

## Digital resources for teaching geochemistry

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The *On the Cutting Edge* (NSF grant Grant DUE-0127310) faculty development program supports on-line resources to improve teaching geochemistry, petrology and mineralogy. Included in these collections are a) internet resources that are useful for designing and teaching courses, including lecture notes and PowerPoint presentations with images, illustrations and diagrams, course syllabi, projects, and online galleries of photomicrographs; b) activities and examples of educational resources including classroom exercises, labs, and problem sets; c) an analytical equipment database useful for researchers, instructors and students looking to gain access to analytical instrument and for lab managers seeking to extend their user base; d) listservs and working groups to facilitate networking among faculty; e) journal articles that are useful for teaching; and f) information about the agenda and outcomes of related workshops. Searching for resources is facilitated by faceted search capabilities developed at the Science Education Resource Center (SERC), Carleton College, and allows users to refine their queries according to topic, resource type, application, tectonic or geologic setting, Earth process, or type of Earth material. These collections are linked to related collections at SERC that include strategies, methods and resources on effective instruction in the geosciences. Contributions by colleagues from all fields of geochemistry, mineralogy and petrology are invited and encouraged, and can be submitted via the websites.

Websites for SERC, On the Cutting Edge, Teaching Geochemistry, Teaching Mineralogy, and Teaching Petrology are listed respectively below:

<http://serc.carleton.edu>

<http://serc.carleton.edu/NAGTWorkshops/index.html>

<http://serc.carleton.edu/NAGTWorkshops/geochemistry/index.html>

<http://serc.carleton.edu/NAGTWorkshops/mineralogy/index.html>

<http://serc.carleton.edu/NAGTWorkshops/petrology/index.html>

## Teaching mineralogy with crystal structure databases and visualization software: A digital resource collection

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Perception and understanding of three-dimensional crystal structures is a source of difficulty for many introductory mineralogy students. Traditionally, physical models (e.g., "ball and stick" and polyhedral models) have been used to ameliorate this problem. With newer computational and graphics technology, however, large online crystal structure databases (e.g., the American Mineralogist Crystal Structure Database) and software for visualizing and manipulating crystal structures (e.g., XtalDraw and CrystalMaker) are also available. We believe that the full potential of these new tools for enhancing and improving the teaching of crystallography has not been fully explored.

As part of a multipronged effort to integrate research and education, we have created a digital resource collection ([http://serc.carleton.edu/research\\_education/crystallography/index.html](http://serc.carleton.edu/research_education/crystallography/index.html)) on the Science Education Resource Center (SERC) website devoted to exploring novel ways to apply crystal structure databases and visualization software in undergraduate geoscience courses.

The sample exercises included in the collection are designed to complement class lectures and highlight diverse ways by which the new databases and visualization programs can be used to facilitate discovery-based explorations of crystallography and crystal structures. Example exercises include: directed discovery of crystal structures using visualization software, identifying minerals using chemical and crystallographic data, order/disorder within crystal structures as a function of temperature, variation of a crystal structure with pressure, structural change through a phase transition, and crystal structures as geobarometers. Guided with detailed tutorials and step-by-step instructions, students are led into the databases to retrieve crystal structure data, and then use crystallographic visualization software to manipulate, investigate, and interpret the data to answer a series of questions. Answers are provided in hidden tabs for many of the questions, and connections to research results published in the mineralogy and petrology literature are made throughout the site.