

# Marine Science - The World of Water

## Grades 9-12

### INTRODUCTION

The earth viewed from the South Pole makes it apparent that we live on a water planet. Where does the Pacific Ocean end and the Atlantic begin? How about the Indian Ocean? The waters have no clear boundaries, and are really just one global ocean. The health of our planet depends to a great extent on the health of this ocean.



Two-thirds of the earth is covered by water; we're living in a three room house, with two of these rooms devoted to ocean. Clearly, it is important to educate our citizenry about that ocean. Your students are tomorrow's voters. Undoubtedly, they will be asked to make decisions about the use of ocean resources. *MARINE SCIENCE: The World of Water*, FOR SEA: Grades 9-12 - Oceanography and Marine Biology is designed to give students some of the background necessary to make appropriate decisions. The emphasis is on places in the sea. Weaving oceanography, marine biology and human issues, each unit first explores a physical factor that shapes life in a particular habitat, then focuses on the biology of the organisms in the habitat and the issues facing humans in our use of the sea.

The first unit, *The Oceans: Historical Perspectives*, takes a look at human interaction with the sea in several cultures through time. Unit Two, *Currents and the Open Ocean*, looks at the oceans as if from space, seeing the great patterns of ocean circulation and the organisms that inhabit those vast expanses of saltwater. The next three units focus on specific habitats that one can find along the edges where sea and land meet: rocky shores in Unit Three, *Tides and the Rocky Shore*; sandy shores and kelp beds in Unit Four, *Waves and Life in the Surf Zone*; and Unit Five: *The Deep Sea*. The sixth and final unit, *The Estuaries*, brings students home to the estuaries where rivers meet the sea and where humans find the most hospitable homes and the richest fisheries.

While each activity has been designed to stand alone, presented together they provide a coherent introduction to the marine sciences. It is recommended that the teacher add his or her own ideas, experiences, and background. It is important to develop the natural enthusiasm students have for learning about the sea. This is the time to add aquariums, preserved and dried specimens, books, journals, posters and appropriate videos and laser discs. If possible, access marine related bulletin boards and networks via the

Internet. Consider inviting water quality scientists, aquaculturists or marine scientists in your area to speak to your classes or, perhaps even more engaging, to help you try these lessons with your students. The sea and the marine life that lives there is inherently interesting to students and can be an excellent vehicle for teaching elements of chemistry, physics, biology and social and political issues.

### **About This Guide...**

*MARINE SCIENCE: The World of Water, Grades 9-12*, is divided into six units. Each unit contains several lessons. Each lesson has student activities preceded by a “Teacher Background” section which contains: key concepts, background information, materials needed, teaching hints including items for which advanced planning is required, extension ideas, and answer keys. Important vocabulary terms are listed and defined in the “Key Word” section of each “Teacher Background.” The words are also defined in the text, either directly or by context.

Most activities require few materials not readily available in your classroom or in variety and grocery stores. It is strongly recommended that the activities be performed along with the reading and discussion of the text. The activities are designed to enhance reading skills, as well as investigation skills. Some activities provide practice in math skills. The activities can be modified to suit your particular needs, but will work “as is.”

Skim the contents of the units to discover the organizational scheme. Please read the text and activities before you use them. The materials have all been prepared with ease of duplication in mind. Please feel free to duplicate any and all materials you need to effectively utilize this unit with your class.

Please let us know how much you liked or disliked the lessons. If you have some marine activity that you have tried successfully with your students, please let us know about it. Perhaps we can incorporate it in future revisions. This guide is one of a series designed to develop and foster an understanding of the marine environment. Other units in the Investigating Marine Science series include:

**Life in the Tidal Zone - Grade 1**

**The Sea Around Us - Grade-2**

**Life in the Estuary - Grade 3**

**Beginning in the Watershed - Grade 4**

**Life with Pagoo - Grade 5**

**Investigating the Ocean Planet - Grade-6**

**The Year of the Gray Whale - Grade 7**

**Ocean Studies, Ocean Issues - Grade 8**

**Acknowledgments...**

Adequate acknowledgment cannot be made to all who helped by their writings, conversations, or loans of materials. Nonetheless, some particular efforts need recognition. Special thanks goes to Karen Mattick, master teacher and FOR SEA teacher trainer from Poulsbo, Washington who coordinated the revision of this guide. Judy D'Amore (Port Townsend, Washington), Holly Foley (Poulsbo, Washington), Neil Glickstein (Beverly, Massachusetts), Ardi Kveven (Snohomish, Washington), Jerry Mohar (Hood River, Oregon), Holly Shewbridge (Pacific Grove, California), Michael Vollmert (Oxnard, California), Susan Wertz (Olympia, Washington), and Gene Williamson (Manning, Oregon) made valuable contributions of new material. As with the other guides in this series, Laurie Dumdie provided clarity of vision and coordinated resources. National Oceanic and Atmospheric Administration scientists Bud Antonelis, Ed Baker, Peggy Busby, Doug DeMaster, Art Francis, Stephen R. Hammond, Orlay Johnson, Linda Jones, Harold Mofjeld, Frank Morado, Paulette Murphy, Debbie Payton, Jim Schumacher, Carla Stehr, and Judy Sohl (Education Specialist) reviewed the scientific accuracy and provided helpful suggestions. Joan Paulson supplied valuable administrative assistance. Larry Burtness, Jake Schlumpf, and Tom Armentrout provided the electronic expertise which made a project of this magnitude possible. The beauty of the illustrations and "eye-appeal" of the format are the contribution of Diane Gusset. For any errors or deficiencies that remain, none of these colleagues has any share of the responsibility which rests entirely upon the Principal Investigator.

James A. Kolb  
Principal Investigator  
Author/Editor

## FOR SEA...A short history

The FOR SEA marine science curriculum and teacher training program has its roots in the recognition of both the power and the fragility of the world ocean and in the need for individuals to understand and appreciate these seemingly contradictory aspects of the sea. Since 1978, FOR SEA has helped teachers provide high quality science education. From its modest beginnings in a few classrooms, the project grew to regional and then national prominence as the materials and teaching strategies led to student success in science.

In recognition of this effectiveness, the National Science Teachers Association, the Council of State Science Supervisors and the National Science Supervisors Association selected FOR SEA as an exemplary middle school/junior high school curriculum, as an exemplary career awareness in science curriculum, and as an exemplary environmental education curriculum. In addition, on five separate occasions FOR SEA received national validation from the U.S. Department of Education and the National Institute of Education for the FOR SEA elementary and secondary curriculum materials and teacher training program.

### Why does it work?

#### **FOR SEA marine science curricula have been widely accepted and effective because they are:**

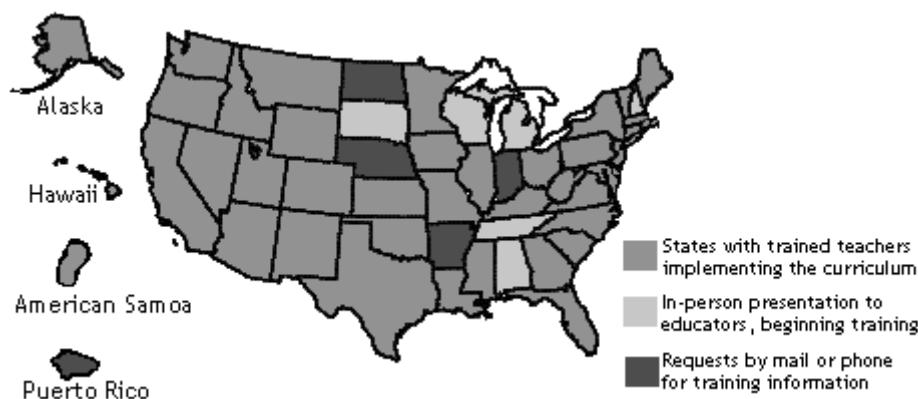
- developed by professional marine educators
- read for scientific accuracy by noted scientists in the field
- analyzed for gender/cultural bias by noted specialists
- read for reading level by reading specialists
- trial taught by experienced and naive teachers
- revised in accord with above reviews, and
- periodically updated using the above process.

#### **FOR SEA teacher training has been effective because teacher trainers:**

- have utilized the materials in classroom settings
- are trained by project staff in program content and adult presentation skills
- begin with short awareness presentations provided under the guidance of project staff and progress to longer trainings and still longer residential institutes, and
- become part of the FOR SEA Teacher Training Network which provides on-going support in arranging and delivering teacher training workshops nationally.

The FOR SEA Teacher Training Network supports a cadre of outstanding “teachers of teachers”. At workshops and residential institutes, teachers engage in FOR SEA hands-on activities, learn from leading scientists and science educators, practice successful marine science teaching strategies, and develop a plan for their own use of the FOR SEA materials.

Thanks to financial support from the National Science Foundation, the U.S. Department of Education National Diffusion Network, school districts, and many individuals, FOR SEA trained teachers are now providing high-caliber science instruction in 41 states and over 2,000 public and private schools.



For more information about FOR SEA materials and available teacher training services, please contact FOR SEA at (360)779-5122 or P.O. Box 188, Indianola, WA 98342 or [jkolb@krl.org](mailto:jkolb@krl.org), or visit our web page at [www.forsea.org](http://www.forsea.org).

This article originally appeared in *CLEARING, the Magazine of Environmental Education*, special thanks to Larry Buettler, Editor



## Making A Diference...

There is a phenomenon that's important for you to know about. In it may lie our only hope for a future for our species. Here is the story of the Hundredth Monkey:

The Japanese monkey, *Macaca fuscata*, has been observed in the wild for a period of over 30 years. In 1952, on the island of Koshima, scientists were providing monkeys with sweet potatoes dropped in the sand. The monkeys like the taste of the raw sweet potatoes, but they found the dirt unpleasant. An 18-month-old female named Imo found she could solve the problem by washing the potatoes in a nearby stream. She taught this trick to her mother. Her playmates also learned this new way and they taught their mothers, too. This cultural innovation was gradually picked up by various monkeys before the eyes of the scientists. Between 1952 and 1958, all the young monkeys learned to wash the sandy sweet potatoes to make them more palatable. Only the adults who imitated their children learned this social improvement. Other adults kept eating the dirty sweet potatoes. Then something startling took place. In the autumn of 1958, a certain number of Koshima monkeys were washing sweet potatoes—the exact number is not known. Let us suppose that when the sun rose one morning there were 99 monkeys on Koshima Island who had learned to wash their sweet potatoes. THEN IT HAPPENED! By that evening almost everyone in the tribe was washing sweet potatoes before eating them. The added energy of this hundredth monkey somehow created an ideological breakthrough! But notice. The most surprising thing observed by these scientists was that the habit of washing sweet potatoes then spontaneously jumped over the sea—Colonies of monkeys on other islands and the mainland troop of monkeys at Takasakiyama began washing their sweet potatoes!

Thus, when a certain critical number achieves an awareness, this new awareness may be communicated from mind to mind. Although the exact number may vary, the Hundredth Monkey Phenomenon means that when only a limited number of people know of a new way, it may remain the consciousness property of these people. But there is a point at which if only one more person tunes-in to a new awareness, a field is strengthened so that this awareness reaches almost everyone. The experiments of Dr. J.B. Rhine at Duke University repeatedly demonstrated that individuals can communicate private information to each other even though located in different places. We now know that the strength of this extrasensory communication can be amplified to a powerfully effective level when the consciousness of the "hundredth person" is added.

—from *The Hundredth Monkey* by Ken Keyes, Jr.

This story is currently being used in reference to the growing concern and protest over nuclear weapons proliferation. We are reminded that any one of us, in our personal awareness and actions, might be that "hundredth monkey" that will trigger an expanded energy field and bring about global awareness and action.

The Hundredth Monkey is a metaphor that can be applied to other local and global issues as well, including the environment.

No less crucial than nuclear weapons, in that it threatens our very existence, the degradation of the environment needs to be addressed at all levels of society. Awareness and education are the key factors in bringing about change.

Marine studies is the way in which we can connect the various and independent disciplines of education in teaching toward a common goal. Social studies, science, language arts, math and humanities can all use marine studies as the common thread in their course work.

This is how we are going to find the "hundredth monkey" that will make the difference. We can, and we must, be united toward a common educational goal to literally save the world.

And marine studies is the way to make that happen.