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Ocean Motion

Teachers Guide

Grade 8

Program Description: Allow us to show your students that the fundamentals of physics are found in all facets of nature. From electromagnetic wave detection in the world's top predators to conservation of matter, the physical sciences can be found in many clever situations. Students will discover the fundamentals of physics in multiple exhibits and behind the scenes areas.

Enduring Understandings for Ocean Motion:

- ◆ The characteristics and laws represented in the physical sciences can be found in many different aspects of the natural world.
- ◆ The characteristics of the ocean make it a unique environment for animals as well as research.
- ◆ The physical sciences describe the laws of matter. Chemistry describes the qualities of matter. Physics describes how matter interacts.

Objectives:

- ◆ Students will be able to recognize the laws of motion in action.
- ◆ Students will gain a unique understanding for the behavior and qualities of physical wave motions.
- ◆ Students will understand the relationship between masses and pressure in the ocean.
- ◆ Students will gain insight as to how animals have adapted to use magnetic and electric forces to their advantage.

Georgia Performance Standards for 8th Grade:

S8CS1. Students will explore the importance of curiosity, honesty, and skepticism in science and will exhibit these traits in their own efforts to understand how the world works.

S8CS5. Students will use the ideas of system, model, change, and scale in exploring scientific and technological matters.

- Observe and explain how parts can be related to other parts in a system such as the role of simple machines in complex ones.
- Understand that different models (such as physical replicas, pictures, and analogies) can be used to represent the same thing.



S8P2. Students will be familiar with the forms and transformations of energy.

- a. Explain energy transformation in terms of the Law of Conservations of Energy.
- d. Describe how heat can be transferred through matter by the collisions of atoms or through space. In a liquid or gas, currents will facilitate the transfer of heat.

S8P3. Students will investigate the relationship between force, mass, and the motion of objects.

- a. Determine the relationship between velocity and acceleration.
- b. Demonstrate the effect of balanced and unbalanced forces on an object in terms of gravity, inertia, and friction.

S8P4. Students will explore the wave nature of sound and electromagnetic radiation.

- a. Identify the characteristics of electromagnetic and mechanical waves.
- b. Describe how the behavior of light waves is manipulated causing reflection, refraction, diffraction, and absorption.
- d. Describe how the behavior of waves is affected by a medium (such as air, water, solids)

S8P5. Students will recognize characteristics of gravity, electricity, and magnetism as major kinds of forces acting in nature.

- a. Recognize that every object exerts gravitational force on every other object and that the force exerted depends on how much mass the objects have and how far apart they are.
- c. Investigate and explain that electric currents and magnets can exert force on each other.

Pre-activity:

- ◆ **Putting ourselves under Pressure:** Students will workout the pressures at different depths of the ocean.

Post-activity:

- ◆ **Making waves:** Students will explore the motion of waves in the ocean and the effects on strong and weak waves.

Putting Ourselves Under Pressure

Objectives:

- ◆ To investigate the pressure at different depths of the ocean
- ◆ Understand the effects of pressure on the human body and how that limits our ability to explore the ocean

Materials:

- ◆ Pencils and calculators
- ◆ One copy of the Putting ourselves under pressure worksheet per student

Background information:

Ever since ocean exploration began, scientists have tried to discover what is happening under the waves of the ocean. Due to the extreme pressures that build up quickly we still know more about outer space than we know about our own oceans. The human body can only go just below the surface before pressure begins to affect our physiology. The technology and innovations developed recently have expanded our ability to explore the depths of the ocean. From autonomous unmanned submersibles to mixed gas re-breathing apparatus for divers, the opportunities for exploration are growing. It is difficult to imagine the pressures exerted on a body at depth, even for animals that are adapted to live there, but with some quick math and examples of how we push the limits of depth exploration, it can quickly come to our grasp.

Learning Procedure:

1. Discuss with students some of the limitations that scientists have faced with ocean exploration.
2. Explain what pressure is and provide examples.
3. Pass out the “putting ourselves under pressure” worksheet, and have the students work through the problems, calculating the pressures exerted at different depths.
4. Discuss the questions when all students are done.

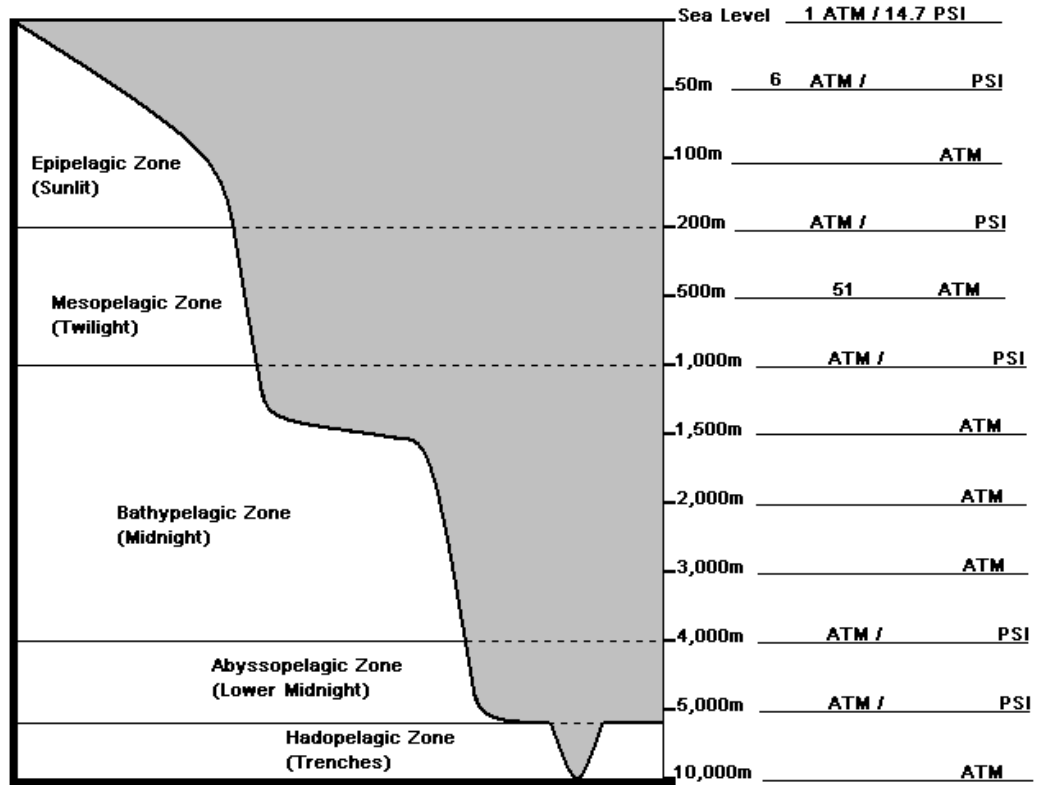
Assessment:

Refer to the answer key to evaluate how the students responded to the questions.

Putting Ourselves Under Pressure

Name: _____

1. Water pressure increases with depth in the ocean. The farther down something is, the more mass there is above it. Scientists have determined that pressure increases by 1 atmosphere for every 10 meters of depth below the surface. One atmosphere is a unit of pressure that is approximately 14.7psi. Remember, gravity already creates one atmosphere of pressure at sea level. **Calculate the pressures for the graph.**



2. The deepest part of the ocean is the in the Challenger Deep in the Pacific Ocean reaching down 10,924

meters. In 1960, three explorers in the submersible *Trieste* managed to travel down to a depth of 10,915 meters. Recently scientists were finally able to send an unmanned submersible dubbed *Nereus* to collect samples of the silt and environment. At these depths, what is the pressure exerted on an object in PSI?

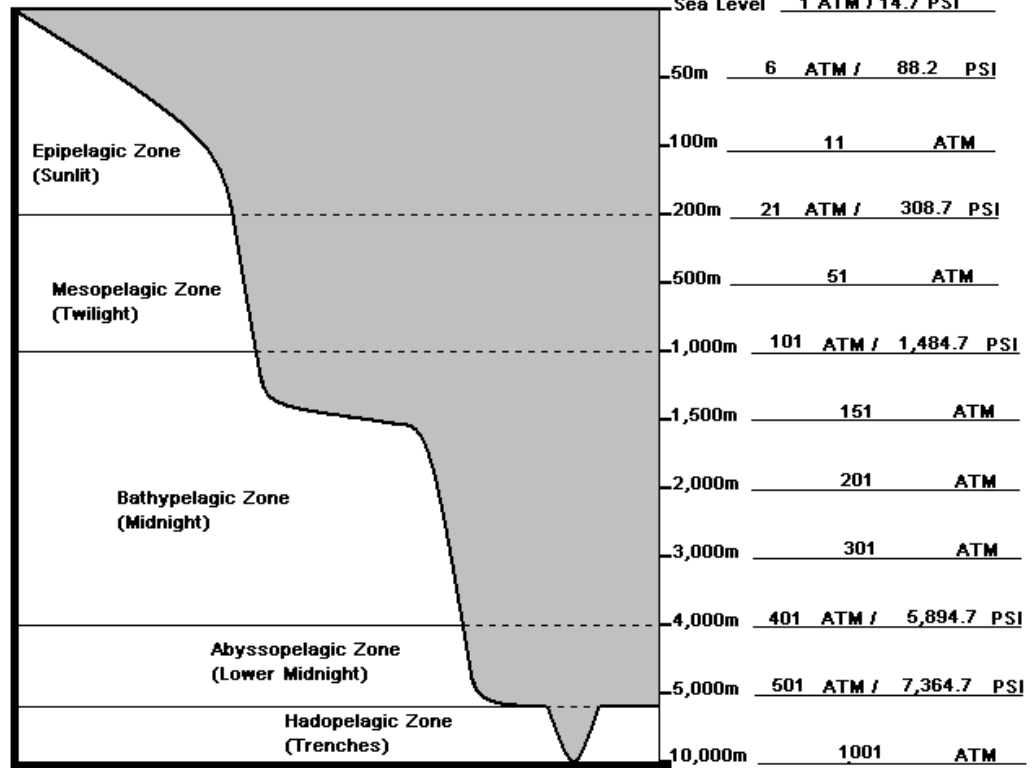
3. Ever since the development of SCUBA (self contained underwater breathing apparatus), people have explored our oceans freely both recreationally and scientifically. Recreational diving is generally to a depth of 40 meters. Going beyond 40 meters is considered Technical Diving. The current record for deepest SCUBA dive is held by a 52 year old who managed to dive to a depth of 318 meters. Note his depth on the graph and calculate the pressure in PSI that his body was forced under.

4. Another feat of humans pushing the depths is in Free Diving, which is when someone dives as deep as they can go without any breathing apparatus, and then resurfaces. The last recognized record was 214 meters. Because of the multiple hazards with this style of diving like nerve damage and loss of consciousness, the Guinness Book of World Records no longer accepts new depths. At 214 meters, how many pounds of pressure were being exerted on the free diver's body? Mark the depth of the dive on the graph and discuss what other effects being under such pressure could have on the human body.

Putting Ourselves Under Pressure KEY

Name: _____

1. Water pressure increases with depth in the ocean. The farther down something is, the more mass there is above it. Scientists have determined that pressure increases by 1 atmosphere for every 10 meters of depth below the surface. One atmosphere is a unit of pressure that is approximately 14.7psi. Remember, gravity creates one atmosphere of pressure already at sea level. **Calculate the pressures for the graph.**



2. The deepest part of the ocean is the Challenger Deep in the Pacific Ocean reaching down 10,924 meters.

In 1960, three explorers in the submersible *Trieste* managed to travel down to a depth of 10,915 meters. Recently scientists were finally able to send an unmanned submersible dubbed *Nereus* to collect samples of the silt and environment. At these depths, what is the pressure exerted on an object in PSI?

$$1,093.4\text{atm} \times 14.7 = 16,072.98 \text{ PSI}$$

3. Ever since the development of SCUBA (self contained underwater breathing apparatus), people have explored our oceans freely both recreationally and scientifically. Recreational diving is generally to a depth of 40 meters. Going beyond 40 meters is considered Technical Diving. The current record for deepest SCUBA dive is held by a 52 year old who managed to dive to a depth of 318 meters. Note his depth on the graph and calculate the pressure in PSI that his body was forced under.

$$32.8\text{atm} \times 14.7 = 482.16 \text{ PSI}$$

4. Another feat of humans pushing the depths is in Free Diving, which is when someone dives as deep as they can go without any breathing apparatus, and then resurfaces. The last recognized record was 214 meters. Because of the multiple hazards with this style of diving like nerve damage and loss of consciousness, the Guinness Book of World Records no longer accepts new depths. At 214 meters, how many pounds of pressure were being exerted on the free diver's body? Mark the depth of the dive on the graph and discuss what other effects being under such pressure could have on the human body.

$$22.4\text{atm} \times 14.7 = 329.28 \text{ PSI}$$

Answers of effects will vary

Making Waves

Objectives:

- To investigate the effect of wave action on a beach.
- To investigate the difference in summer and winter waves.

Materials:

- Shallow container (transparent sweater box, large rectangular baking dish, aquarium)
- Block of wood
- Sand
- Erase markers or crayons
- Container of water
- Copies of the observation table for each student (2 if conducting two trials)

Background information:

Ocean Waves are continually shaping and reshaping the shoreline. Every time a wave rolls up onto the beach it carries sand with it and when it rolls back out to the ocean it carries sand also. In the winter waves are stronger and carry more sand off the beach than is deposited on the beach. That sand that is removed is deposited on offshore sandbars. During the summer, the waves are gentler and carry sand from offshore sandbars and deposit it back onto the beach. The strong backwash of winter storm waves leaves the beach with a steeper incline than summer waves, which create a gradual slope.

Learning Procedure:

1. Prepare a beach at one end of the shallow container. It should occupy about one fourth of the container. Slope the sand to look like a real beach.
2. Pour water into your model at the opposite end from your beach. Pour slowly so as not to disturb the sand.
3. Use an erasable marker or crayon and outline the profile of your beach. Draw this profile or cross section in your observations table labeled *original beach*.
4. Using a block of wood as a wave generator, create strong waves winter waves. Continue this for several minutes until about half of the sand has been removed from your beach. Record your observations
5. Using a different color of marker or crayon, trace the new profile of your beach. Draw this new profile or cross section in your observations data table labeled *beach after winter waves*.
6. Using the block of wood again, create some gentler summer waves for several minutes. Record your observations.
7. Using a different color of marker or crayon, trace the new profile of your beach. Draw this new profile or cross section in your observations data table labeled *beach after summer waves*.
8. Rebuild your beach. This time add a sandbar a short distance off shore
9. Repeat steps 4-7.

10. Have student answer the following questions:

- a. What happened to the sand on the beach after the influence of the stronger winter waves? Where did the sand go?
- b. What happened to the sand on the beach after the influence of the gentler summer waves? Where did the sand go?
- c. Did you notice any evidence of the formation of an offshore sandbar? If so where did it begin to form?

Assessment: Review the student observation tables and responds to the three questions.

Extension: Have the students expand the variables of the wave motion and coastal interaction: Change the size of the container to something much larger, use gravel instead of sand. Introduce jetties and other man made objects to reflect or refract the wave motion.

Additional Resources:

South East Atlantic Coastal Ocean Observing system – SEACOOS for additional lesson on waves and today’s wind and wave information – www.seacoos.org

This activity was taken with permission from Coastal DNR’s Sapelo Island, Georgia’s Coastal Treasure - http://knowtheconnection.com/int_sapelo.htm

Beach Observations

Name: _____

Trial 1 or 2

	Description of beach	Drawing of beach profile
Original beach		
Beach after winter waves		
Beach after summer waves		