Ideas for Using the Poster "Inside the ALS"

The Advanced Light Source (ALS) is a really big tool used to "look" at really small things. "Inside the ALS" intends to share with you and your students the wonder and excitement of one of the newest research tools in America and the world's brightest source of light from ultraviolet through soft x rays. The poster can be used as a classroom resource for a variety of topics, such as light, magnets, electricity, optics, technology, and powers of ten (to list just a few), over a broad range of grade levels.

The following are some ideas for how the "Inside the ALS" poster could be used with your students, whether or not you are able to make a field trip to Lawrence Berkeley National Laboratory and visit the ALS.

For additional copies of the "Inside the ALS" poster, contact
ALS User Office [(510) 486-7745].

For more information about the ALS, contact
Elizabeth Moxon [(510) 486-5760 or ejmoxon@lbl.gov].

1. Set up a treasure hunt around different ideas found on the poster. Of course, the questions you choose for your students will depend on their abilities and your curricular focus. Here are a few sample ideas:
    - Describe one way in which the ALS is like a light bulb.
    - Describe one way in which the ALS is different from a light bulb.
    - Find one example of how the ALS can be used to benefit people.
    - Locate the x-ray man and everywhere else that x rays are mentioned on the poster. Discuss how people use x rays to see things they can't see with visible light (teeth, bones, luggage at airport security, etc.).
    - Name two ways in which "soft" x rays are different from "hard" x rays.
    - What part of the ALS is responsible for the greatest acceleration of electrons? (Show your calculations to justify your answer.)
    - List two different places where magnets are used in the ALS and describe what the magnets are used for. Determine whether they are permanent magnets or electromagnets and explore the differences. Think of other places where magnets are used in daily life.
    - Write down three things that you understand from the poster.
    - Write down three things that you would like to know more about.

2. Have students make their own posters to illustrate the intersections between science, technology, and society as well as to demonstrate their understanding of how function follows form. The ALS poster can be used as an example for students to see how their own posters can include information about
    - what the invention or technology looks like
    - how it works
    - what it is used for
    - how it is potentially beneficial and potentially hazardous to people
    - what key scientific concepts make the technology functional

3. In preparation for a field trip to the ALS, students can read the poster and imagine what the ALS really looks like inside. They can make a pre-trip written description or drawing showing how big they think the ALS is, what it might look like on the outside and inside, and what the people who work there will be doing. Students can brainstorm about questions they want to ask when they visit the ALS.

4. Take some chalk, go outside, and draw the pieces that the students remember from the poster to make a "virtual ALS." Let the students be virtual electrons by following the path

an electron takes at the ALS, starting at the electron gun and continuing through the linear accelerator (linac), booster ring, storage ring, and undulator. For example, they could speed up in the linac, throw out something that represents light (photons) when they go around a curve, etc.

5. Many visitors to the ALS are amazed that a machine the size of a football field is used to produce an electron beam the width of a hair, and that the electron beam in turn produces a scientifically useful beam of light (x rays) that can be smaller than one-fifth the width of a hair when it hits an experimental sample. In order to explore the "powers of ten" aspects of the ALS such as size, speed, and time, try some exercises to make connections between things students know and what appears to be unfathomable. Some examples:
    - Speed and Distance. Get students to close their eyes and count to 9 or 10, then let them figure out how far an electron bunch traveled at the ALS while they were counting. Draw a relationship to other distances by figuring out how many times something traveling so close to the speed of light would have gone around the world in that amount of time, gone to the moon and back, etc. Figure out where the electron bunch would be in the ALS. (Is it in the booster ring? the storage ring? How many revolutions has it completed?)
    - Size. Have students think about the size of a football field (the ALS) compared to the size of an atom (hint: 50,000 carbon atoms could sit side-by-side on the width of a strand of hair). Using the electromagnetic spectrum at the bottom of the poster, determine what wavelengths of light would be able to "look inside" something as small as an atom. Then consider a water molecule (How big is it? How many atoms are in it?) and figure out the frequency or wavelength of light that would be able to look at molecular structure. Have students compare objects in terms of atomic, molecular, and cellular size and consider how one could study them and what "tools" you would need: an x-ray machine? the ALS? a light microscope?

6. When learning about relationships between advances in science, advances in society, and advances in technology, have students brainstorm about different ways in which we are able to see or detect things that are very far away, very small, or in hard-to-reach places. Think of how tools from telescopes to light microscopes to scanning tunneling microscopes have allowed us to "see" things that we were not able to see before. How have these new capabilities to probe deeper and farther provoked profound societal changes? Consider some of the research being done at the ALS: What kind of impact do you foresee in terms of technological and social advances?

7. Let students imagine that they are scientists and that they can look into many tiny things using the "bright" light of the ALS. What would they like to look at? What kinds of questions would they ask? Why would they want to study this particular thing? How could this knowledge be used or how would they want it to be used?

Comments Welcome!

We welcome your criticisms, suggestions, helpful hints, and any other information that will help us improve these curriculum ideas. Please send your comments to:

Elizabeth Moxon, Berkeley Lab, MS 4-230, Berkeley, CA 94720
Tel: (510) 486-5760, Email: ejmoxon@lbl.gov.