Title: *Wormcam: Looking From the Bottom Up*
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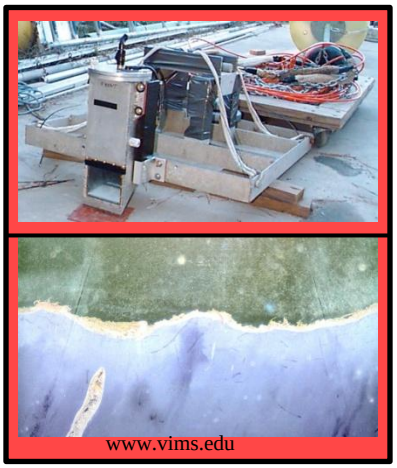
Background Information

Wormcam was created at the Virginia Institute of Marine Science (VIMS) in 2005 as an underwater camera system, inserted into the sediment to help scientists understand dynamics of the ocean bottom. It is tethered to a surface buoy for real-time transmission of data and Wormcam records the sediment-water interface over time. Some examples of what scientists observe via Wormcam include: a mixing of the sediment by living organisms, how and where these living organisms move, different ways these organisms search for food, particulate organic material from the water column, and how these organisms die. Images are captured in a time-lapse format, so long-term observations allow the time-lapsed version which displays change on a grander scale. Marine biologists have been using Wormcams in coastal areas impacted by the BP oil spill. The goal is to evaluate how the oil concentration has impacted the sediment-water interface and behavior of the organisms living within the sediment. If marine biologists determine any changes in behavior, it may help people understand how organisms in the environment are affected by future oil spills.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Louisiana State Standards (Grade-Level Expectations)

SI GLE: Predict and anticipate possible outcomes (SI-E-A2).
Design, predict outcomes, and conduct experiments to answer guiding questions (SI-M-A2).
Write and defend a conclusion based on logical analysis of experimental data (SI-H-A6) (SI-H-A2).

SI GLE: Select and use developmentally appropriate equipment and tools and units of measurement to observe and collect data (SI-E-A4).
Select and use appropriate equipment, technology, and tools and metric systems units of measurement to make observations (SI-M-A3).

SI GLE: Recognize that a variety of tools can be used to examine objects at different degrees of magnification (e.g., hands lens, microscopes) (SI-E-B3).

SI GLE: Choose appropriate models to explain scientific knowledge or experimental results (e.g., objects, mathematical relationships, plans, schemes, examples, role-playing, computer simulations) (SI-H-A4).

SI GLE: Pose questions that can be answered using students' own observations and scientific knowledge (SI-E-A1)
Generate testable questions about objects, organisms, and events that can be answered through scientific investigations (SI-M-A1).
Describe how investigations can be observation, description, literature survey, classification, or experimentation (SI-H-A2)

SI GLE: Identify and use appropriate safety procedures and equipment when conducting investigations (e.g., gloves, goggles, hair ties) (SI-E-A7).
Given a description of an experiment, identify appropriate safety measures (SI-H-A7).
Use relevant safety procedures and equipment to conduct scientific investigations (SI-M-A8).

SI GLE: Identify and explain the limitations of models used to represent the natural world (SI-M-A5).

SI GLE: Explain how technology can expand the senses and contribute to the increase and/or modification of scientific knowledge (SI-M-B3).
Use technology when appropriate to enhance laboratory investigations and presentations of findings (SI-H-A3).

SE GLE: Analyze positive and negative effects of human actions on ecosystems (SE-H-A7).
Give examples and describe the effect of pollutants on selected populations (SE-H-A11).

SE GLE: Determine the interrelationships of clean water, land, and air to the success of organisms in a given population (SE-H-C1).

PS GLE: Follow directions using vocabulary such as *front/back, above/below, right/left,* and *next to* (PS-E-B1).

PS GLE: Evaluate how different media affect the properties of reflection, refraction, diffraction, polarization, and interference (PS-H-G1).

Ocean Literacy Principles

Principle 2d: Sand consists of tiny bits of animals, plants, rocks and minerals. Most beach sand is eroded from land sources and carried to the coast by rivers, but sand is also eroded from coastal sources by surf. Sand is redistributed by waves and coastal currents seasonally.

Principle 5e: The ocean is three-dimensional, offering vast living space and diverse habitats from the surface through the water column to the seafloor. Most of the living space on Earth is in the ocean.

Principle 6e: Humans affect the ocean in a variety of ways. Laws, regulations and resource management affect what is taken out and put into the ocean. Human development and activity leads to pollution (such as point source, non-point source, and noise pollution) and physical modifications (such as changes to beaches, shores and rivers). Humans have removed most of the large vertebrates from the ocean.

Principle 7b: Understanding the ocean is more than a matter of curiosity. Exploration, inquiry and study are required to better understand ocean systems and processes.

Principle 7d: New technologies, sensors and tools are expanding our ability to explore the ocean. Ocean scientists are relying more and more on satellites, drifters, buoys, subsea observatories and unmanned submersibles.

Time Requirement

The teacher can allow the students to make the Wormcam replicas due to the brevity of this project. The teacher will probably have to make the Wormcam replicas for elementary age students. As long as the supplies are set out, making the Wormcam should only take 10 minutes because it is mostly taping items inside a container. The time allowed for the remainder of the project depends on how the teacher customizes this activity (e.g., use sediment samples in a bin or actual samples outside).

Materials	**Source**	**Cost**
Tall oatmeal container with lid	Grocery store	$3.50
Push light	Craft store	$5.50
2 small mirrors	Craft store	$1.50 each
Scissors	Grocery store	$3.80
Transparent duct tape	Grocery store	$5.80
Thin, small sheet of plexiglass	Craft store	$2
Tub or bin of sediment/dirt **(optional)**	Craft store	$5-10
Small hand shovel **(optional)**	Craft store	$7
Protractor **(optional)**	Grocery store	$2.50

Lesson Description

Creating the Wormcam Replica

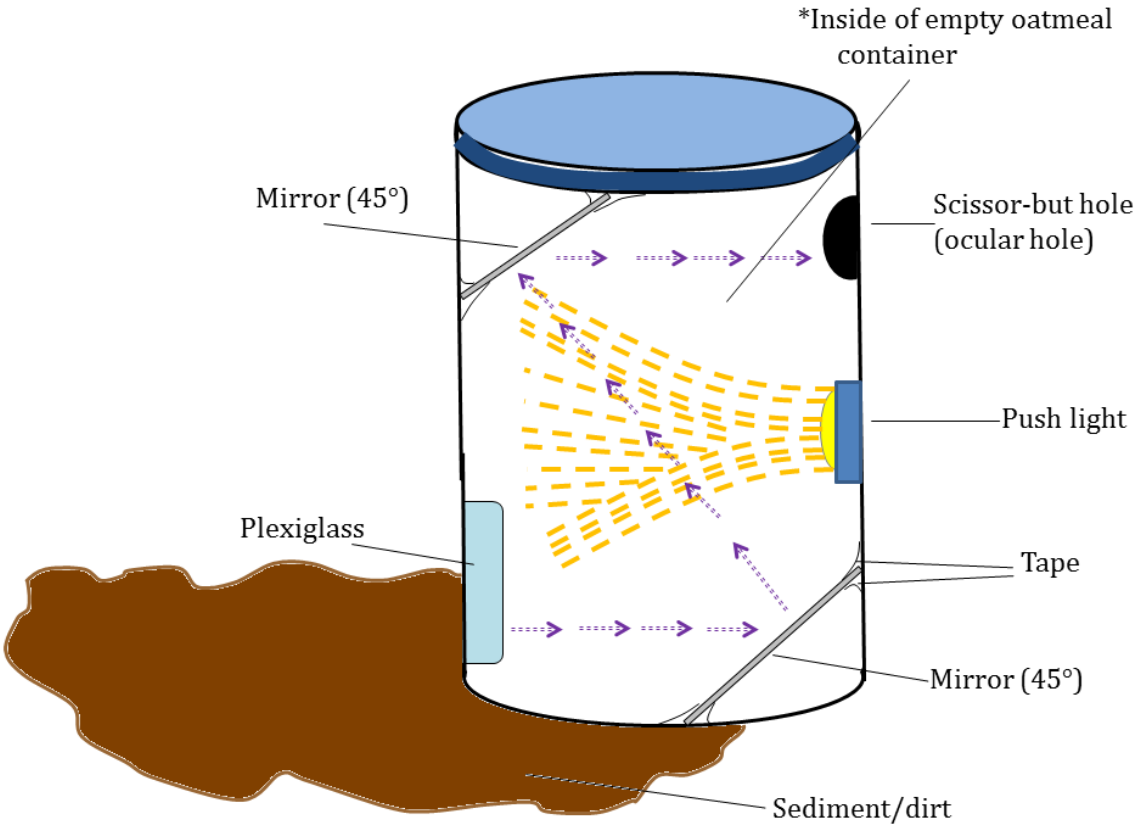
1. Cut a 1-2 inch hole near the top of the empty oatmeal container; make sure the hole (i.e., ocular hole) is not cut too high because the lid must go back on.
2. Cut a 4-5 inch square near the bottom of the container, on opposite sides of the ocular hole; do not cut into the base of the container because that is needed to support the mirror.
3. Attach a thin, small sheet of plexiglass on the outside of that square opening near the bottom of the container. Transparent duct tape should be applied on the outside and inside edges of the plexisglass and container.
4. Tape a small mirror on the opposite side of the plexiglass. Apply the tape at the base of the container, as well as the adjacent side. Try to create a 45° with the mirror; using a protractor can be optional. The mirror should be directly under the ocular hole.
5. Stick the push light to that same adjacent side of the container; the push light

comes with adhesive on the backside of it. It should be centered between the ocular hole and the mirror below it.

6. Tape a small mirror on the opposite side of the ocular hole. This mirror should be directly above the plexisglass near the bottom of the container. First tape the mirror to the lid, and then close the lid on the container. In order to tape the mirror to the opposite side of the opposite side of the container (i.e., away from the ocular hole), stick your fingers through the ocular hole to apply the tape. Try to create a 45° with the mirror; using a protractor can be optional.

Methodology

The wormcam uses a camera to observe the sediment-water interface, but the wormcam replica will use light reflected by dual mirrors for observatory measures. To operate the wormcam replica, open the lid to the container and turn the push light on. Close the lid and stick it in the medium you desire (e.g., bin of sediment or real sediment outside). If you choose to use the wormcam replica outside using real sediment, use a shovel to dig a hole the circumference of the container. Only stick the wormcam replica into the sediment to the point in which 50-60% of the plexisglass is inundated. The empty oatmeal container is somewhat soluble to moisture, so this can only be a one-time ordeal. Make enough wormcam replicas to use in groups.



Standard Evaluation (Student Deductions)

1. How do the mirrors in the replica imitate the camera in the real wormcam?
2. Why is light needed inside the replica? Why shouldn't the light be pointed into either mirror?
3. What is the importance of not sticking the replica so far in the sediment that the plexisglass is fully covered (i.e., instead of the 50-60% coverage)?
4. Does the replica allow any visibility of layers within the sediment? Why or why not?
5. Is there any evidence of any organisms that live in the sediment?
6. This replica has been used as a more advanced version on submarines; how and why?

*Students can watch a time-lapsed video from a wormcam to supplement the new material learned from this activity.

The evaluation can be in the form of a test, essay, questions and answers worksheet, or any other mode of measuring retainment or comprehension of material.