



## Soil Science Education for Primary and Secondary Students

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Soils is one of the science investigation areas in the Global learning and Observations to Benefit the Environment (GLOBE), an international science and education program (112 countries) that teaches primary and secondary students to learn science by doing science. For each area of investigation GLOBE provides background information, measurement protocols and learning activities compiled as a chapter in the GLOBE Teacher's Guide. Also provided are data sheets and field guides to assist in the accurate collection of data as well as suggestions of scientific instruments and calibration methods. Teachers learn GLOBE scientific measurement protocols at professional development workshops led by scientists and educators, who then engage their students in soil studies that also contribute to ongoing science investigations. Students enter their data on the GLOBE website and can access their data as well as other data contributed by students from other parts of the world. Soil characterization measurements carried out in the field include site description, horizon depths, soil structure, soil color, soil consistence, soil texture, roots, rocks and carbonates. Other field measurements are soil temperature and soil moisture monitoring while the following measurements are carried out in the classroom or laboratory: gravimetric soil moisture, bulk density, particle density, particle size distribution, pH and soil fertility (nitrogen, phosphorus and potassium). Learning activities provide support for preparing students to do the measurements and for better understanding of science concepts. Many countries in GLOBE have adopted standards for education including science education with commonalities among them. For the Teacher's Guide, the National Science Education Standards published by the US National Academy of Sciences, selected additional content standards that GLOBE scientists and educators feel are appropriate and the National Geography Standards prepared by the (US) National Education Standards Project, are being used. Educational objectives for students include gaining scientific inquiry abilities in addition to understanding scientific concepts. The Soils chapter also includes some suggestions for managing students in the field and classroom. A new protocol has also been developed by the Seasons and Biomes project, one of the GLOBE earth system science projects. Active Layer monitoring uses a Frost Tube that measures when and how deeply soil freezes and is currently being used in more than 200 sites in Alaska. Teachers have successfully implemented soil studies in their curriculum and have used it to teach about the science process.