



INTRODUCTION TO NANOTECHNOLOGY

FOR MIDDLE SCHOOL STUDENTS

SUBMITTED BY JAN GROUT



- TEKS:** *(8.2) **Scientific processes.** The student uses scientific inquiry methods during field and laboratory investigations. The student is expected to:
- *(E) construct graphs, tables, maps, and charts using tools including computers to organize, examine, and evaluate data.
- *(8.3) **Scientific processes.** The student uses critical thinking and scientific problem solving to make informed decisions. The student is expected to:
- *(A) analyze, review, and critique scientific explanations, including hypotheses and theories, as to their strengths and weaknesses using scientific evidence and information;
 - (D) evaluate the impact of research on scientific thought, society, and the environment;
- *(8.9) **Science concepts.** The student knows that substances have chemical and physical properties. The student is expected to:
- (D) identify that physical and chemical properties influence the development and application of everyday materials such as cooking surfaces, insulation, adhesives, and plastics.

5E Learning Model

Introduction to Nanotechnology

ENGAGE: 1) Have students examine a piece of hair and estimate the diameter of the hair. Ask the students to imagine something that is 75,000 times SMALLER than the diameter of the hair. Explain that at this size, $1/75000$ of a human hair, we are in the measurement realm of nano-measurements.

2) Show **Secret Worlds: The Universe Within** to help students understand the implications of increasing and decreasing a view in increments of powers of ten.

URL: <http://micro.magnet.fsu.edu/primer/java/scienceopticsu/powersof10/index.html>

EXPLORE: **Does Size Matter?** Lab Activity.

Lab available at: http://www.nsec.ohio-state.edu/teacher_workshop/Does_Size_Matter.pdf

Objective of Lab: to demonstrate that different sized particles of the same substance exhibit different properties because of their different particle sizes.

EXPLAIN: Working in groups of 3, students will conduct one of the following research activities.

- 1) Webquest What is Nanotechnology? (Webquest follows)
- 2) Read Ch 1 **Nanotechnology for Dummies** pp. 11-12 and make a poster showing the comparison size range of a human down to the diameter of a hydrogen atom. Students will explain what they have learned about nanotechnology and explain the significance of the poster. See Poster Rubric 1.
Ch 1 available at <http://www.nanotechnologyfordummies.com/Chapter%201.pdf>
- 3) Read **Small Science Big Deal** http://www.nsec.ohio-state.edu/teacher_workshop/Mystery_Fluids.pdf
Separate groups will prepare 3-4 ppt slides summarizing the use of nanotechnology in each of the following areas: See Rubric 2
 - Introduction to Nanotechnology and Electronics
 - Health
 - Man-Made Resources
 - Natural Resources and Safety and Security
- 4) Listen to the podcast: **A Gentle Introduction to Nanotechnology and Nanoscience**
<http://www.nanohub.org/resources/1021/>
Prepare a Poster depicting major points in the Podcast. Use Nanotechnology Rubric.

EXTEND: Students are to brainstorm in groups and decide on answers to each of the following questions.


Students compose and post their responses on large Post-It sheets to be hung in classroom

- 1) Do you think nanotechnology is going to play an important role in the future? Explain
- 2) How important do you think it is for scientists to continue to research nanotechnology?

EVALUATE Use Rubrics prepared for each activity in the Explain portion of the lesson

NANOTECHNOLOGY WEBQUEST

Go to Nanotech Kids website: <http://www.nanonet.go.jp/english/kids/index-n.html>

 Click on blue sphere at bottom of page - What is Nanotechnology.

1. Nano means _____

2. nm is the unit abbreviation for _____

Fill in the units

3) 1000m = _____

5) 1/1000m = _____

4) 1/100m = _____

6) 1/1,000,000,000m _____

7) According the article, what is nanotechnology? _____

 Click on What is nanotechnology? at the bottom of the page.

 Click on How small is it?

8) One nanometer = _____-meter

9. Click on the To Smaller World button. What object is shown to be 1 nm in size? _____

10. Click on To Larger World. What object is shown as 2,000,000 km? _____

 Click on: What is nanotechnology? at the bottom of the page.

 Click on: Nanotechnology World.

11. One nanometer is about the length of _____ atoms

12. True or False Nano-sized particles of elements have the same properties as larger samples of the same element.

13. Describe the "TOP DOWN" method for making nano particles. _____

14. Describe the "BOTTOM UP" method for making fine, small things. _____

15. At present these two methods of fabrication are advancing the door to new _____

Making A Poster : Nanotechnology Poster Rubric

Teacher Name: **Mrs. Grout**

Student Name: _____

CATEGORY	4	3	2	1
Use of Class Time	Used time well during each class period. Focused on getting the project done. Never distracted others.	Used time well during each class period. Usually focused on getting the project done and never distracted others.	Used some of the time well during each class period. There was some focus on getting the project done but occasionally distracted others.	Did not use class time to focus on the project OR often distracted others.
Graphics -Clarity	Graphics are all in focus and the content easily viewed and identified from 6 ft. away.	Most graphics are in focus and the content easily viewed and identified from 6 ft. away.	Most graphics are in focus and the content is easily viewed and identified from 4 ft. away.	Many graphics are not clear or are too small.
Content - Accuracy	At least 7 accurate facts are displayed on the poster.	5-6 accurate facts are displayed on the poster.	3-4 accurate facts are displayed on the poster.	Less than 3 accurate facts are displayed on the poster.
Attractiveness	The poster is exceptionally attractive in terms of design, layout, and neatness.	The poster is attractive in terms of design, layout and neatness.	The poster is acceptably attractive though it may be a bit messy.	The poster is distractingly messy or very poorly designed. It is not attractive.
Title	Title can be read from 6 ft. away and is quite creative.	Title can be read from 6 ft. away and describes content well.	Title can be read from 4 ft. away and describes the content well.	The title is too small and/or does not describe the content of the poster well.

Powerpoint Appearance and Content : Nanotechnology Powerpoint Rubric

Teacher Name: **Mrs. Grout**

Student Name: _____

CATEGORY	4	3	2	1
Content - Accuracy	All content throughout the presentation is accurate. There are no factual errors.	Most of the content is accurate but there is one piece of information that might be inaccurate.	The content is generally accurate, but one piece of information is clearly flawed or inaccurate.	Content is typically confusing or contains more than one factual error.
Use of Graphics	All graphics are attractive (size and colors) and support the theme/content of the presentation.	A few graphics are not attractive but all support the theme/content of the presentation.	All graphics are attractive but a few do not seem to support the theme/content of the presentation.	Several graphics are unattractive AND detract from the content of the presentation.
Effectiveness	Project includes all material needed to gain a comfortable understanding of the topic. It is a highly effective study guide.	Project includes most material needed to gain a comfortable understanding of the material but is lacking one or two key elements. It is an adequate study guide.	Project is missing more than two key elements. It would make an incomplete study guide.	Project is lacking several key elements and has inaccuracies that make it a poor study guide.
Text - Font Choice & Formatting	Font formats (e.g., color, bold, italic) have been carefully planned to enhance readability and content.	Font formats have been carefully planned to enhance readability.	Font formatting has been carefully planned to complement the content. It may be a little hard to read.	Font formatting makes it very difficult to read the material.
Spelling and Grammar	Presentation has no misspellings or grammatical errors.	Presentation has 1-2 misspellings, but no grammatical errors.	Presentation has 1-2 grammatical errors but no misspellings.	Presentation has more than 2 grammatical and/or spelling errors.