Classroom Lesson Development

Title of Lesson	**Powers of Ten and Nanotechnology**
RET Project Connection	We work in the High Rate Nanomanufacturing Center at UMass Lowell, and the idea of a nano-sized scale is directly related to the work we do.
RET Teacher	Ryan Hoffman
School	North Reading High School
Town/District	North Reading, MA
Subject(s) taught	C++, PreCalculus, Calculus
Subjects covered in lesson	Powers of ten, general idea of and applications for nanotechnology
Grades appropriate	9 through 12
Lesson duration	78 (probably 2 lessons)
Goals/Objectives of lesson	To Introduce the idea of nanotechnology and help the students understand why it is and will be extremely useful to our society.
Background information	Nanotechnology means working with extremely small materials. About 10 atoms lined up in a row would be about 1 nanometer in length. Scientists with the right equiment and knowledge can manipulate individual atoms and form new and possibly better materials. It has been postulated that this technology could create another industrial revolultion with even more ramifications than the first one.
Essential questions	What does nano mean? Why is it good to talk about?

Links to Frameworks and Standards

National	NM-NUM.9-12.1
	• develop a deeper understanding of very large and very small numbers and of various representations of them
State	8.N.4 Represent numbers in scientific notation, and use them in calculations and problem situations
Local	8.N.4 Represent numbers in scientific notation, and use them in calculations and problem situations
Materials required	Laptop w/ projector and internet connection. Lab with internet for students. Posters and crayons/markers for student presentations.

Lesson development

Show students the "Powers of Ten" video, perhaps on a projector. Go to http://www.youtube.com/watch?v=qrUQboKx_KE

Have a discussion period for another 10-15 minutes about the video. Move towards how nanotechnology, 10 to the -9 power, is all the rage in science now since we have only recently been able to manipulate "objects" at so small a range.

After discussing, I will give the students their assignment for the rest of the class and the next class. They will need to search different websites, like the museum of science website, www.nano.gov, or certain articles that have been posted here on blackboard. Or they can look for their own websites on the internet. They will be searching for applications of nanotechnology -- specifically, "how will nanotechnology affect my life in the next 5 to 10 years? Also, what are some benefits and dangers to this new technology?" Students will list 3 applications, 2 benefits, and 1 danger with nanotechnology each of which will affect their life. Students will be given markers which with they can draw or write on their poster about their findings. Each student will do a 3-5 minute presentation (amount of time will depend on class size)

References

Charles and Ray Eams, and IBM - "Powers of Ten" Video
Museum of Science
www.nano.gov

Powers of Ten and NanoTechnology

How does it affect you?

By:	Ryan Hoffman
Grade:	11th and 12th grade math
Where in Curriculum:	In the beginning, almost as a "What did you do over the summer?"

First part of lesson

- Powers of 10 video and discussion
  - Show video to students
  - Discuss:
    - Have you seen this before?
    - Did anything surprise you in the video?
    - What was the most interesting part?
- Introduce Nanotechnology
  - Really small (WAY smaller than Ipod nanos)

Second part of Lesson

- Inquiry part of Lesson
  - Students must research nanotechnology, and present their findings to their classmates in a poster.
  - Students need to find:
    - 3 applications of nanotechnology that would affect their lives.
    - 2 benefits to their lives
    - 1 danger with nanotechnology in general

Second part of Lesson (cont.)

- Presentations may go into a second class
  - One 78 min. block may not be enough
- Students can use markers to draw or write about their discoveries
- Depending on class size, each student will have 3-5 minutes to present

Conclusion

- Why this lesson?
  - It's current: it discusses science today
  - Classic "Power of 10" video has new meaning w/ nanotechnology
  - Inquiry based: students can focus on what interests them within nanotechnology
  - It's a topic that touches all aspects of math and science