Final Report, April 14th, 2008
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Project: Software to Support Nanoscience Outreach Education

Overview:

The NWACC funded project, “Software to Support Nanoscience Outreach Education” was successfully completed and the outcomes of the project are described here. A final version of the software is complete and available on line at http://map.chem.pdx.edu/. The software was used to create maps of chemically related objects found in the real world. Outreach classes were taught using the software in conjunction with chemical analysis tools to teach chemistry concepts to students grades 7-10 while engaging the students in the topic.

Software:

The Academic and Research Computing (ARC) department at PSU developed software that couples an image database with an online map interface and an online periodic table. The interface allows users to create maps consisting of images of naturally occurring and synthetic materials in the world around them. The object information, related images, and metadata are stored in a database. ARC has incorporated a general layout design that includes all functionalities, links to each feature, and a visual display with header and graphics.

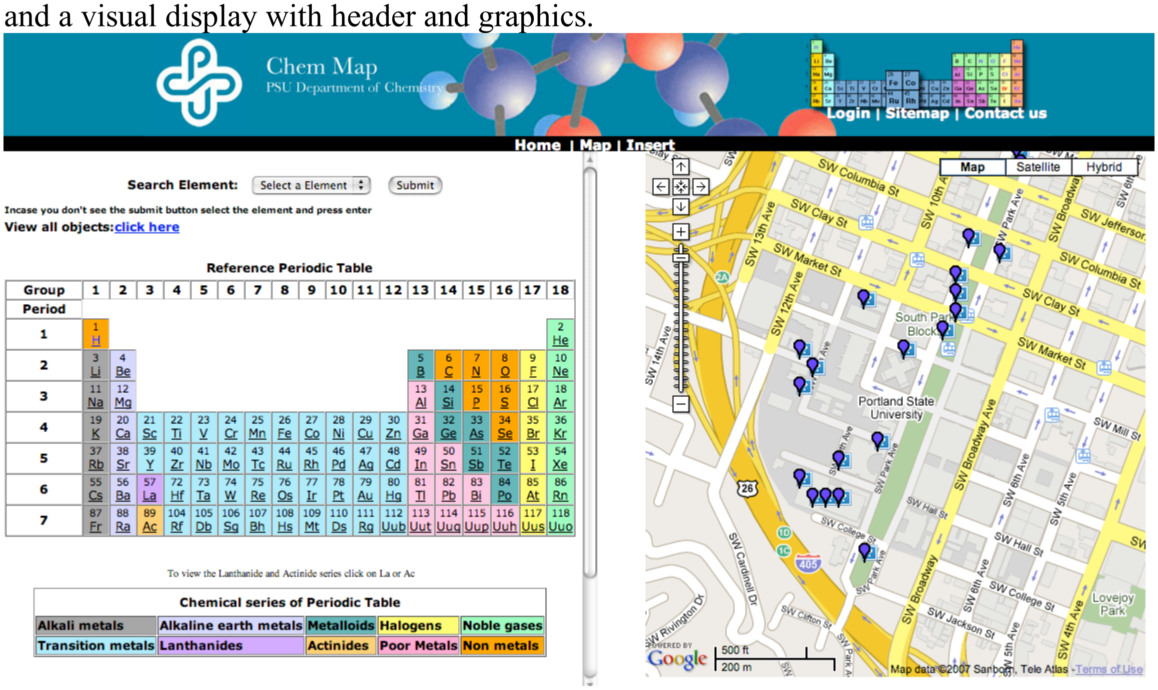

Figure 1. Screenshot of http://map.chem.pdx.edu/ website.

A table was designed to store student images and GPS metadata as well as object descriptions. Recorded photographs in digital format and data that was related to the photographs were used to create a map of everyday objects. By appending chemical identifiers to each object, the maps become a catalog of chemical information. The photographs and data are stored in the database. ARC has improved the software based on feedback from the instructors and students. The standard layout (Figure 1) shows the Periodic Table, a drop down list of elements, a map and links for logging in and viewing all objects posted.

The webpage is designed to give access not only to individual students, but also group accounts and administrators. Administrators are allowed to make changes such as erasing incorrect GPS coordinates or exchanging pictures for more updated data. Any user is allowed to upload data such as SEM images, UV-Visible Spectra or digital photos. GPS coordinates are easily stored from Exchangeable Image File (EXIF) format taken from a GPS unit, cell phone or simply by clicking on the map.

The interactive periodic table gives users the ability to pinpoint objects on the map that contain a particular element by clicking that element (Figure 2). In addition, a drop down menu gives alphabetically ordered list of the elements. By selecting a particular element, objects are displayed on the map giving examples of where that particular element is found in the real world and the precise location where it can be found. This can be used not only for mapping elements found, but also for creating scavenger hunts for students to discover on their own these elements and their uses.

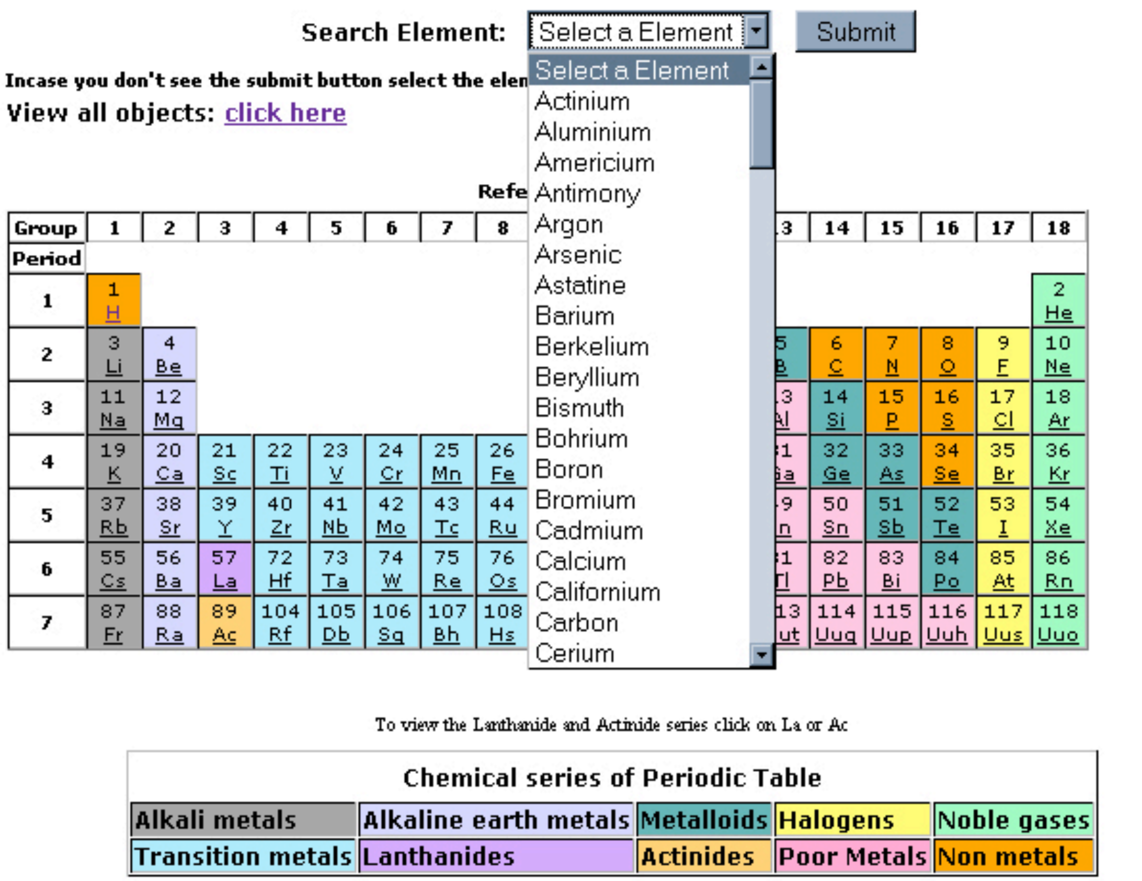

Figure 2. Screenshot of Periodic Table and drop down menu for selecting elements.

Outreach Classes:

Three classes were taught with students grade 7 through 10. Classes were organized by Saturday Academy and held in the chemistry labs at Portland State

University. The first class meeting focused on training the students in use of the webpage and techniques for identifying chemical composition in the lab. Experiments were designed to show students how these concepts can be used. The second class meeting focused on letting the students independently perform experiments on samples and design their own procedures for these experiments. This hands on approach made students enthusiastic about the field as seen in their feedback after classes.

Students went out into the area surrounding PSU to photograph and collect samples of materials they encounter everyday. Upon returning to the lab, they added their data to the database, creating maps of those elements (Figure 3). Experiments were performed to analyze samples they collected. Other experiments were performed to help elucidate the processes that are used to make these materials. Experiments consisted of synthesizing gold nanoparticles, flame testing of materials, UV-Visible spectroscopy of materials synthesized, and fabrication of solar cells. Students also used an FEI Phenom Scanning Electron Microscope (SEM) to take images of samples collected.

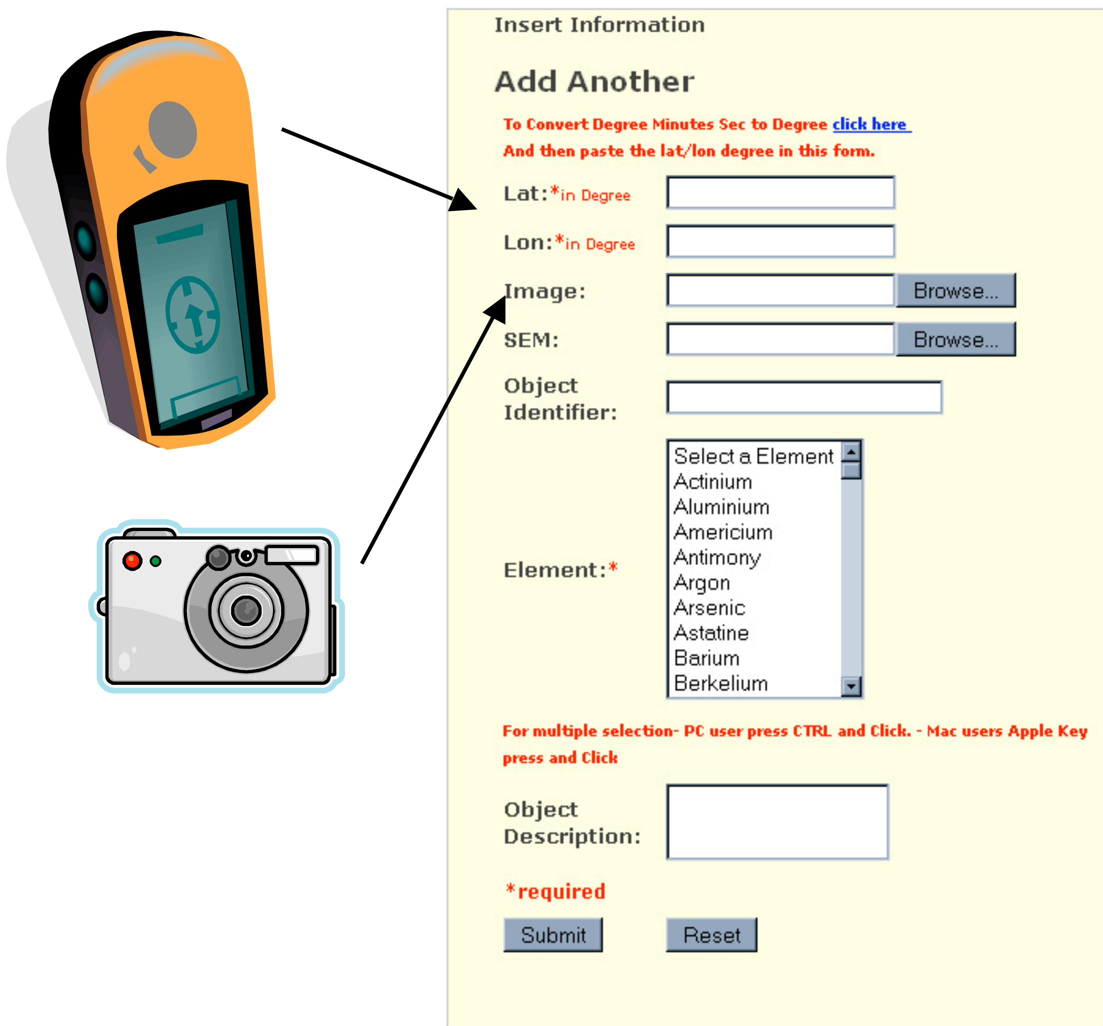

Figure 3. Screenshot of data input form from http://map.chem.pdx.edu/

The students were split into two groups and a competed to determine which group could identify the most elements. By allowing them to compete, students were more proficient at identifying new ideas of sources of elements. Feedback from the students expressed their enthusiasm towards not only the geocaching portion of the class, but also towards the experiments they performed to synthesize materials. Using this feedback, instructors were able to find new experiments to perform with the students and also make changes to the software itself to help simplify the database entry for students. Students quickly adapted to the software as well as the interfaces used for the SEM and UV-Vis spectrometer.

Using the "Software to Support Nanoscience Outreach Education," students were taught the importance of materials in real world applications. They were allowed to map these materials and then perform experiments to analyze their function. Students were given independence and allowed hands on approaches to this end making them more enthusiastic about the class. The feedback returned from the students allowed us to make adjustments to the curriculum and helped to streamline future classes.

Impact

To ensure that the project has a substantial impact, efforts have been made to publicize the results from this pilot project. A paper has been submitted to the Journal of Chemical Education, describing the web site and its utility in a variety of informal and formal education settings. The Journal of Chemical Education is the premier journal for disseminating novel methods of teaching chemistry. It is read by chemical researchers and educators at all academic levels. Through this venue, it is hoped that a broad audience will be reached. Furthermore, a poster describing this project was presented at the National American Chemical Society meeting in New Orleans on April 6th, 2008. This meeting draws over 15,000 attendees representing chemists from around the world. We anticipate that these two efforts will improve the visibility of the project and create opportunities to partner with additional educators. Through these presentations and publications, the impact of this project will expand beyond the PSU campus.

Closing financial statement

All funds have been expended according to the guidelines defined by the NWACC.