A	Plastic B	Plastic C
	Type:	Type:	Type:
Year 1			
Year 5			
Year 10			

Scale: _____

4. How do you think scientists sample for plastic in the Central North Pacific Gyre?

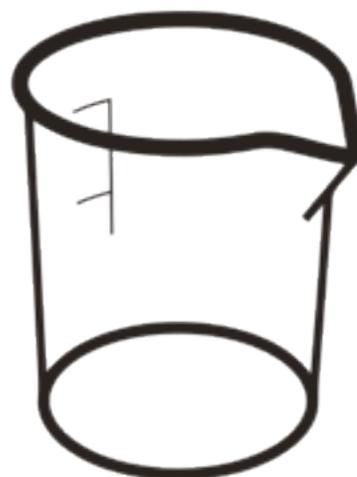
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STUDENT WORKSHEET Page 2

5. CREATE a Plastic Micro-Debris Slurry.

- a. As a class cut out *two*, 1 x 1 inch squares from a Styrofoam cup and a Dixie plastic cup. Add these plastic pieces to a blender with 500ml of your 3.5% salt water. Cover and blend on “chop” setting for 45 seconds. Pour slurry into a 600ml beaker. Label beaker with class information. Cover with parafilm (or aluminum foil) and let “rest” for one (1) minute.
- b. After your slurry has rested for one minute, sketch where debris can be found in the beaker’s water column. Is more floating, or sinking? Include a mark for the water line and volume demarcations as well.
- c. Describe in your own words how plastic in the ocean’s water column may/ may not be similar to your beaker water column.



6. SAMPLING PROCEDURES:

- a. Fill your water tub with 19.5 liters of 3.5% salt water.
- b. Collect your plastic slurry from the previous day and stir it gently for 5 -7 seconds. Immediately pour the slurry into the water tub that already has the 19.5 liters of 3.5% salt water and stir this mixture for 10 seconds. Let this mixture settle while you perform the next step.
- c. After the transect sampling grid and 50ml beakers are ready, sampling can begin.

7. DATA COLLECTION: Consistent Sample Volume =

While sampling is taking place, group members can examine the collection samples using a dissecting microscope, magnifying glass for number of pieces found and take approximate measurements using a ruler. All data can be recorded on the table.

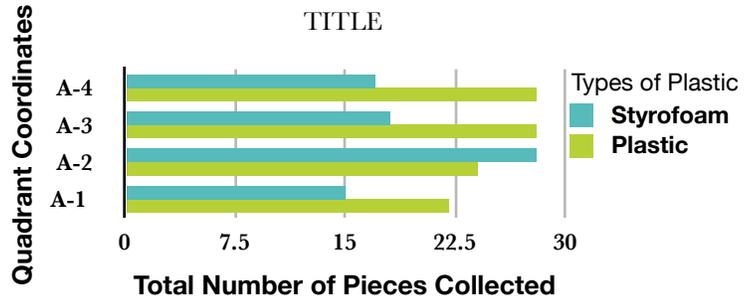
Quadrant Number of Pieces		<1mm	1mm - 2mm	2.01 mm-3mm	3.01mm -4mm	> 4mm
Quadrant Label	Number of Styrofoam Pieces					
	Number of Plastic Pieces					
Quadrant Label	Number of Styrofoam Pieces					
	Number of Plastic Pieces					
Quadrant Label	Number of Styrofoam Pieces					
	Number of Plastic Pieces					
Quadrant Label	Number of Styrofoam Pieces					
	Number of Plastic Pieces					

PLASTIC MICRO-DEBRIS

STUDENT WORKSHEET Page 3

8. MICRO-DEBRIS ANALYSIS

Once you finish measuring and counting your debris samples from your assigned quadrant, analyze your totals by placing your data on a chart like the one provided.



TITLE:

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Types of Plastic

9. FINDINGS/DISCUSSION:

Watch the SEAPLEX video <http://sio.ucsd.edu/Expeditions/Seaplex/Newsroom/>.

Then, write a conclusion summarizing your experience with this inquiry investigation. Introduce the topic of plastic micro-debris, identify how you collected, measured and categorized it in your beaker 'water column'. Discuss any limitations you might have encountered regarding plastic breaking down in your beaker. Include explanations for the abundance of plastics in the ocean near you, and the potential impacts of plastic micro-debris to the health of the marine ecosystem.

GLOSSARY

CalCOFI – (California Cooperative Oceanic Fisheries Investigations; www.calcofi.org) A scientific program that studies the marine environment off the coast of California. Formed in 1949 to investigate the collapse of the sardine fishery, CalCOFI is now of the most comprehensive studies of an ocean ecosystem over time.

Manta Net (Tow) – A fine meshed net used by scientists to sample plankton and marine debris at the ocean's surface. <http://swfsc.noaa.gov/textblock.aspx?Division=FRD&ParentMenuId=213&id=1360>

Mechanical Degradation - A physical interaction between ocean waves and plastic, in which rubbing, smashing, or grinding against the water and/or other solid objects causes the plastic to break into smaller pieces.

Photodegradation – A chemical reaction between sunlight and plastic, which causes the plastic to become brittle or break into smaller pieces.

SEAPLEX - A Scripps Institution of Oceanography expedition that explored the problem of plastic in the Central North Pacific Gyre. SEAPLEX stands for the Scripps Environmental Accumulation of Plastic Expedition, and took place from August 2-21, 2009, aboard the research vessel R/V *New Horizon*. <http://sio.ucsd.edu/Expeditions/Seaplex/>

Transect Grid - A path or grid along which a researcher makes a series of observations.