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Oceanography

Why Teach What When?

BY TOM GARRISON

Most readers of this column hold academic positions that include the responsibility of teaching. Some of my previous articles have suggested ways the teaching process might be made more effective, but I haven't touched on *what* to teach. We teach oceanography, you say? Yes, we do. But what exactly does that include, and how should one balance the parts that make up the whole? What an interesting question!

Assume for a moment that you have been given the appealing responsibility of organizing and teaching a general education course in marine science for college undergraduates, the majority of whom are not majoring in the science. (I'll get to more advanced courses in a moment.) Weeks before you meet, you and your audience launch yourselves on a collision course—you will be planning a broad introductory course, and they will be scanning the college's catalogue and schedule of classes for a class to fill a graduation requirement.

Most students decide on a particular class based on three factors. (1) When does it meet—does it fit conveniently into my schedule? (2) Does the topic appeal? (3) Who is teaching the class? The actual order depends on the student's motivation—students enrolling in an open-door community college may place top value on a convenient schedule, while students at an elite university would think first about the inherent appeal of the topic and its value in his or her overall education goals. Schedule is always a toss-up—a three-hour lecture class meeting late on Friday afternoons is probably doomed. But fortunately for us, ocean-related classes have a natural appeal (all dolphins and sharks, right?), and that draw might lessen the impact of a less-than-optimal time. As for who is teaching the class, only the diligentsia will interview a prospective prof or visit a faculty ratings website. For most students, it's a roll of the dice.

Long before the prospective students consider registering for the class, however, the lucky faculty member will have taken some blank paper and a pencil to a quiet, dark place to figure out what this course will be like. Merlin-like, he or she will conjure oceanic wonders from past experiences, recall the lessons of inspiring mentors, revisit exciting travels, thumb through textbooks, and remember the irresistible wonder of learning new things. Ah, what a class this will be! Group projects! The latest research findings! A rehash of one's dissertation! Side explorations into history, economics, anthropology, or perhaps even oceanic music and art!

And then reality takes hold. Many of the students will arrive with little or no science background, no sense of deep time, a suspicion of evolution, limited ability to write or think critically, weak math skills, and a distorted view of marine science (no, *not* all dolphins and sharks). And there are only 16 weeks and three hours per week. Now what will you do?

The first obligation: Consider the Goal. If this is a general education, elective, non-majors course, the college catalogue will probably include the word "overview" or "orientation" or "introduction." Let that be your guide.

It has been my pleasure to lead a great many students through large ocean intro courses. I invariably begin with a broad overview—students are asked not to take notes but just watch and listen (the course outline provided as a handout or online covers the mechanical course details)[1]. An observer randomly entering the lecture hall in this first hour might not know if this class is about astronomy, ship design, zoology, exploration, climate change, or robots. He or she would probably be surprised not to hear anything about the scientific method, the pH of seawater, the classification of waves, or taxonomy.

All that will come later. Your first obligation is the generation of a consuming interest, something our specialty has *no* problem providing. After all, the ocean is our planet's dominant feature.

Here's the course order that I have used for many years: Because all matter

[1] For more information on course outlines, please see *Oceanography* 23(1):220–221, http://dx.doi.org/10.5670/oceanog.2010.102.

on Earth except hydrogen and some helium was generated in stars, our story of the ocean necessarily begins with the stars. Have oceans evolved elsewhere? The nature of scientific thought and a brief history of marine science follows (with additional historical information sprinkled through later lectures). A summary of our understanding of Earth structure and theory of plate tectonics are presented next, as a base on which to build the discussion and explanation of bottom features that follows. A survey of ocean physics and chemistry prepares us for the complexities of atmospheric and oceanic circulation, classical physical oceanography, and coastal processes. Oceanography incorporates marine biology, and our look at marine biology begins with an understanding of evolution by natural selection followed by an overview of the problems and benefits of living in seawater, continues with a discussion of the production and consumption of food, and ends with taxonomic and ecological surveys of marine organisms. The last topics treat marine resources and environmental concerns.

The textbooks I write follow a similar plan. Years ago, a few peer reviewers asked me to reverse the presentation order in marine geology, feeling that a survey of submarine features (trenches, guyots, island arcs, etc.) should precede any discussion of plate tectonics. I argued that cause should come before effect, and left things alone.

A reader of this plan might complain that this ancillary information (astronomy, marine biology, climate change) takes away from the real meat of the subject. Aren't wave equations, the memorization of water-mass densities, and carbonate physics worth proportionally more time? I would argue that, for a predominantly non-majors course, the answer is no. If your general students leave each day's lecture thinking, "That was cool—I can't wait to tell somebody what I learned today," we win.

There's another advantage to this plan. Good students often over-enroll with the intention of dropping classes with which they're not connecting or that are taught by uninspired instructors. Make your class a keeper!

What about advanced courses?

Our department requires its majors to complete a general course (Marine Science 100, as just described) before tackling more advanced subjects (physical and coastal oceanography, marine biology, island ecology, etc.). Here is the place for the aforementioned meat. These students are simultaneously working through the chemistry, calculus, physics, and biology courses needed to understand water masses, carbonate balance, and tides. Now Coriolis acceleration can be given a mathematical underpinning rather than just a vigorous arm-waving. You're free to discuss your dissertation (within limits, please).

So, that session in the quiet and dark room with the well-chewed pencil really has two parts: The survey course part and the majors course part. Yes, you can have your cake and eat it, too!

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