Lesson Plan

Title

Seeing Atoms

Primary Subject Area

Physical Science

Grade Level

6 (5-6)

Overview

How big is an atom? How do scientists know that atoms are real? In this activity, students learn about the limits of optical microscopes then work as a group on a challenge to find how much magnification you need to see at atom.

Approximate Duration

90 minutes (Two 45 minute blocks)

NH Frameworks

S:PS1:6:1.1 Recognize that all matter is composed of minute particles called atoms; and explain that all substances are composed of atoms, each arranged into different groupings.

Interdisciplinary Connections

ITEEA Standards 11.I: Specify criteria and constraints for the design

Lesson Objectives

After this activity, students should be able to:

- Explain that all substances are composed of atoms
- Discuss different arrangements of atoms in different substances
- Evaluate the magnification constraints of a microscope
- Describe features that can be seen at different levels of magnification

Lesson Materials and Resources

Each group of 4 needs:

- Exploration lens kit
- Pencils and paper (maybe handouts for taking notes…)
- Internet access

For the entire class:

- Digital microscope
- Computer and projector
- Just how big is an atom? Video

Technology Tools and Materials

Digital microscope, personal internet devices

Background Information

Before this lesson, students have been introduced to the idea that atoms are everywhere and they form different combinations to make up everything around us.

Engineering Connection: Like engineers, students consider the constraints of a system (the optical microscope). Students then develop criteria for a new system that will be able to image an atom. Then students will find or design a system that can meet these criteria.

Useful Vocabulary

Vocabulary Word	Meaning
Atom	
Microscope	
Wavelength	

Lesson Procedures

Introduction/Motivation:

(Before the lesson, set up a demonstration of Brownian motion using a small amount of milk and water on a slide. The fat droplets in the milk should be visible at 200X to 400X magnification. Although the water molecules are not visible at this magnification, you can see random motion of fat droplets due to bombardment by these much smaller particles. Resources: http://www.aip.org/history/einstein/brownian.htm http://www.microscopy-uk.org.uk/dww/home/hombrown.htm)

What is moving? (Give students a minute to write a guess in their notebooks. Take several answers.) We will consider two central questions: How big is an atom? How do scientists know they exist?

Day 1 - With the students:

1) Divide the class into groups of 4 or work with pre-assigned teams.
2) Explain that you will be passing out a set of lenses to each group and briefly demonstrate how the track system works to hold the lenses in place.
3) Allow groups several minutes to explore.
4) Ask students to make a telescope using two lenses and sketch their solution in their notebook. (include possible solutions here - http://science.howstuffworks.com/telescope2.htm)
5) Ask students to make a microscope using two lenses and sketch their solution in their notebook. (include possible solutions here - http://science.howstuffworks.com/light-microscope.htm)
6) Collect the lens kits.

7) Return to a class discussion: What did you see with your telescopes? What did you see with your microscopes? Was anybody able to see individual atoms?
8) Use the digital microscope to show several samples. Go through several powers of magnification and describe the feature you can see:
    - 10X – single grain of salt
    - 100X – skin cell
    - 500X – red blood cell
9) Assign homework: Challenge introduction (see Resources) video/handout.
    - (I'll make a video or a nice handout with some history about how the atom was discovered and explain the challenge)
    - Challenge: Figure out a number representing the size of an atom and what units (labels) that number should be in (miles? millimeters? or something else?). Then figure out how much magnification your microscope would need to be able to see it.

Day 2 - With the students:

10) Warm up with Review Ball (Ask questions about the video – if a student raises their hand to answer, throw them the ball then take their response. Ask another question and have the student throw the ball to the next responder.)
11) Students get back together with their challenge group. Each group should have at least one computer or internet accessible device and a reference book.
12) Allow students 10 minutes to work on the challenge together. After 10 minutes or if the groups seem to be struggling, show "Just How Big is an Atom?" TED talk or discuss the size of an atom (10^{-10} m) compared to a millimeter (10 million times smaller), a strand of hair (500,000 times smaller), and the wavelength of visible light (5000 times smaller).
13) Allow students to work for 10 more minutes. If needed, show an example of how find the amount of magnification needed to see a 10^{-10} m object:
    Ex. If we know that we can see a cheek cell ( ) under Xx magnification, how much magnification do we need to see an grain of salt: cheek → Xx and salt m → ?
    I can multiple salt by ? to get cheek so I need to multiple ? by ? and that's my magnification.

(try it with the digital microscope).

14) If groups finish early, research how scientists have managed to reach this magnification.

15) When groups have finished the challenge, ask a few groups to share their solution.
16) As a class, look at SEM images of different materials. Discuss different arrangements of atoms on different surfaces.

Assessment Procedures

Collect solutions from each group to check for understanding. Include material on final unit assessment.

Accommodations/Modifications

Make sure groups include a diversity of talent sets and encourage students to support each other.

Reproducible Materials

Telescope/Microscope handout
Challenge introduction handout/video
Magnification practice handout

Explorations and Extensions

Lesson Development Resources

http://physics.bu.edu/~duffy/java/Opticsa1.html
http://www.aip.org/history/einstein/brownian.htm
http://www.microscopy-uk.org.uk/dww/home/hombrown.htm
http://science.howstuffworks.com/light-microscope.htm
http://science.howstuffworks.com/telescope2.htm
http://www.pblproject.org

Reflections

Contact Information