

WATER PROPERTIES AND OCEAN TECHNOLOGY: INTRODUCTION

The ocean is mostly a vast unknown, offering many exploration opportunities. It provides people with food, work, and travel. The ocean regulates climate and affects immediate weather conditions. Many species make their homes in the ocean, and many natural resources are contained there. Most of the earth's photosynthesis is carried out by phytoplankton in the ocean, supplying the atmosphere with breathable oxygen.

There are three main properties of water that are important to the study of the ocean. Density is a measure of mass divided by volume- in other words, how much matter is in a given space, or how close together the particles of matter are. Water can exist in three states, and in a unique occurrence, solid water- ice- is less dense than liquid water, causing it to float. Water vapor, a gas, is the least dense. Another property is water pressure, which is the amount of force exerted on an object by water. Pressure increases as ocean depth increases. The ability of an object to float in water is known as buoyancy, which depends on the mass and density of the object, the density of the fluid, and how much fluid is displaced by the object. The resulting force, equal to the weight of the displaced fluid, keeps the object afloat.

Study of the ocean requires continuous technological advances. People have been using varying degrees of technology to study the ocean for hundreds of years. One important development was the ROV, or remotely Operated Vehicle, in the 1960's. ROV's take the place of divers in certain areas because they can go deeper and stay longer.

KEY WORDS

Water Properties

Density
Pressure
Buoyancy
Viscosity

Ocean Technology

Diving bell
Submersible
ROV
AUV
Mariana's Trench
SONAR: Passive/Active
CTD
ACDP
Drifters
Hydrophones
Satellites

FOCUS QUESTIONS

Water Properties

1. Why do people study the ocean?
2. What is density?
3. What is pressure?
4. What is buoyancy?

History of Ocean Technology

5. How can we explore the ocean?
6. Why do you think we need many different pieces of technology to study the ocean?

LEARNING OBJECTIVES

The students will:

- define “ocean technology” and identify different types of ocean technology and their uses throughout history.
- define density and observe the densities of various liquids.
- define water pressure and observe the pressure environment of the deep ocean and the effect that it has on humans and exploration.

MATERIALS

Student lab books with worksheets

- Focus questions
- Power Point questions
- Lab worksheets

Water Pressure Demo

- hot plate
- 3 different size metal soda cans
- hot mitt
- goggles
- pitcher of ice cold water

Buoyancy Demo

- clear bucket of water
- 3 objects with different states of buoyancy- positive (floats), negative (sinks), neutral (hovers)

Density Column Lab

- liquids of different densities, each with a different color of food coloring- water, rubbing alcohol, corn syrup, vegetable oil (no food coloring)
- small clear cups
- 50 mL graduated cylinder

Convection Lab

- convection tubes
- hot and cold water
- salt
- red and blue food coloring

AUDIO-VISUAL MATERIALS

Computer, projector/monitor, flash drive, screen

- Slideshow: “Water Properties”
- Slideshow: “History of Ocean Technology”

LEARNING PROCEDURE

See “Lesson 2 Demo Instructions” for details.

- Prompt Questions (5 minutes)**
 - Why do scientists explore the ocean?
 - How do scientists explore the ocean?
- Begin “Water Properties” slideshow. Have students answer questions on “Water Properties Worksheet” as they follow along. **(15 minutes)**
 - After slide 12: Water Pressure Demo **(10 minutes)**
 - After slide 16: Buoyancy Demo **(10 minutes)**
- Convection Demos **(20 minutes)**
- Density Column Lab **(20 minutes)**
- Have students complete Water Properties Vocabulary worksheet. **(10 minutes)**
- Begin Underwater Technology slideshow. Have students answer questions on Ocean Technology Worksheet as they follow along. **(15 minutes)**
- Have students complete Ocean Technology Vocabulary worksheet. **(10 minutes).**

Wrap-up:

- Review water properties and how they affect our ability to study the ocean. **(5 minutes)**
- Go over Ocean Technology Vocabulary. **(5 minutes)**

STANDARDS

Alaska State Standards:

SA The student will demonstrate an understanding of the processes and applications of scientific inquiry.

(5) SA1.1 asking questions, predicting, observing, describing, measuring, classifying, making generalizations, inferring and communicating.

(5) SA1.2 using quantitative and qualitative observations to create their own inferences and predictions.

- SA1** The student will develop an understanding of the processes of science used to investigate problems, design and conduct repeatable scientific investigations, and defend arguments.
- SA2** The student will develop an understanding that the processes of science require integrity, logical reasoning, skepticism, openness, communication, and peer review.
- (5) SA2.1** supporting their statements with facts from a variety of resources and by identifying their sources.
- SA3** The student will develop an understanding that culture, local knowledge, history, and interactions with the environment contribute to the development of scientific knowledge, and local applications provide opportunity for understanding scientific concepts and global issues.
- (5) SA3.1** identifying the limiting factors (e.g., weather, human influence, species interactions) that determine which plants and/or animals survives.

National Science Education Standards

Content Standard A: Scientific Inquiry

All students will develop abilities necessary to do scientific inquiry.

Identify questions that can be answered through scientific investigations.

Design and conduct a scientific investigation.

Use appropriate tools and techniques to gather, analyze and interpret data.

Develop descriptions, explanations, predictions and models using evidence.

Think critically and logically to make the relationships between evidence and explanations.

Communicate scientific procedures and explanations.

All students will gain an understanding about scientific inquiry.

Different kinds of questions suggest different kinds of scientific investigations.

Technology used to gather data enhances accuracy and allows scientists to analyze and quantify results of investigations.

Scientific explanations emphasize evidence, have logically consistent arguments and use scientific principles, models and theories.

Content Standard B: Physical Science

All students will develop an understanding of properties and changes of properties in matter.

A substance has characteristic properties, such as density, a boiling point, and solubility, all of which are independent of the amount of the sample. A mixture of substances often can be separated into the original substances using one or more of the characteristic properties.

Ocean Literacy Standards

7. The ocean is largely unexplored.
 - a. The ocean is the last and largest unexplored place on Earth – less than 5% of it has been explored. This is the great frontier for the next generation’s explorers and researchers, where they will find great opportunities for inquiry and investigation.

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

RESOURCES

National Research Council (U.S.), (1996). *National Science Education Standards: observe, interact, change, learn*. Washington, D.C.: National Academy Press.

Project 2061 (American Association for the Advancement of Science), (2001). *Atlas of Science Literacy*. Washington, DC: American Association for the Advancement of Science: National Science Teachers Association.

Web Resources: www.raft.net/more. Investigate density, pressure, and the gas laws with this easy-to-make Cartesian diver.

FEEDBACK

We value your feedback on this lesson.

Send your comments to: khoffman@pwssc.org

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