

Problem # 1: How Do Chemists Measure? Nanoparticles Are Part of My Life Lesson Plan

Introduction:

One of the first units in the chemistry curriculum is about measurement. Students need to understand the metric system and how to work in metric units. This lesson is designed to help students understand the relative size of the metric prefixes, why it is critical to convert in the metric system and how the metric system relates to their life.

Learning Outcomes:

- Students will know the metric prefixes they will encounter in chemistry class and in their daily life
- Students will understand how nanotechnology is being used in everyday applications
- Students will be more aware of the chemistry they encounter each day
- Students may develop an interest in a area of science they knew little about
- Students create an advertisement for the use of nanoparticles in their daily life

Curriculum Alignment:

North Caroline Standard Course of Study in Chemistry 1.02 Evaluate reports of scientific investigations from an informed scientifically-literate viewpoint including considerations of:

- Appropriate sample.
- Adequacy of experimental controls.
- Replication of findings.

National Science Content Standard A

- Abilities necessary to do scientific inquiry
- Understandings about scientific inquiry

National Science Content Standard G

- Science as a human endeavor
- Nature of scientific knowledge
- Historical perspectives

Classroom Time required:

2.5 85 minute class periods

Materials Needed:

- "The Metric System" Powerpoint
- Gold Nanoparticle Lab adapted from "Color My Nanoworld" lab from the Journal of Chemical Education • Vol. 81 No. 4 April 2004 • www.JCE.DivCHED.org
- Gold Nanoparticle Lab rubric
- My Nanoparticle: Student Ad Project

Technology resources:

- Students can benefit from access to computers for their research on the *My Nanoparticle Advertisement*
- Computer and projector for presenting powerpoint, video or computer generated projects.

Student Pre-activities:

1. Students should have some idea of the relative size of the metric prefixes and dimensional analysis.
2. Students should be familiar with proper lab safety and have a signed safety contract on file with the teacher.

Teacher Pre-activities:

1. Introduce the students to the metric system, nanoparticles and dimensional analysis. You may use or modify the *How Do Chemists Measure?* powerpoint under Web Sites and resources.
2. Ensure that all students are familiar with proper safety procedures and have signed safety contracts on file in the classroom.
3. Prior to class the teacher prepares the solutions needed for the *Gold Nanoparticles lab* activity. See Teacher notes included on the *Gold Nanoparticles lab* sheet for instructions to prepare enough solutions for 8 lab groups with 4 students per group.

Activities:

1. Students will make gold nanoparticles using the *Gold Nanoparticles lab*. This is one of the first lab experiences of the year, so it is necessary to remind students of the need to follow all safety procedures. They must wear gloves and goggles for this lab. They will learn how to find and use the proper pieces of lab equipment. Ensure that students are using the 25 ml graduated cylinders and that they are reading the tool from the bottom of the meniscus and at eye level.
2. Students should notice the color change that occurs as the nanoparticles form. This is due to a change in the oxidation state of the Au. Have students put their solutions in labeled vials and store them in a cool dark place to be used later in the year during the unit on light. They can be used in a spectrophotometer to show the wavelength of light that is absorbed by the purple colored particles. They may be used again during the conductivity lab to demonstrate that the nanoparticles are ions and that their solution will conduct electricity.
3. Students will complete the lab questions prior to the next class.
4. About 15 minutes prior to the end of class, introduce the *My Nanoparticle Advertisement* activity by distributing the *My Nanoparticle: Student Ad Project* sheet. Ask students to read through the assignment, visit the web site referenced and come to class the next day with ideas for their project. Students may work with a partner or as individuals.
5. When students arrive to class the next day, they will be given 15 minutes with their group or partner to decide on their topic and write a one paragraph explanation of why they chose that particular application.
6. Students will use computers to gather data about their application and they will begin to create their ads. The ads are limited in size and time as outlined on the student project sheet.
7. Students will complete their projects at home over the next few days and present their ads during class on a specified day.

Assessment:

- Students will write a short summary of what happened during the *Gold Nanoparticles* lab which focuses on the observations made during the lab. In addition, they will answer the questions at the end of the *Gold Nanoparticles Lab*.
- The *My Nanoparticle Ads* will be assessed using the rubric included on the *My Nanoparticle: Student Ad Project sheet*

Modifications:

The *Gold Nanoparticle lab* could be expanded to so that different groups of students work with differing concentrations of the sodium citrate solution. The sodium citrate binds to the gold nanoparticle surface and affects the size of the nanoparticle. This in turn affects the color of the final solution.

Alternative assessments:

1. The *Gold Nanoparticle lab rubric* is included if the teacher is ready to implement a simple lab report format. The rubric includes a summary of the method as well as observations and possible errors.
2. Rather than a written summary of the lab observations, each lab group could orally share their observations with the class.

Teacher Notes:

Directions to prepare solutions are found at the end of the *Gold Nanoparticles Lab*

Critical Vocabulary:

Metric system
Nanotechnology
Nanoparticles
Beaker
Graduated cylinder
Glass vial

Web Sites and resources:

This web site is a great place for students to start when researching their nanoparticle

<http://www.nanotechproject.org/inventories/consumer/browse/>

The following web sites contain great information about nanotechnology

- http://www.nisenet.org/viz_lab_image_scaler
- <http://www.mrsec.wisc.edu/Edetc/>
- <http://www.exploratorium.edu/ti/podcasts/smalltalk.php>

How Do Chemists Measure? Powerpoint

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