Reports from Other Journals

News from Online—Smithsonian's *Dig It!* Web Site Shows That Soil Is Not a Dirty, Four-Letter Word

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Observed from space, the chemistry of Earth's atmosphere is highly unusual and can be explained only by the dramatic effects of life on the distribution of elements. Half of Earth's biological activity takes place on land, particularly in soils. Yet most of us are far less conscious of "land" or "soil" than we are of air and water. To celebrate the Earth is to celebrate its soil, a vast and unseen world of microbes and plants that together dominate our planet's water and element cycles. Educating students about the secrets of soils is now far easier than before, thanks to a new Web site developed by the Smithsonian Institution. The Web site is a virtual version of an award-winning exhibit called *Dig It! The Secrets of Soil (1)* that provides fun and illuminating teaching resources. We encourage you to celebrate Earth Day 2010 by sharing the inspiring story of soils.

Using the Web Site

For people who think of soils as a rather dry or boring topic concerned with the erosion of brown dirt, this Web site will be a pleasant experience. Visitors may be surprised to learn that soils come in every color of the rainbow, that they keep rivers supplied with clean water, and that they influence climate. Far from being a collection of lifeless inorganic minerals, soils teem with life, flow with water, and breathe gases. There are more microorganisms in a teaspoon of soil than there are people on Earth.

What Will Visitors Find?

Dig It! was designed to engage students of all ages. It takes a big-picture view of the topic by illustrating soils at the center of both human-made and natural ecosystems such as farms, cities, forests, grasslands, savannahs, wetlands, and tundra. Thus, kids with a wide range of interests and experiences can relate to the topic at a personal level. Compared to traditional educational treatments of the topic, the Web site does not emphasize agriculture over other topics.

Videos and interactive games are woven throughout the Web site, making it both informative and entertaining. In one video *(2)*, students learn why so many types of soils exist by watching two chefs compete to make the best soil from a single starting ingredient: sand (Figure 1). One chef creates a bog soil; the other makes a colorful forest soil. The video illustrates how subtle interactions among environmental factors produce a vast variety of soils, numbering more than 20,000 types in the United States alone. A six-minute video titled *Soil Science Investigations* follows a team of soil detectives as the detectives solve a murder mystery *(3)*. In the process, the audience learns that microbes decompose dead plants, thereby converting nutrients back into forms that can be used by plants. As the video notes, "soils are nature's ultimate recycling bin". The movie intersperses live actors with animations that help students visualize the activity of microbes. For example, animated microbial cells release extracellular enzymes that break apart organic matter and release nutrients. Other videos combine sound and rich images to introduce students to the surprising everyday objects manufactured from soils *(4)* and the negative impacts of human activity on soils *(5)*. Students can play a quiz game that teaches them about surprising ways that soils affect the planet *(6)*. In another game, you can play "farmer" and choose which crops to grow and how much fertilizer to add in order to get a good harvest while minimizing greenhouse gas emissions *(7)*.

Of Special Interest to Chemistry Teachers

Teachers can use the *Dig It!* Web site to address learning goals for chemistry. There are several sections where links can be made between chemistry and the life sciences. For example, the difficult topic of reduction—oxidation chemistry is introduced as a key feature of microbial respiration. The exhibit explains how soil microorganisms take electrons from organic compounds and combine them with oxygen, nitrogen, sulfur, and other elements to "breathe". The site also mentions that microbes in the soil add electrons to PCBs, arsenic, and uranium to transform the harmful chemicals into less-toxic chemicals. Perhaps the most surprising link between microbes and redox chemistry is a toy car powered by soil microbe-generated electricity *(8)*. There are references to elements bound into both organic compounds and inorganic compounds such as primary and secondary minerals *(9)*. Organic carbon cycling is addressed from many perspectives, including the fixation of carbon dioxide in photosynthesis, its release in respiration, and the consequences of these processes for global climate *(10)*. Polyatomic ions essential for plant life such as phosphate, ammonium, and nitrate are described in the context of natural and synthetic fertilizers. Acid—base chemistry is addressed with a true story about a suburban housing development built on a type of soil that generates acid when excavated. Residents of the development were unable to grow grass until they applied 12 tons of lime per acre *(11)*.

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Figure 1. Scenes from the "Soil Chef" cartoon showing the live actors who played competitors Pierre LaTerre and Sandy Marsh. The cartoon judges (top right) included a box turtle, a methane-making microbe, and a thrush. The chefs created a forest soil (middle right) and a bog soil (bottom right).

Check It Out!

Soils are every bit as fundamental to life on Earth as air and water, and they are an inspiring, fascinating, and largely unseen world where chemistry abounds. Come to the Smithsonian's *Dig It!* Web site to explore the realm where the atmo-, hydro-, geo-, and biospheres all converge. Whether part of a special Earth Day celebration or folded into the regular curriculum, both teachers and students alike will find the *Dig It!* site to be both fun and informative.

Acknowledgment

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