The Changing Structure of American Education

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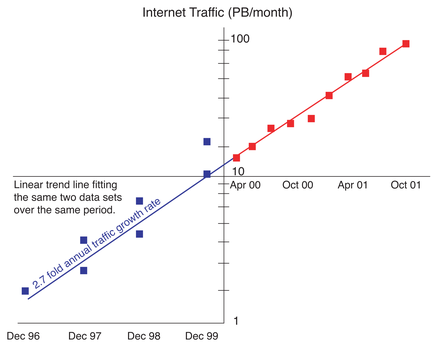
Introduction: Why do we Care?

- Oceanography is not being taught in many classrooms. Here's why.
- We now know so much about science that we cannot possible teach is all. So what do we teach, and what do we not teach?
- Various scientific groups have met and decided what ought to be taught at each grade level. These are called the national standards for teaching math, science, geography, history, and other subjects.
- The groups include:
  - The American Association for the Advancement of Science, publisher of *Science for All Americans*.
  - The National Academy of Sciences/National Research Council's *National Science Education Standards*.
  - National Science Teachers Association, *Scope, Sequence, and Coordination of Secondary School Science*.
  - Texas Education Agency, *Texas Essential Knowledge and Skills*.
  - Other states have similar standards, all derived from the national standards.
- Each state has adapted their own standards, and this is what is taught in the classroom.
- Texas and a few other states have taken the standards to their natural conclusion, other states will probably follow, especially with federal pressure.
  - Texas textbooks must be aligned with the Texas Essential Knowledge and Skills.
  - Texas tests student performance at the end of each grade.
  - The test is tied to the Texas standards.
  - Schools are evaluated based on the state test: results are published, and teachers are evaluated on how well their students perform on the test.
  - As a result of this rigorous accountability, Texas is leading the nation in improvement of student performance.
- **If it isn't in the standards, it isn't taught. The standards barely mention the ocean. Therefore oceanography is not being taught.**

What Is Changing?

- Rapid changes in technology are changing education.
- Methods for distribution material. Web and CD distribution will dominate.
  - Internet traffic is doubling every 12 months.
  - Cost of data storage drops 270% per year.
  - Cost of bandwidth drops 350% per year.

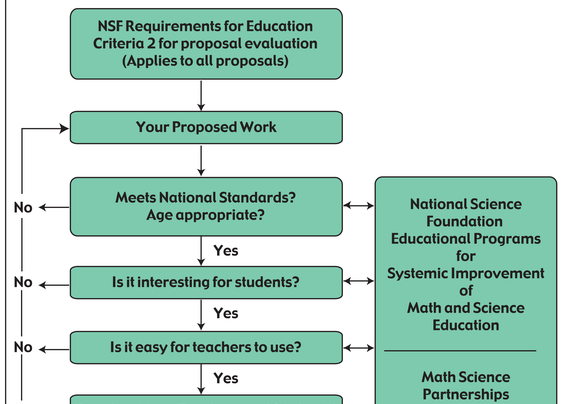


Source: Gilder Technology Report: November 2001, 6 (12)

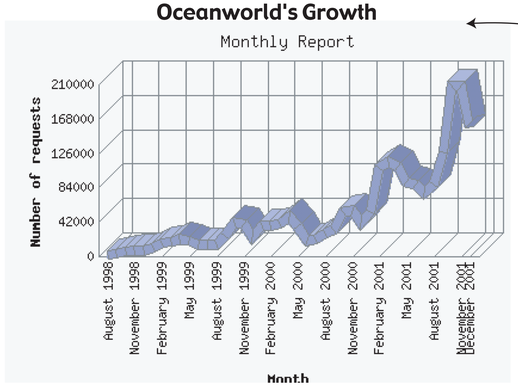
- Web distribution means that material can be constantly updated.
- Web data can fill need for modular material for use in courses.

Improving Education

The National Science Foundation's idea of an ideal merging of science and education looks something like this.



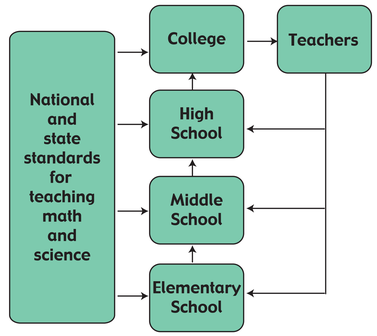
Oceanworld's Growth



What are the Implications?

- "Because the experiences of many future high-school teachers are still being shaped by traditional courses, this situation retards the improvement of high-school instruction."—Gollub & Spital, *Physics Today*, May 2002.
- The implication is clear: We will be expected to change the way we teach science courses taken by students who expect to become teachers.
  - Use more hands-on activities. High school classes have lots of these activities. It is a very effective way to teach.
  - Make sure the material includes the topics included in the national standards.
  - Although the standards don't include oceanography, we can teach physics, mathematics, chemistry, and biology using oceanographic examples.

Vertical Alignment of K–16 Teaching

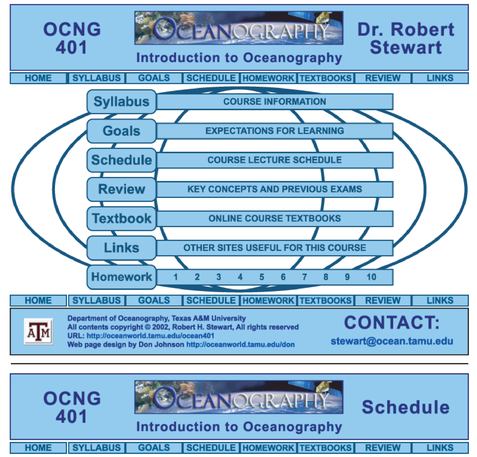


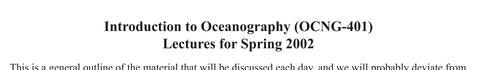
What Can We Do?

- Become more involved in education.
- Some ways are especially effective.
- Let's help teachers.
  - Many teachers have little training in the earth sciences.
  - Therefore they are not effective as they could be teaching earth science or oceanography.
  - They tend to write classroom material that has major errors.
  - Yet the more they know the better they can teach.
- Invite teachers to work in your lab over the summer.
  - Show them why your work is interesting, and how science is done. Most educators don't have a clue.
  - Work closely with them in developing teaching material.
- Let's get undergraduate students more involved in oceanographic research.
  - Hire undergraduates to work in your lab, especially students who have an interest in the earth sciences and teaching.
  - Remember, students are interested in careers as well as science.
- Join the community of teachers.
  - Share your materials with others who teach.
  - Bill Prothero at UC Santa Barbara is creating a community of oceanography teachers.
- Join your local NSF Math Science Partnership.
- Work with us to create material for Oceanworld.
  - Oceanworld reaches thousands of teachers and students each month.
  - Material is tied to national standards.
  - We have good ties to teachers.
  - We are growing exponentially.

An Example

A Problem-based Oceanography Course For Teachers





Introduction to Oceanography (OCNG-401)
Lectures for Spring 2002

This is a general outline of the material that will be discussed each day, and we will probably deviate from it as the course progresses. It is meant to be an overview of the topics to be discussed in roughly the order they will be discussed. Some topics may take more or less time than listed.

You must read the appropriate chapter before coming to class, and you must turn in your solution to each day's problem. See the Course Information page for details.

Fisheries: The Ocean as Food Source

Where are my Orange Roughy?

Julie loved orange roughy. She liked it even better than catfish. Her mother liked it because it was cheap compared with most other fish at the market. But now it was seldom for sale. Her mother asked the manager at the fish counter and he said he couldn't get it any more.

Can we help Julie?

Can we find out what happened to the orange roughy? To prepare for this section, look up orange roughy at http://www.fishbase.org/search.cfm. so we know what fish we are learning about. Then write down possible explanations of why the fish is no longer sold. For example, few were sold so the market stopped carrying it. etc.

1 March 2002 - Fisheries: An Introduction

Why do we care about fisheries? How important are fisheries to the economy of any region? Get an overview of the scientific and policy issues from the American Association for the Advancement of Science, the publishers of Science. Then learn a little about recreational fisheries, and commercial fisheries in this country. You can download a brochure on recreational fisheries in the Gulf of Mexico for more details. Get the total value of all fish landed by commercial fisheries in the US in 1999 (use the default value for the search), then get the total value for all fish caught in Texas for 1999.

The basic question is: How many fish can be harvested from the sea? The answer is not simple. Some fish stocks are declining. Is the decline due to overfishing? is it due indirectly to fishing for other types of fish? Or is it due to the natural variability of the stock? If it is due to overfishing, what can be done? Reduce the number of ships? Limit the fishing season?

Here is a brief quote from National Geographic magazine's article on Cuba Reefs: A Last Caribbean Refuge in the February 2002 issue.

> "It was almost like a hallucination. Immediate. A sense of dislocation. Something was awry... I had flopped overboard from a dinghy on a glassy Caribbean sea in the summer of the year 2000 and in an instant, apparently, slipped backward nearly half a century into an underwater realm that had not existed, so far as I knew, since the 1950s... Residents swarmed over me, welcoming me to the neighborhood, animals in numbers and diversity I hadn't seen in decades, not since Lyndon Johnson was president... Schools of yellowtail snappers and blue creole wrasses darted about in a frenzy... A squadron of glittering tarpon passed regally by, ... Green moray eels slid part way out of their crevice homes,... "

Problem 12: What is the tragedy of the commons? The term was used by Garrett Hardin in his now famous article in Science in 1968. Hardin, Garret. The Tragedy of the Commons. Science, 1968. 162:1243-8.

Results of Class Discussion