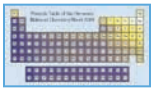
Report



# A Research Paper on the Elements, in 3-D

by Laura E. Slocum

An icosahedron is the Platonic solid with the largest number of faces—20; in a regular icosahedron, each of the 20 faces is an equilateral triangle. I use the icosahedron as the basic form for a very successful and popular student project that involves the elements.

In this combination research project and construction activity, an icosahedron represents one of the 111 elements on the periodic table. Each student researches an element and puts information about it on the faces of the icosahedron. The information that the students research about their selected element includes:

- Discovery: how, when, where, and by whom
- Physical properties (at least five)
- Chemical properties (electron configuration plus at least four others)
- Uses of the element (at least five)

## How the Project Evolved

Gathering scientific information is quite different from researching information for a historic event or literary work, something students do in their other courses. I wanted my students to learn how to find and catalog information in scientific literature and journals; however, I did not want them to write yet another typical research paper. When I started using this project about 14 years ago at the school where I was then teaching, students were already writing 2–3 research papers each year in their humanities classes. Quite honestly, I did not want to grade another research paper; grading all their lab reports was enough! So, I looked for a unique way to incorporate a meaningful research project into my first-year chemistry course.

In the summer of 1994, I attended my first Biennial Conference on Chemical Education (BCCE) at Bucknell University where I met Jeff Hepburn. Over lunch on the last day of the conference, Jeff and I talked about various projects we had tried in our classrooms. That's when he told me about his "Element Ball" research project. I was captivated by the way he described it and asked him if he would send me his directions. Not only did he send me his directions, he also sent several photographs of the icosahedra that some of his students had made. I was hooked!

This was just the type of research project I wanted for my students. They could use various types of scientific literature to find information about the element that they chose to research, but they would not be writing a paper. Instead, they would find and catalog the information in the form of lists, diagrams, pictures, or reactions and then place that information onto the 20 faces of their icosahedron (Figure 1).

I took Jeff's directions (see online supplement) and made some modifications for my own students. My changes focused on the use of various scientific sources—journals, reference books, CD-ROMs, the Internet, etc. My students also had to prepare a rough draft bibliography and note cards for the "faces" of their icosahedron, which they turn in prior to completing their icosahedron and final bibliography.

I give my students one lab period and one class period to research their element during which I am available to answer questions and help them navigate through the various scientific sources. I also teach them how to cite scientific sources for the information that goes on their note cards and "faces" (Figure 2), and how to assemble an icosahedron from the 20 individual triangles.

photos by Laura Slocum

Figure 1. A view across a row in the periodic table.

Once the students turn in their rough draft bibliography and note cards, I grade them and return them the next day. The icosahedron and final bibliography are usually due about a week later; once I have graded these, I hang the icosahedra on the ceiling in my classroom according to each element's location on the periodic table—thus my classroom ceiling is one huge periodic table (Figures 3 and 4). At my first school, it took me two years to assemble a complete table. At my present school, it has taken me four years, but I have now rotated the table through almost two complete turnovers. When alums return, it is one of their favorite things to revisit—the first thing they do is check to see if their icosahedron is still hanging in its correct place on my periodic table.

## History of This Activity

As I mentioned earlier, Jeff Hepburn shared this idea with me; however, he is not the Element Ball's originator. He learned about it from Steve Long. Steve and Jeff have both talked about the Element Ball at various conferences and workshops throughout their teaching careers; their directions for using and grading the Element Ball in their own teaching are included in the online supplemental materials for this article. Steve was introduced to the Element Ball at a CAST (Conference for the Advancement of Science Teachers) meeting in the early- to mid-1980s. Steve Long doesn't remember who introduced him to the Element Ball project. A number of people were contacted at the Science Teachers Association of Texas, but no one knows exactly who started the idea. But it is a project that many teachers have picked up over the years, incorporated into their classrooms, modified to fit their teaching style and students, and continue to use.

When I returned to graduate school at Ball State University in 1999, I made a number of modifications to this project. I was taking a graduate course called Reading Across the Curriculum in which I had to develop a WebQuest. Like most of us taking education classes, I thought, "not another hoop to jump through, please". Then I remembered my Element Icosahedron project. (I had changed the project name from Element Ball to Element


photos by Laura Slocum

Figure 2. Here are close-up views of the triangular sides of example icosahedra: the bottom of the xenon icosahedron (left); side and bottom triangles of scandium (note the "1" in the "blue face", which serves as the mark for the reference on the final bibliography) (second from left); two bottom triangles for radium (third from left); and the sides and bottom of the seaborgium icosahedron (right).

Figure 3. Here we see the middle of the periodic table from transition metals over to Group 1.

Figure 4. Here we look at the periodic table from the lanthanides and actinides.

photos by Laura Slocum

Icosahedron after the first year I used it, when one of my students said to me, "Ms. Slocum, this is not a ball." I had to agree.)

So, in that education class, my Element Icosahedron project took on a whole new look *(1)*. I no longer give my students any handouts. Everything they need, except for due dates, is on the WebQuest. I have also added a concept map because I find that students have a lot of trouble differentiating between physical and chemical properties. Part of this confusion is because of the way some information is posted on various Web sites; I have found that some of these misconceptions were corrected when a concept map is a part of the student's note cards.

At my present school, the faculty has agreed to all use MLA citation format for citation. I make sure to reinforce the use of this citation method—for my students and for myself—in the rough draft bibliography.

I have found this to be a very useful project for my students. I talked about this project in my Especially column in the July 2007 issue of this *Journal (2)*. As I mentioned, I had my students make a different project that year, but it was not as instructive as the Element Icosahedron project. This past school year all the students did the icosahedron project again.

## Acknowledgment

I thank Erica Jacobsen, Secondary School Editor, for her invaluable help with researching the history of the Element Ball/Icosahedron activity. I thank my brother, Chris Sarjent, for guidance as well as the use of his camera to take the photographs of the icosahedra in my classroom.

## Literature Cited

1. Slocum, Laura E. Element Icosahedron WebQuest *http://www.universityhighschool.org/webquest/chemhmwrkwebquest.html* (accessed Jun 2009).
2. Slocum, Laura E. *J. Chem. Educ.* **2007**, *84,* 1081.

## Supporting *JCE Online* Material

*http://www.jce.divched.org/Journal/Issues/2009/Oct/abs1142.html*

Abstract and keywords

Full text (PDF) with links to cited URLs and *JCE* articles

Supplements

Icosahedron patterns, project guidelines, and sources of electronic information

Jeff Hepburn's directions

Steve Long's directions

*Laura E. Slocum teaches chemistry at University High School of Indiana, 2825 W. 116th Street, Carmel, IN 46032;* lslocum@universityhighschool.org.