BRINGING ALL OF SCIENCE WITH US: BUILDING WEB SITES FOR SCIENCE LITERACY

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ABSTRACT: While scientific knowledge or content is the heart of science, there are universal scientific themes and processes which must be understood before anyone can truly understand and evaluate science and scientific information. This paper will examine these themes and processes and explore how database producers and information professionals can use them to foster science literacy.

Introduction

The purpose of this paper is to explore:

- Types of Science Literacy
- What We can do in Developing Web Sites for Science Literacy

http://horizons.sb2.pdx.edu/~fem-sci-lit/defin-scilit.html

The following are definitions of science literacy from a variety of sources.

(Compiled by B.Chadwick, research assistant)

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National Science Foundation Report

Shaping the Future: New Expectations for Undergraduate Education in Science, Mathematics, Engineering and Technology, National Science Foundation, 1996.

Focus on improving education for all undergraduates: preparing K-12 teachers, a technical workforce, science majors, and improving science literacy for all. The need of all citizens for a "higher level of competence in science, mathematics, engineering and technology" is presented as primarily an economic concern, as corporations and employers are demanding more informed and proficient workers; but also a societal concern, in that scientifically knowledgeable citizens will be better able to make decisions about the use of technology and science.

Goals for educators:

- believe every student can learn
- have "high expectations, in a supportive climate"
- encourage a spirit of inquiry, excitement, a sense of wonder
- communication and teamwork
- teach critical thinking
- emphasize lifelong learning skills

Scientific literacy is knowing:

- what science is
- what science professionals do

http://horizons.sb2.pdx.edu/~fem-sci-lit/revised.htm

Scientific Literacy and Women's Studies

How we think about scientific literacy as an educational goal can either open up or close off avenues for introducing feminist perspectives into the science literacy curriculum (i.e., the coursework through which students will become scientifically literate). In our team, it seemed logical to begin at the beginning: how do we define scientific literacy? And therefore what are our educational goals? What do we think students ought to know by the time they leave our campus? As it turned out, this was a VERY contested question and what we thought would be a day's discussion turned out to take up most of our summer seminar. We started with the different positions in the literature on scientific literacy. We've come to a working consensus on what scientific literacy is and why we should value it. We reject some of the definitions of and justifications for scientific literacy, agree with some and find ourselves still debating others.

AGREE	UNDER DEBATE	DISAGREE
"Science as part of the liberal arts contributes to the satisfaction of the human desire to know and understand" (AAAS)	Allows citizens to engage in decision-making about public policy-(NRC)	Knowing a particular body of facts and scientific laws
"Scientific habits of mind" (Shamos, Dewey)	Allows citizens to engage in decision-making about personal life (NRC)	Create a common knowledge base through a standardized curriculum (Project 2061, Trefil)
Confidence in exploring the unknown in the natural/physical world	Promote a "rational" society	Sustain the Science Pipeline
Understand science in the making rather than science made	Scientific knowledge supplants superstition (Laetsch)	
Demystifying Science (Stephan J. Gould) facilitates entry into natural/physical science for previously excluded groups	Better Living Through Science:	

Scientific Literacy

- Practical scientific literacy
- Cultural scientific literacy
- Civic scientific literacy

Civic Scientific Literacy

A person who is has achieved civic scientific literacy has enough understanding of scientific terms,concepts, and processes to that she can read a newspaper or magazine and understand the essence of a controversy and make an informed decision.

Civic Science Literacy

- Vocabulary and concepts
  - » Use of jargon-explained
  - » Definitions in context

- Knowledge of processes
  - » "Science in the making rather than science made"
  - » The same science being described to all levels

WWW Science Sites for the Public

- Started as professional but expanded for public use.
- Started from beginning for general public.
- Designed for children

http://www.npr.org/programs/sfkids/showarchive/sfkc.98.06.26.html

Hour Two: Acoustical Oceanography

How do you discern a blue whale from a humpback, or a weakfish from a red drum, for that matter? Well, you could probably see the difference, but could you hear the difference? In this hour, we'll talk to scientists who are listening to the ocean and its inhabitants and learning about everything from whale migration to global warming.

Student Questions

1) Do fish make sounds?
2) How do they make them?
3) Why do they make them?
4) What does a blue whale song sound like?
5) Where do blue whales spend the winter? How about the summer?

Special Guests

Robert Spindel
Director, Applied Physics Lab
University of Washington
Seattle, Washington

Joe Luczkovich (LUHS-koh-vitch)
Associate Scientist
Institute for Coastal and Marine Resources
East Carolina University
Greenville, North Carolina

http://www.npr.org/programs/sfkids/showarchive/sfkc.98.06.26.html

Student Project: What is in a sound?

Goal:
To understand that sound can be used to find out about areas we can observe by sight (e.g. inside our bodies, within the ocean depths and far into outer space)

Background:
Sound is employed in equipment like sonar and echo-location to map the ocean floor and determine the location of large animals, submerged ships and other objects in the ocean. Sound is employed in medical equipment like ultra-sound to observe the growth and development of a human fetus prior to birth. Sound is also used to map oil and mineral deposits deep within the earth and to explore the properties of space objects. In some equipment the element being measured is the time it takes for sound to be sent out and returned. In other types of equipment the characteristic being measured is the frequency of sound wave which is produced by interacting with the object .

Procedure:
1. Place one hand flat, palm down, on a spot on your body. Strike the tip of the third finger of the hand with the third finger of your other hand. Practice until you get a consistent and clear sound. (This is what doctors do when they check the condition of your lungs).
2. Make a map of the internal structures of you body using the following sound guidelines:

- a) A dull sound indicates solid muscle (like on your thigh)
- b) A hollow sound indicates airy parts (like the stomach and lungs)
- c) A resonate or ringing sound indicates air and mass (like ribs)

http://www.npr.org/programs/sfkids/showarchive/sfkc.98.06.26.html

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- Earle, Sylvia A. ***Sea Changes - A Message of the Oceans.*** Fawcett Columbine, New York, 1995.
- Hall, Michelle and Howard. ***Secrets of the Ocean Realm.*** Beyond Words Pub., Hillsboro, OR, 1997.
- McMillan, Beverly and John A. Musich. ***Oceans: Life in the Deep.*** Freedman/Fairfax Pub., New York, 1997.
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ON-LINE ARTICLES:

Acoustics Research - Penn State
Acoustical Scattering Models of Zooplankton and Microstructure By Timothy K. Stanton
Advanced Ocean Acoustics
Marine Ecosystems Studies
Questions About Careers in Oceanography: Who Supports Oceanographers?

Sonar Research - Penn State

INTERNET SITES:
Acoustical Oceanography News and Notes
Acoustical Oceanography Research Group!
Coastal Oceans Acoustic Center
Massachusetts Institute of Technology - Woods Hole Oceanographic Institute
National Oceanographic and Atmospheric Administration (NOAA)

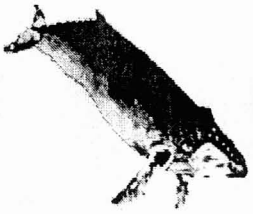
http://atocdb.ucsd.edu

Acoustic Thermometry of Ocean Climate (ATOC)

NEW What's New

ATOC Summary and Results

ATOC's Climate Research



ATOC's Marine Mammal Research

ATOC's California Source

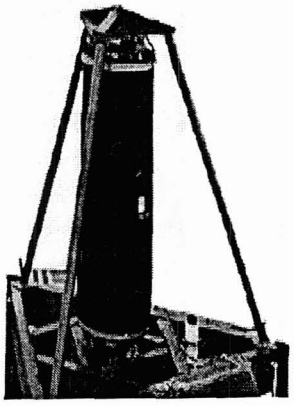
http://atocdb.ucsd.edu/Climate_page.html

Acoustic Thermometry of Ocean Climate:

ATOC's Climate Research

The basic idea of ATOC is simple. Sound travels faster in warm water than in cold water. The travel time of a sound signal from a source near California to a receiver near Alaska, for example, will decrease if the intervening ocean warms up, and will increase if the ocean cools down.

The travel time is a direct measure of the average temperature between the source and receiver. The information obtained is similar to that which is obtained for the atmosphere by averaging temperature data from the many thousands of land-based weather stations that exist.



By measuring the travel times of these sounds, it is anticipated that basin-scale (entire ocean) measurements of ocean temperatures can be obtained that will provide important information for studying global climate questions, particularly global warming due to the "greenhouse effect."

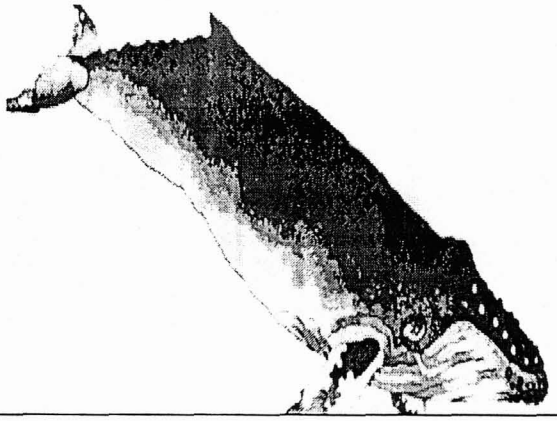
ATOC plans to employ two sources, one offshore California and one north of Kauai, and numerous receivers in the North Pacific. The transmission schedule is dictated by the marine mammal research program, but valuable climate data can be gleaned using the travel time data from these transmissions.

http://atocdb.ucsd.edu/MMRP_page.html

Acoustic Thermometry of Ocean Climate:

ATOC's Marine Mammal Research Program

The Marine Mammal Research Program (MMRP), led by Dr. Christopher W. Clark of Cornell University's Bioacoustic Research Program, is designed to provide information on hearing capabilities of marine mammals and sea turtles, response of marine mammals and other marine organisms to man-made sounds, (both from the ATOC source and from other sources, such as shipping noise), and to provide information needed to direct policies for long-term protection and conservation of marine species. The MMRP recognizes that the available data on the effects of low frequency sound on marine mammals are sparse and has designed a research protocol to broaden the information base.



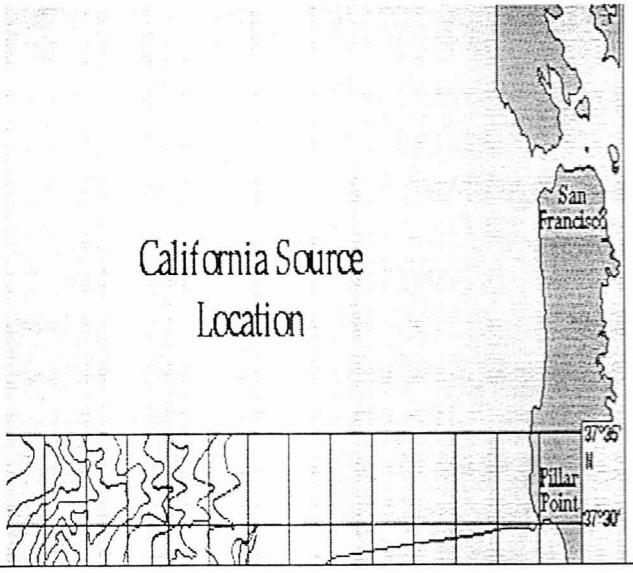
http://atocdb.ucsd.edu/CAsourcepg.html

Acoustic Thermometry of Ocean Climate:

ATOC's California Source

ATOC's California sound source is located on Pioneer Seamount, 3,000 feet below the ocean's surface and approximately 50 miles offshore Half Moon Bay.

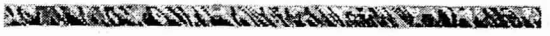
The Pioneer Seamount source began transmitting on December 2, 1995. Since then, the schedule of transmissions has been dictated by the California Marine Mammal Research Program (MMRP), led by Dr. Dan Costa of the University of California, Santa Cruz.



http://atocdb.ucsd.edu/CAsourcepg.html

The MMRP's decision to start a series of transmissions is based on a number of factors, primarily dependent on observation/survey opportunities. Once initiated, a series consists of twenty minute transmissions every 4 hours, following a 5 minute ramp-up period, which alerts any marine mammals in the vicinity of the source. The transmissions last from 2 to 4 days and are accompanied by a series of aerial surveys conducted in the days prior to and during the series of transmissions. (Click here to see transmission schedules.)

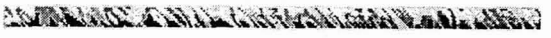
While Dr. Costa and his team are gathering marine mammal information, ATOC Climate data is simultaneously being collected by the network of receivers that rim the Pacific.



Return to ATOC Home

The Alternate Source Test

Recent Activity in California: A cable fault reported on 3/21/97, and possible fishing entanglement with the ATOC cable on 3/27/97



The ATOC Homepage is located at http://atocdb.ucsd.edu/

contact the ATOC Webmaster at atoc@igpp.ucsd.edu . Last updated 8/4/96

http://atocdb.ucsd.edu/atpubspg.html

Acoustic Thermometry of Ocean Climate:

ATOC Acoustic Thermometry Publications

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2.	Howe, B. M., S. W. Leach, J. A. Mercer, and R. I Odom. Designing the ATOC Global Array. *IEEE Oceans* Œ93, I-258 (1993).	CONFERENCE PROCEEDING
3.	Dzieciuch, M. Numerical Solution of the Acoustic Wave Equation using Chebyshev Polynomials with Application to Global Acoustics. *IEEE Oceans Œ93*, I-267 (1993).	CONFERENCE PROCEEDING
4.	Forbes, A. Acoustic Monitoring of Global Ocean Climate. *Sea Technology*, **65** (May 1994).	POPULAR ARTICLE
5.	Shang, E. C., and Y. Y. Wang. Ocean Acoustic Thermometry and Vertical Slice Tomography. Theoretical and Computational Acoustics, Vol. 2, 1994.	BOOK CHAPTER
6.	Dushaw, B. D., B. D. Cornuelle, P.F. Worcester, B. M. Howe, and D. S Luther. Barotropic and Baroclinic Tides in the Central North Pacific Ocean Determined from Long-Range Reciprocal Acoustic Transmissions. *J. Phys. Oceanogr.*, **25**, No. 4, 631 (1995).	RESEARCH ARTICLE
7.	Voronovich, A. G., and E. C. Shang. A note on horizontal-refraction-modal tomography. *J. Acoust. Soc. Am.* **98** (5), Pt. 1, 2708 (1995).	RESEARCH ARTICLE
8.	ATOC Instrumentation Group: Howe, B. M., S. G. Anderson, A. B. Baggeroer, J. A. Colosi, K. R. Hardy, D. Horwitt, F. W. Karig, S. Leach, J. A. Mercer, K. Metzger, Jr., L. O.	CONFERENCE PROCEEDING

http://atocdb.ucsd.edu/what'snewpg.html

NEW NEW NEW

Acoustic Thermometry of Ocean Climate:

What's New

KAUAI MMRP PILOT SUDY COMPLETE - QUICK-LOOK REPORT AVAILABLE

NEW The "Quick Look Report of the Hawaii ATOC-MMRP Hawaiian 1997/98 ResultsÓ is now available. The report, which provides the data and preliminary results from the 1998 Kauai Pilot Study, is being provided pursuant to the Final Environmental Impact Statement (FEIS) for the Kauai MMRP in conjunction with the ATOC Project.

As indicated in the report, the overall conclusion from the research to date is that no acute or short-term effects, as defined in Table C-1 of the Kauai FEIS, were observed and that Ôpresently there are no MMRP results indicating that any species shows any biologically significant adverse response to the operational ATOC sound or playback of the ATOC sound using several different underwater speakers.Ó

A brief summary of the Kauai Pilot Study results are as follows:

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