**Activity 2: Think Like a Marine Biologist**

Introduction:

**Primary producers**, like land plants, form the base of the **food chain** in all ecosystems. In the oceans, most primary producers are microscopic floating plants known as **phytoplankton**. Despite their small size, the food they produce from sunlight supports marine ecosystems and is ultimately responsible for feeding large organisms like whales and penguins. This is because phytoplankton are eaten by small animals which are in turn eaten by bigger animals that are prey for large, well-known animals. In addition, phytoplankton produce about half of the oxygen in the atmosphere, meaning that every other breath you take comes from these amazing creatures.

However, because of their small size, few people know about the importance of phytoplankton and even fewer have been “up close and personal” with these miniature, single-celled plants. In this activity, students will have the opportunity to directly observe marine phytoplankton using a low-cost microscope (*Foldscope*) that will be theirs to keep. This activity is intentionally simple, as we want to emphasize that much of science is driven by the wonder and excitement of directly observing living organisms, and that this only requires a willingness to look and have fun!

Leaving this activity, we hope that students will be able to connect these microorganisms to the big picture (literally!) and be amazed by their diversity of shapes and sizes as well as their beautiful shells which are made out of transparent silicon (biological glass!). While this activity focuses on diatoms that have biogenic glass shells, there are many other types of phytoplankton as well including some that have calcium carbonate shells (the same material as clamshells). These other types of phytoplankton are briefly introduced in the slide presentation but the actual slides provided to students should mainly be made up of diatoms.

Overview:

Students will learn how to use the *Foldscope,* observe microscopic organisms, and draw specimens they observed on a provided worksheet. This worksheet is structured as a “microscopic scavenger hunt”, and the questions will point them towards fundamental questions about what the phytoplankton are made of.

Learning Objectives:

By the end of the lesson, students should be able to:

1. Use the foldscope independently, and explain its key parts, including the lens.
2. Compare the size of the microscopic organisms they are observing to familiar animals in terms of size.
3. Draw and explain several different phytoplankton shapes, and be able to speculate on why they look the way they do and what their shells might be made of.
4. Explain that microscopic phytoplankton form the basis of many marine food webs.
5. Know how to access additional video training for preparing their own slides with the foldscope, including water samples, pollen, etc.

Session plan:

1. The teacher will guide students through a powerpoint presentation interspersed with multiple choice questions to promote active learning (teachers will have to provide a response system or could just use a show of hands). This presentation will introduce phytoplankton and their importance, as well as what microscopes are and how to use them.
2. After the presentation, the teacher will demonstrate how to use the foldscope with the included diatom slides. Students at this point should learn the different parts of the microscope, including where the lens and slides are.
3. Students will then have ~30 minutes to look at the phytoplankton found in the slides and independently fill out the worksheet (could also do it in small groups, but each student ideally will have their own *Foldscope*). The teacher should circulate to help students to use the microscope and answer questions.
4. At the end of this time, students will be asked about what they thought of the activity, perhaps including a “Mentimeter” poll (if online or students have their own electronic devices) to get a wordcloud.
5. Conclude with final slides that show some real-world examples of algae and resources on how to prepare one’s own slides with the foldscope.

Materials:

1. Foldscope ($6 preassembled)
2. Pre-made slide of mixed diatoms, placed into foldscope prior to class if high student:teacher ratio.
3. Scavenger hunt worksheet with scientific setup, questions, space for drawing each organism.

More resources for exploration:

* **Videos and activities for foldscope:** foldscope.com/resources
* **Interactive map to see beautiful images of phytoplankton taken by satellites:** https://pace.oceansciences.org/storymaps.cgi?id=1885
* **More information on phytoplankton:** https://earthobservatory.nasa.gov/features/Phytoplankton
* **Nice microscopic images of phytoplankton:** http://blacksea-education.ru/phytoplankton.shtml
* **More images:** https://askabiologist.asu.edu/plankton-gallery
* **A 5 minute overview of phytoplankton with interviews from scientists (some references to climate change):** https://youtu.be/H7sACT0Dx0Q