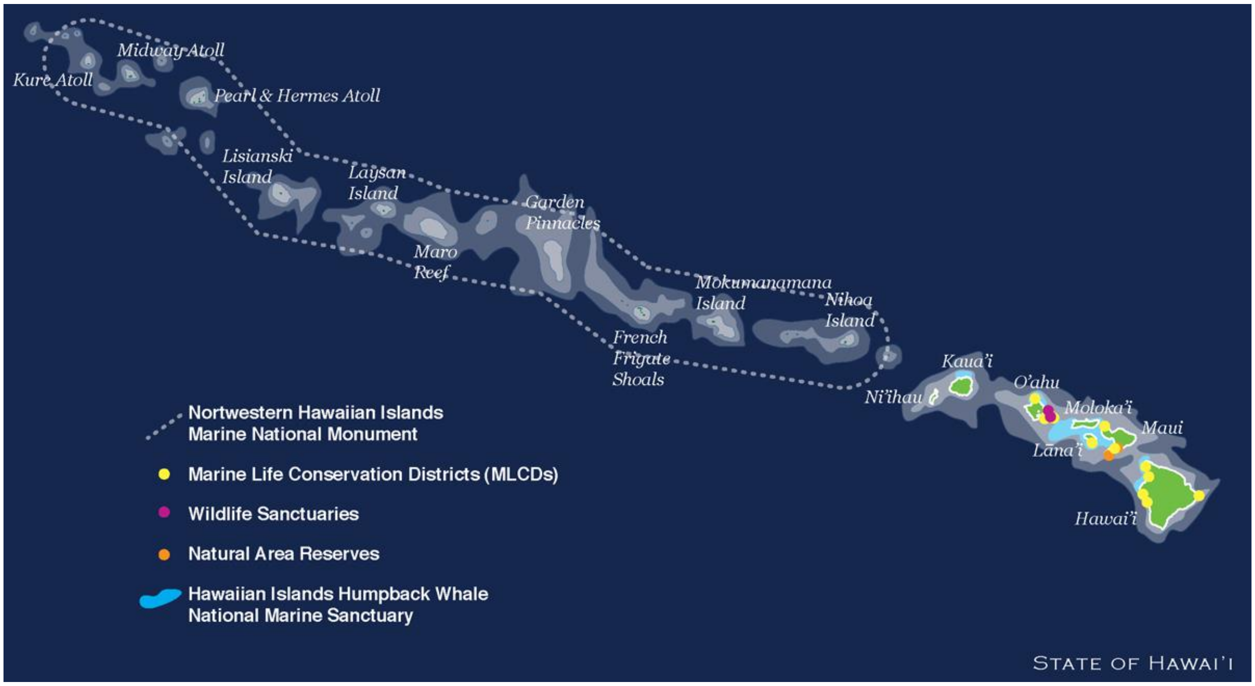
NOAA FISHERIES

Papahānaumokuākea Marine National Monument
Marine Debris Student Worksheet

Name____ Date____

Part 1: Size of a monument

Papahānaumokuākea Marine National Monument (PMNM) is the largest conservation area within the United States. It was established in 2006 and in addition to its National Monument status has also been declared a natural and cultural World Heritage Site by UNESCO. PMNM encompasses 139,797 square miles and extends northwest for 1,200 *nautical miles* starting north of the islands of Ni'ihou and Kaua'i, Hawai'i.



Something of this size is hard to for most people to visualize, especially when it consists mostly of water. In order to better understand the size of this conservation area, compare the length of PMNM to a land-based distance that might be more familiar to you. For this you will need an atlas or access to an online mapping program (such as Google Earth/Maps) that will calculate distance.

1. Convert the length of PMNM (1200 nautical miles) to kilometers. Be sure to show your work! Hint: 1 nautical mile = 1.852 km.

2. Using an atlas or Google Earth/Maps, find a distance between two points that is comparable to the length of PMNM. What are those two points?

3. How many states and/or countries does your land-based calculated distance cross?

4. What might be some issues with trying to manage an area the size of PMNM?

Part 2: Marine debris on the move

Surprisingly, one of the significant issues in PMNM is trash. This is particularly striking since there are no permanent human residents in PMNM. Almost all the trash found in Papahānaumokuākea is generated outside PMNM and introduced into PMNM by visitors, fishing boats and ocean currents in the form of ***marine debris***. Whether through ocean dumping, loss of fishing gear, or litter being washed out to sea in rivers, all the countries in and around the Pacific Ocean are possible sources of marine debris. In order to determine how marine debris moves around in the ocean scientists create models of ocean surface currents and track how debris particles move over long periods of time. Today we will make use of one of these models to investigate where marine debris in Papahānaumokuākea may have originated.

Directions: Using a computer with internet access, navigate to www.adrift.org.au and locate Papahānaumokuākea (note you can click and drag the map to reposition). Next, spend some time exploring possible sources of marine debris to PMNM.

1. List five countries in the Pacific region that are modeled to be sources of marine debris to PMNM.

2. List three countries in the Pacific region that are **not** modeled to be sources of marine debris to PMNM.

3. What are other likely sources of marine debris to PMNM besides the countries you listed above?

4. What are some ways we can prevent marine debris from impacting PMNM and waters closer to home?

Part 3: Beach Walk

Now that you have determined where some of the marine debris might be coming from, it will be important to determine what types of marine debris are actually ending up in PMNM. Unfortunately getting to the islands to survey marine debris is both time consuming and expensive. When faced with situations similar to this, scientists will often turn to ***remote sensing*** techniques to gather data. These techniques allow data to be collected about an object or an environment without the scientist being physically present. Probably the oldest and most well-known form of remote sensing is photography, but other techniques include sonar imaging (radar), multispectral imaging, infrared sensing, and satellite observations, to name just a few. Today we will make use of a series of photographs taken in PMNM to try and determine what types of marine debris actually end up in PMNM.

Directions: Find as many different pieces of marine debris on Lisianski Island (26.056477, -173.961058) or Laysan Island (25.781036, -171.727775) you can and list them below. As you list the pieces of marine debris, classify them by size (see chart on the next page), type of material, and likely source of the debris. Use the data you collect to help answer the questions on the following pages.

Marine Debris Item Type	**Item Count**	**Size Class**	**Material**	**Source**
Fishing Floats	**#**	**Macro**	**Plastic, rubber, etc.**	**Fishing Vessel**
Totals		**-NA-**	**-NA-**	**-NA-**

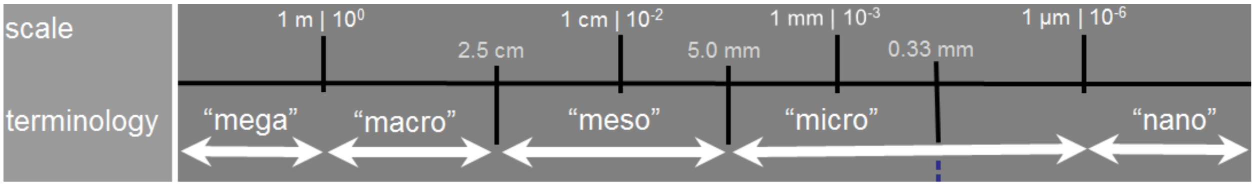


Figure 1: Size classes of marine debris from Lippiatt, S., Opfer, S., and Arthur, C. 2013.

1. What is the dominant size class of marine debris that you found? What percentage of your items fall into this size class?

2. What was the most common material you found in your marine debris survey?

3. What do you think is the most common source of marine debris in PMNM?

Part 4: Characteristics of marine debris

Compare your data with another group of students. As a group discuss and answer the following questions.

1. What characteristics make a material very likely to become marine debris? Does the most common material in your survey have all of these properties?

2. What sizes of marine debris did you NOT find in your visual survey? Where do you think this size of marine debris might be in the environment? How might you go about counting this size of marine debris?

3. List some major impacts (both positive and negative) of marine debris in the environment.

Part 5: Float test

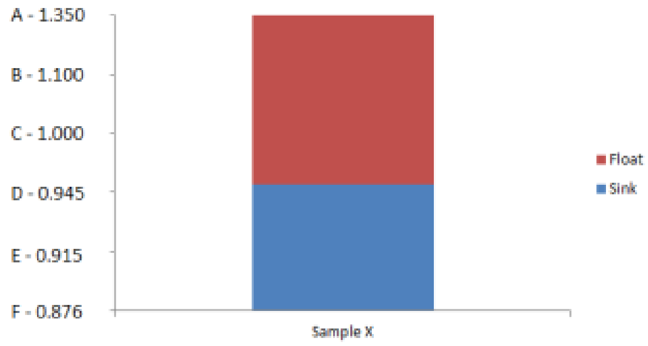
Experimental Data Collection: In your group, use tweezers to test if the plastic pieces float or sink in each of the solutions. You should test each piece of plastic in each solution. Make sure there were no anomalies in your test by testing a second piece of the same type of plastic. This type of testing is called **replicate sampling** and is commonly used by scientists to help ensure accuracy of their sampling data. Make sure you label each sample in the boxes below. You have three pieces of each type of plastic. Make sure you test each separate piece. When you are done use your data to begin making a graph on the following page (**be sure to read the directions!!**).

	Solution A **Density: 1.35**	**Solution B** **Density:** **1.10**	**Solution C** **Density:** **1.00**	**Solution D** **Density:** **0.945**	**Solution E** **Density:** **0.915**	**Solution F** **Density:** **0.876**
Sample X **Replicate 1** **(example)**	**Floats**	**Float, barely**	**Sinks**	**Sinks**	**Sinks**	**Sinks**

Sample ___ **Replicate 1**						
Sample ___ **Replicate 2**						
Sample ___ **Replicate 3**						

Sample ___ **Replicate 1**						
Sample ___ **Replicate 2**						
Sample ___ **Replicate 3**						

Experimental Data Visualization: Working with your group, use the space provided below to graph your results. Be sure to leave enough room to include data from the rest of the groups in the class (hint: each group will have three observations to graph). Once everyone is done graphing their personal data we will compile data from all groups on the board. Please use a stacked bar type graph that shows the relationship between the density of the solution and where plastic samples floated and sank (see example). Make sure that you label your axes and use the **average** of your observations.



Experimental Data Explanation: Use your data and the class data to answer the following questions. Work with your partner to complete the worksheet.

1. What property of the plastic do you think is responsible for which pieces float and which ones sink?

2. If the plastic pieces you tested were 100 times bigger, would your results be different? Why or why not?

3. Based on your tests, what are the density ranges of your samples? Based on that density range, what type of plastic (by recycle code) is your unknown plastic?

4. If you were told that solution C was fresh water, given what you know from your tests, which plastics (by recycling codes) are most likely to end up in the marine environment? Why do you think that?

5. What physical property of the plastic could change naturally in the marine environment that might cause plastic pieces to sink out of the surface water?

6. What do you think might naturally cause such a change?

Part 6: Marine debris life cycle

Create a life-cycle model for a piece of marine-debris that you found in Papahānaumokuākea. Be sure to address the following: Where did the object enter the environment? How was the object transported to Papahānaumokuākea? What processes impacted the object during its travels? What are potential impacts of that marine debris to the environment? How was the object removed from the marine environment? What is the likely fate of this marine debris? What potential impact could this marine debris have on me? What potential impact can I have on marine debris?