Statement on Educational Backgrounds of Marine Science Faculty

Oceanography, the study of all aspects of the oceans, is a very complex discipline, and many terms have been applied to describe its components. Marine Science is considered a synonym for Oceanography, and so our college is called the USF College of Marine Science, or CMS.

The fundamental concepts of Oceanography have been divided into four groups that, taken together, apply to or cover all of the major processes within the oceans. Not surprisingly, the four groups are aligned with four major academic sciences: physics, chemistry, biology, and geology.

Physical oceanography emphasizes the circulation of ocean water at all depths and all time-and-space scales. It is concerned with the distribution of the Sun's heat, the effects of prevailing and occasional winds, the impact of tides, and frictional and other interactions at the ocean's boundaries. Ocean-atmosphere interaction and dynamics also play a major role in the study of ocean physics, and theoretical principles of fluid dynamics are readily transformed to the study of the ocean, the most massive accumulation of fluid on the Earth's surface.

Chemical Oceanography, sometimes called Marine Chemistry, considers all of the dissolved and particulate components in the ocean that might become involved in chemical reactions, both biologically influenced and biologically independent, on virtually all time scales from nanoseconds to millions of years. Some of these components are: inorganic ions like magnesium or chloride that exist in high concentrations, minor or trace substances like nitrate or iron that are quite reactive on short time scales, various particles like biological organic debris or minerals, dissolved atmospheric gases like oxygen or carbon dioxide, and stable and radioactive isotopes like carbon-13 or tritium that provide time clocks for or details of chemical processes.

Biological Oceanography, sometimes called Marine Biology, is the study of everything in the sea that has characteristics of life, from viruses to whales. It considers the nature of their interactions, often referred to as marine food webs, and the exterior physical or chemical influences on those interactions. Virtually all of the established aspects of biology, such as ecology and molecular biology, are applied in some fashion to the study of biological oceanography, and some of the most interesting and critical <u>biological</u> questions are in fact marine. The ocean is by far the largest ecosystem on the planet!

Geological Oceanography, sometimes called Marine Geology, covers a vast range of time and space scales since it considers processes that occur in minutes over millimeter-scale distances as well as processes that effect entire ocean basins and continents over time spans of millions of years. Its focus is more on the lower boundary of the ocean, the sea floor, than ocean water *per se*, but processes in the water like the growth of organisms that make shells have considerable impact on the geology of the sea floor. The use of stable and radioactive isotopes has been especially beneficial in sorting out geological history and processes, but conventional sedimentology is a mainstay of the study of the materials that pile up on the sea floor.

Oceanography may be the most inherently interdisciplinary of all academic disciplines because potentially most or all of the processes studied by the four subdisciplines function most or all of the time. Unless one understands how and why the water circulates, for example, one cannot explain many biological, chemical, or geological features of the sea. Marine food webs are affected by both the chemicals and the debris in the water, and, as mentioned, living organisms can be very important suppliers of sediments to the sea floor. So oceanographers by necessity have had to learn more than the particular subdiscipline that they have chosen. Conversely, scientists studying one of the mainline sciences can find that their research interests ultimately lead them into the study of the oceans; marine-related aspects of their science prove to be the most fruitful avenues for them to pursue. Such a transition is a natural outcome of intellectual curiosity and investigation, and they find that they must acquire a knowledge of oceanography in order to proceed with their research.

Oceanography is replete with examples of scientists from other disciplines who have "made the switch" and have become leading oceanographers. The link between geology and geological oceanography provides many fine examples because the oceans lie in the major basins on the Earth's surface and are underlain by a much thinner crust, which is composed of substantially different minerals than the continents. Yet one cannot understand crustal processes in one region without considering the other. Thick continental crustal plates and thin oceanic plates are both affected by Earth's plate tectonics. Likewise, the study of sedimentary rocks on land absolutely requires an understanding of marine sedimentary processes. Thus both geophysicists and sedimentary geologists make the transition to oceanography fairly often. Biology provides other examples. The principles of photosynthesis apply equally to both land plants and marine plants, and, since the annual amount of carbon fixation by plants in the sea is very close to the annual amount of carbon fixation by land plants, one cannot understand the impact of plants on the Earth without studying the ocean. Similarly, the principles of ecology and ecosystems apply to both sea and land, and the massive size of the ocean ecosystem cannot be ignored when studying global biology. Meteorologists shift over to being physical oceanographers because (1) the ocean is a major driver of weather and climate and (2) the principles of fluid flow apply equally well to the atmospheric fluid (air) and the oceanic fluid (water). The fact that scientists, or university faculty, making the transitions to oceanography have terminal degrees in other disciplines has only positive results. Oceanography has developed in vital new directions because of the outside expertise that they bring!

Thus among the teaching faculty in the USF College of Marine Science can be found individuals with advanced and/or terminal degrees in many disciplines: geology or geological science, ecology, atmospheric physics, several types of oceanography, marine science, earth science, biology, environmental science, and, most recently, chemical engineering. This individual is an expert on techniques for measuring aspects of living cells and particles that apply extremely well to marine samples. All of these individuals bring expertise that is designed or can be adapted to advance the study of the oceans, and all of them have had to learn enough about the many aspects of oceanographic processes to make the necessary adaptations and successfully transmit their knowledge to marine science students.

This general introduction explains the nature of oceanography as well as the reasons why several CMS faculty at the University of South Florida have degrees in non-oceanographic sciences. It should be noted that, in this regard, CMS is no different than any of the larger and older oceanographic institutions in the US. CMS follows a well-established practice and tradition.