Curriculum Units by Fellows of the Yale-New Haven Teachers Institute
2007 Volume IV: The Science of Natural Disasters

Introduction

Earth is a highly active, mobile and, at times, hazardous planet. Earth's violent activity arises not only from its oceans and atmosphere, but also from its deep interior as well its orbital journey through a debris-filled solar system.

The Earth's deep interior is continuously turning itself inside out through the action of convection (hot material rises, cold material falls), leading to plate tectonics, and hence earthquakes and volcanoes. Such phenomena are powered by heat flow from the planet's interior. In contrast, the power received from outside the planet, from the Sun, is tens of thousands times greater and drives more frequent disasters in the atmosphere and oceans in the form of hurricanes, mid-latitude cyclones (i.e., nor'easters), thunderstorms, and tornadoes. Finally, huge quantities of energy are released upon the rare but catastrophic collisions with space objects such as Earth-crossing asteroids.

This seminar was designed to study the science of some of the most prevalent and/or catastrophic natural disasters. Such natural hazards are not only of enormous societal importance, but the variety of scientific processes acting during disasters provides a profound window into the both the origins and workings of our planet. Seminar meetings covered a wide range of topics, including the following:

1. The energy sources that power natural disasters
2. Plate tectonics
3. Earthquakes: principles and events around the globe
4. Volcanoes: volcanism at plate boundaries and volcanic eruptions
5. Climate change
6. Weather and atmospheric circulation
7. Tropical cyclones: Hurricanes, Cyclones and Typhoons
8. Storms, Tornadoes and Lightning
9. Space objects, impact disasters and extinctions
10. History of life, human impact, population growth

The seminar focused primarily on elucidating the common scientific themes that thread through our understanding of all disasters, primarily relating to both the Earth's solid interior and its atmospheric envelope. This approach is required for using disasters as a vehicle for employing basic physics, chemistry and math in learning how the Earth works. Resources for this seminar were largely derived from standard college texts (e.g., *Natural Disasters* by Patrick Abbott). Internet sources were made available on the seminar Web page and were drawn from government science agencies such as the U.S, Geological Survey (USGS), National Oceanic and Atmospheric Administration (NOAA), National Science Foundation (NSF) and National Aeronautics and Space Administration (NASA).

The seminar was designed for any level of K-12 course, and the 2007 seminar Fellows were from the full range of grades in subjects ranging from non-fiction literature and social-studies (history, geography) to upper-level math and science. For elementary and middle-school classes, the material may be used for basic earth/environmental science class work and any other related subject. For high school classes, the topic of natural disasters can be used for showing how math, physics, chemistry and biology are employed in studying topics of enormous societal, ecological and environmental impact.

The seminar units that were developed could be roughly categorized as (1) themes common to all disasters (e.g., convection, energy sources, and disaster cycles); (2) extreme weather, global warming and the effect of global warming on extreme weather; (3) earthquakes and tsunami; and (4) the application of natural disasters in core disciplines such as mathematics, geography, literature (non-fiction), and social studies. These units provide a broad sampling of the many themes covered by this field and give fine examples of how the material can be applied across different grades and classes.

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