Oceans

Dr. Dave's Teaching Manual

Second Edition

David Purvis, Ph.D.

Royal Fireworks Press
Unionville, New York

Contents

Introduction

This manual will give you, the teacher, everything you need to teach a unit on the oceans. From the first topic to the last class, it describes how to set up teaching presentations so that they are dynamic, exciting, and meaningful for students. You will see how easy it is to prepare for classes, and you will discover that this teaching approach allows students to experience real learning and real academic success.

Science is a wonderful topic to teach to children. Instead of lecturing for long periods or bogging students down with an avalanche of worksheets, this manual shows you how to make your presentations interesting and challenging to the mind of a child. This is easy to do—once you know how to do it. Children already possess a natural curiosity for science. This manual shows you how to take advantage of their curiosity and to present lessons in a way that creates an exciting learning environment in your classroom.

This manual describes easy teacher demonstrations that use basic materials such as water, construction paper, colored ice cubes, and a slinky. Most of them take only minutes to set up. Blow through a straw to illustrate how ocean water contains carbon dioxide, or use a slinky to show the characteristics of waves. You can be sure that the students will be watching you as you wear a couple of gill cutouts on your neck while teaching about the differences between gills and lungs.

Topics relating to oceans in life science include plankton, fish, mammals, and simple food chains. Students can learn biology by comparing cold-blooded animals (fish) with warm-blooded animals (whales). Echolocation, blubber, and gills are also interesting topics to teach. Plankton have special significance in ocean biology and are not normally given enough attention in textbooks; these animal and plant microbes are in the food chains of nearly all life forms in the ocean. This manual also covers physical and earth science topics such as layers of the ocean, features of the ocean floor, currents, waves, and tides.

Following the teacher presentations, you can run various student activities at levels that are appropriate for your students' abilities. This manual is flexible, and there are many opportunities for integration of core subjects. For example, there are several activities that integrate math concepts, including estimation, percentages, pie charts, and parts per thousand. In addition, you can choose from many demonstrations, visual projects, experiments, group projects, and research projects. Perhaps the students will construct a large ocean mural that can be displayed in the classroom or hallway.

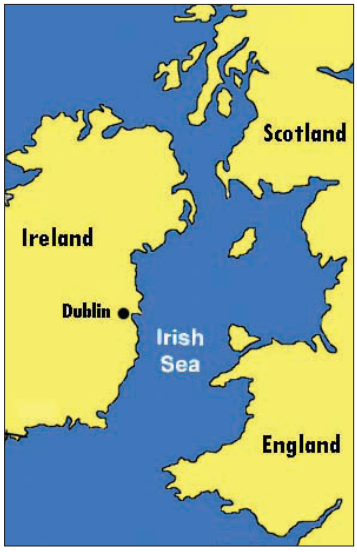
This manual also offers suggestions for assessment and shows examples of exemplary student work. In addition, it provides tips on classroom management, critical thinking questions, modifications, clean-up, and safety. The Teacher Resources section contains a variety of downloadable worksheets that you can use as homework or as in-class assignments; these are available from the Royal Fireworks Press website (rfwp.com). Many of the images in this book can be projected for the students to see and will help them to understand and internalize the concepts being taught; these are available for download as well.

The internet is a rich source of animations and short video clips. If you have the technology available in your classroom, you can use the keywords provided to search the internet to find websites that you can project during your teaching presentations. For example, you could

The Difference between Oceans and Seas

Seas are simply places where the ocean is partially enclosed by land. Project the map below of the Irish Sea so the students can see it.

Teacher Note: Later on in this unit, you can review the location of the Irish Sea when you cover the Gulf Stream. The Gulf Stream brings warmth to Ireland and Britain.



Tell the students to think of seas like the branches of the ocean. Just like the main trunk of a big tree that eventually spreads out into narrower and smaller branches, the vast ocean eventually extends into areas partially enclosed by land. These areas are called *seas*.

Assessment Tip: This comparison makes for a good quiz question. Oceans are to seas as trees are to:

A. branches *C. roots*
B. leaves *D. apples*

Teacher Demonstration: Ocean Pie

It's an easy demonstration to bring in a round cheesecake and add blueberries or strawberries to represent the proportions of land and ocean on Earth. If you have the ability, interest, and resources, you can turn this into a full-blown cooking activity by making the cheesecake from scratch. The students will be eating the Earth and its oceans in short time.

Music Integration

There are many recordings of ocean and beach sounds available. These typically include the sound of waves softly lapping the shore, with the occasional seagull calling in the background. Throughout this unit, you might play these recordings to create a calm learning environment in the classroom. You can even extend this into math by having the students count the number of waves per minute. For a kinesthetic activity, have students act out the waves to the sound of the water.

Student Activity: Word Search

See pages 56-57 in the Teacher Resources section of this manual for a downloadable word search titled "Find the Words in the Ocean." This word search contains ocean words that the students will be learning about as they progress through the unit. The pages include a student version and an answer key.

Salt Water

Objectives

- Students will describe the composition of salt water.
- Students will compare salt water to fresh water.
- Students will identify NaCl as salt.
- Students will view salt crystals under a stereoscope.
- Students will distinguish salt water from fresh water after evaporation.

Key Points

- Nearly all of the water on this planet is salt water.
- The average amount of salt in ocean water is 3.5 grams per 100 ml of water.
- Oxygen and carbon dioxide are two important gases dissolved in ocean water.
- Salt crystals look like cubes under a stereoscope.
- When salt water evaporates, the salt is left behind as a white residue.

Vocabulary Words

Salt	Sodium Chloride	Dissolve	Carbon Dioxide
Oxygen	Marine	Saline	Fresh Water

Start the Class

To grab the students' attention, take a container of salt, and make a show of pouring salt onto a table or into some water. Show the students an index card, and tell them that you have the recipe for making ocean water. Measure 3.5 grams of salt with a double pan balance. It is a better demonstration if you actually do this in front of the class, but if not, you can estimate 3.5 grams and pre-pour the salt into a cup before class.

3.5 grams of NaCl

Teaching Tip: Older students can learn the formula for salt: NaCl, or sodium chloride.

Next measure out 100 ml of water in a graduated cylinder, pour it into a cup, and add the salt. Mix it up, and show the students your homemade ocean water!

Materials

salt water graduated cylinder
cup balance spoon

Tsunamis are the exception to the wave rule, as they are usually produced by underwater earthquakes. All other waves are produced by the wind. The greater the wind, the greater the wave, which is why the waves caused by hurricanes are the biggest. Hurricane-produced waves can be huge. Project the images below to excite the visual learners in your class.

Corbis

The first image shows waves from Hurricane Wilma striking the harbor of Havana, Cuba, in 2005. Scientists have recorded waves as high as 100 feet.

One of the more interesting facts about waves is that there is little forward motion of the individual water molecules as a wave moves. This can be difficult for students to grasp. They think that the water is flowing along with the wave, similar to a surfer. The demonstrations that follow will help students learn this challenging concept.

Technology Integration: Search the internet for "surfing" and "video" to find websites that have videos you can play for the students. Some of these videos show surfers on waves that are incredibly large.

It is energy that is being transferred by the wave; the larger the wave, the more energy that is being transferred. Be sure to use the word *energy* several times when you are doing the wave demonstrations.

Class Activity: Waves

You are probably familiar with the "wave" performed by crowds at sporting events. With a big crowd, it can be impressive. One individual starts the wave by raising both hands above his head, then the next person does the same, and the next, and so on. The best way of doing this in the classroom is to arrange the students in a line and have the first student start the wave. This is an excellent role-playing activity that shows how a wave moves but the individual students go nowhere.

Technology Integration: Search the internet for "waves," "water," and "animation" to find websites that show how the individual water molecules in a wave do not move along with the wave.

What did the two oceans say when they met?
Nothing. They just waved.

Currents

Objectives

- Students will identify wind and water density as the factors that cause currents.
- Students will observe how cold water sinks in warm water.
- Students will understand why warm and cold currents move north and south.
- Students will identify the Gulf Stream as a warm-water current.
- Students will describe the lack of water movement in the Sargasso Sea.

Key Points

- There are two types of currents: surface and density.
- Surface currents are caused by the wind.
- Density currents are caused by differences of water temperature and salinity.
- In general, currents take warm water from the equator to the poles.
- In general, currents take cold water from the poles to the equator.
- The Gulf Stream is a warm-water current.
- The climates of Ireland and Britain are much milder than they should be, thanks to the warm Gulf Stream.
- The Sargasso Sea is a large area in the ocean where the water doesn't move much.
- There are huge floating mats of seaweed in the Sargasso Sea.

Vocabulary Words

Current	Gulf Stream
Sargasso Sea	Density current

Start the Class

Start by reviewing how the wind is responsible for waves. Use the same container of water you used in the previous class. Now tell the students that the wind can also produce *currents*. One way to understand the difference between waves and currents is to teach that waves are not a permanent feature of the water. They come and go. Currents are permanent. To demonstrate this, blow over the water for a sustained period of time, and tell the students that if you could keep blowing for 24 hours a day, you would create a constant flow of water. This is the definition of a current: a continuous flow of water in a set direction. The Gulf Stream is the best example of a wind-driven current.

Teacher Demonstration: Earth-Moon Magnets

Gravity can be an abstract topic for children to understand. One way to give students a sense of gravity is to use magnets. This demonstration helps students understand what gravity and gravitational attraction really mean.

Show the students two magnets, and explain how one represents the Moon and the other the Earth. Although gravity and magnetism are not the same force, the magnets can be used to simulate the attractive aspect of gravity. Have the students observe how each magnet is surrounded by an invisible force. First, demonstrate how they attract and repel each other.

Teaching Tip: Be sure the students understand that gravity and magnetism are not the same force but that being invisible is a common feature of both forces.

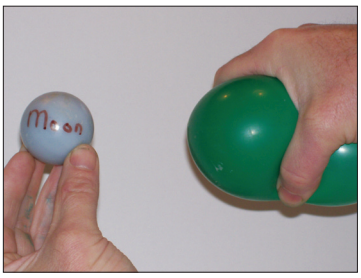
Hold the magnets so that they are attracting each other. Explain that the attraction between the two magnets is a gravity-like attraction. Although the two forces are not the same, they have similar features. Tell the students that you are using two magnets to pretend what gravity is like.

Materials Tip: A package of two economy ceramic magnets is quite inexpensive. It is worth buying enough for the whole class.

The attractive force between the two magnets is like the attractive force of gravity between the Moon and the Earth. The gravity of the Moon tries to pull the water away from the Earth. Connect this concept to the diagram on the previous page. Ask two volunteers to hold the magnets in front of the class. (Note that the attractive nature of the magnets is the similarity to gravity that you want to impress, not the repulsion.)

Teacher Demonstration: Water Balloon Bulging

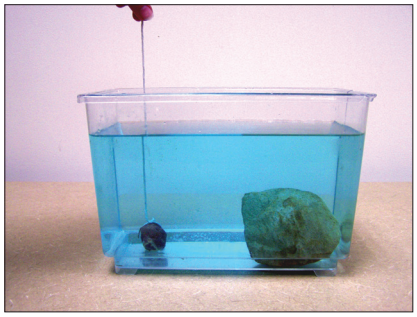
This demonstration helps students understand how the water on the Earth bulges due to the attractive force of the Moon. Prior to class, fill a round balloon with water. Hold the balloon and any round object that can represent the Moon next to each other. Give the balloon a gentle squeeze, and orient the bulge toward the Moon. Make the analogy that the part of the balloon that is bulging represents the gravitational attraction of the oceans to the Moon and that it is high tide on that side of the Earth.

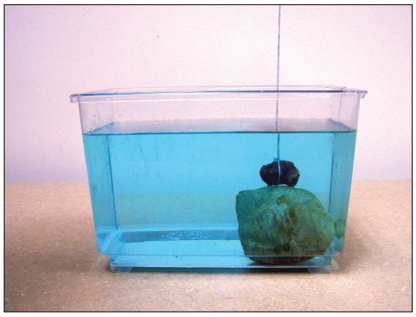


Technology Integration: Search the internet for "tides," "gravity," and "animation" to find websites that offer animations of how the Moon's gravity causes the tides on Earth. Be alert to the timeframes of the animations; some show a 24-hour period, while others show animations of tides over the course of a full lunar month.

Teacher Demonstration: Measuring the Depths of Oceans

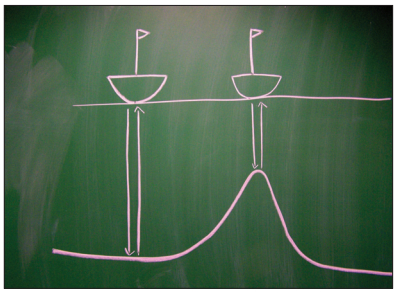
The simplest way to run this demonstration is to place a big rock in a small plastic container and then fill it with water. Tie any kind of weight to a rope or string, and then demonstrate how to measure the depth of the water by dropping the weight down to the bottom of the shallow and the deep points in the plastic container. In the early years of science, this was how the depth of the ocean was measured.





Teacher Demonstration: Sonar

Today, the depth of the ocean is measured much more precisely using sonar, or even using data compiled from satellites. Sonar involves the use of reflecting sound waves. Explain to the students that a ship emits a sound wave that hits the bottom of the ocean and bounces back. The longer it takes the sound to bounce back to the ship, the deeper the ocean is. Most children are familiar with echoes, so use the analogy of an echo bouncing back to a person shouting to help them understand this concept. Draw the simple diagram below on the board.



Later in this unit, you can teach how ocean mammals such as whales and dolphins use a form of sonar that is called *echolocation*. Some students may also be aware that bats use sonar to fly so precisely that they can catch flying insects in the air.

Technology Integration: Search the internet for "sonar" and "animation" to find websites that show how sonar works.

Student Activity: Profile of the Ocean Floor

Have the students use clay or plaster of Paris to make a representative ocean floor in the bottom of a shoebox. This model will include ocean floor features such as the continental shelf, continental slope, the abyssal plain, trenches, and the mid-ocean ridge. At the top of the shoebox, the students should poke a line of holes at regular intervals (3-4 cm) where they can insert skewers or long sticks to measure the depth. The students can switch models, record the data, and make a graph of other students' models.

Student Activity: Fish Prints

The Japanese art of fish printing is called *gyotaku*. Ink placed on a fish is impressed onto a piece of paper or even fabric. You can bring in a fish from the grocery store if you would like to model how this is done.

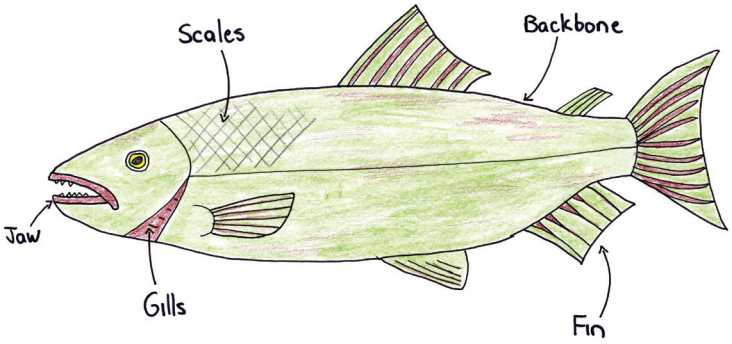
For those who are not so inclined, some companies sell rubber fish that are specifically made for *gyotaku*. This is definitely an art project—the students will use lots of ink, and you will have to be prepared for the clean-up. Perhaps the art teacher in your school would be interested in integrating and running this activity in the art room. The resulting prints can make attractive additions to the walls of your classroom.

An actual print

Art Tip: Use fade-resistant inks and specialty papers to improve the appearance of the artworks.

Student Activity: Diagram of a Fish

Have the students draw a labeled diagram of a fish. The diagram below was made using colored pencils.



Why are fish so smart?
Because they live in schools

How do fish get to school?
By an octobus

Beached Mammals

The phenomenon of ocean mammals beaching themselves is poorly understood. Beaching occurs when dolphins or whales become stranded on land and are unable or unwilling to return to the ocean. Typically, the animals become dehydrated and eventually die. Sometimes the sheer weight of these animals on solid ground crushes their own lungs. It is more common for solitary animals to beach themselves, but at times large numbers of whales or dolphins will beach themselves as a group. There are many theories to explain this mysterious behavior. List these reasons for the students as you project the images below.

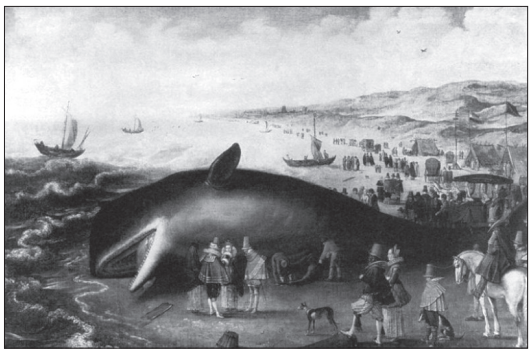
Theories include being caught in ocean currents, rough weather, mistakes in navigation due to problems with echolocation, disease, old age, injuries, following other species, being run aground by killer whales, response to earthquakes, algal blooms, and man-made causes such as sonar.

Stephan Osman (*LA Times*)

Beaching is not a modern phenomenon. There are records of beached whales throughout human history. The old photograph in the middle shows the beaching of hundreds of pilot whales early in the 1900s in Cape Cod, Massachusetts; the image at the bottom shows a whale beaching in Holland in 1598.

> *Technology Integration: Search the internet for "beached whale" and "video" to find websites where the beaching of whales or dolphins has been video recorded.*

Many people who see beached whales are sympathetic and have a strong desire to help the animals. The students might feel the same way. Unfortunately, despite the best efforts by well-intentioned people, returning the animals to water is often unsuccessful. Smaller animals can be removed by stretchers, but the bodies of dead whales are often pulled back to sea, mainly because of fear of disease associated with such a large decaying carcass.



> *Fact: The largest recorded mass stranding of whales occurred in 1918 with approximately 1,000 pilot whales beaching themselves on the Chatham Islands of New Zealand.*

Contents