

## Instructor Information

### **Nanoscale Modeling and Nanotechnology in the Media**

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#### **Summary**

Students will get an idea of the size of a nanometer by producing their own scale to create models of various objects of known length. In the second activity, students will think critically about the way science is presented to them in the media.

#### **Background**

In the nanoscale modeling activity, students will compare a nanometer to other known metric measurements of small objects to provide them with a sense of how small a nanometer is. It involves a review of metric prefixes as well as metric conversions. Students will also have to work to develop the scale they will use to produce the models of the known objects. This will enable students to grasp the concept of the size of objects at the nanometer scale.

In the second activity, students will list the media sources that have provided them with information about nanotechnology, be it film, newspaper articles, science fiction or video games. They will then examine the way in which those sources define what nanotechnology is for the audience. Once this is done, students will be asked to go online and search for actual research that is being done on nanotechnology and find definitions of this technology from those doing the research. They will be asked to compare how the definition of nanotechnology provided by the media is different from that of the researchers and scientists. Students will use imovie to produce their own piece of media that presents the view of scientists and researchers or debunks a media representation of nanotechnology. The skills of analysis and production are important in enabling students to become critical consumers and producers of media.

#### **Integrating the activity into your curriculum**

The nanoscale modeling could be used during a unit on measuring and the metric system. It is useful at any point for reviewing both metric prefixes and metric conversions. Nanotechnology in the media unit can be used to incorporate media literacy into any science classroom. Media literacy is defined as the ability to access, analyze, evaluate and communicate in a variety of forms. Nanotechnology in the media asks students to do all of these things. This curriculum requires that students critically examine the way in which science is present to them in the media, evaluate sources of information and produce their own piece of media. Since young people are in heavily mediated environments, that media shapes much of their understanding of the world around them. Therefore, it is important to provide them with the skills to be able to analyze the information presented to them before deciding to believe it. Media literacy can be integrated into any science class because it encourages the application of critical thinking skills to any source of scientific information.

## About the Activity

### Part I. Nanoscale Modeling

#### Step 1

Review of the metric prefixes and metric conversions.

*Have students fill out the chart below and give their best guess as to what they think “nano” means. After all students have filled out the chart, the teacher can go over the chart. Students can be asked what they put for the meaning of the prefix “nano”. The teacher can give the definition if necessary.*

Complete the chart below:

Prefix	Meaning	How many in one meter?
deci (d)	<b>.1 / tenth</b>	<b>10</b>
centi (c)	<b>.01 / hundredth</b>	<b>100</b>
milli (m)	<b>.001/ thousandth</b>	<b>1000</b>
micro ( $\mu$ )	<b><math>1 \times 10^{-6}</math> / millionth</b>	<b>1,000,000</b>

#### Step 2

Students are asked what the prefix “nano” means.

**$1 \times 10^{-9}$  / billionth**

#### Step 3

Students will use the understanding of the prefix nano to perform metric conversions that will tell them how many nanometers are in a centimeter, a millimeter and a micrometer.

*Once the students know the prefix they can be given time to do the four calculations below. The teacher can be walking around the room while students are working on these problems to answer questions. Students can be asked to put their answers on the board and explain what they did to get them.*

How many nanometers in one meter? 1,000,000,000 /  $1 \times 10^9$   
How many nanometers in one centimeter? 10,000,000 /  $1 \times 10^7$   
How many nanometers in one millimeter? 1,000,000 /  $1 \times 10^6$   
How many nanometers in one micrometer? 1,000 /  $1 \times 10^3$

#### Step 4

Students are given a list of the following objects and their sizes.

Dust mite-200  $\mu\text{m}$   
Human hair-60  $\mu\text{m}$   
Red blood cells- 5  $\mu\text{m}$   
Bacteria diameter –1  $\mu\text{m}$   
Flu virus diameter-100 nm  
DNA diameter-2 nm  
Carbon buckyball diameter-1 nm

Working with a partner, the students will create a scale (ex. 1 cm = 100 nm) that will allow them to construct models of the objects. Students will need metric rulers, scissors, colored pencils and poster paper to produce their models.

## **Part II. Nanotechnology in the Media**

### **Nanotechnology in the Media** *Teacher Edition*

#### **Media Literacy**

Students receive information about their world from a variety of media sources. This is especially true in regards to scientific information. Whether they are aware of it or not students are receiving an education from the media sources they are engaged with. Incorporating media literacy into the science curriculum enables students to “identify and apply strategies to access, evaluate, use and communicate information for learning, decision making and problem solving”<sup>1</sup>. Media literacy can be incorporated into any science curriculum because it encourages students to think critically about the way in which scientific information is presented to them and how this presentation affects their understanding of it.

One of the principles of media literacy is that media representations construct reality. Students who have only heard of nanotechnology as depicted by the media, come to understand this technology through their mediated experience. The unit Nanotechnology in the Media will allow students to first examine how the media has impacted their understanding of nanotechnology. The second aspect of the unit will encourage them to go online to investigate current research on nanotechnology. The research will be compared with the media representation. The final step is for students to communicate their new understanding of nanotechnology by producing their own piece of media

#### **Step 1**

The first task of the teacher then is to lead a discussion in which students identify the media sources and attempt to explain how those sources have impacted their understanding of nanotechnology. To begin ask the students to write down on a piece of paper all of the places in the media they have heard or seen nanotechnology. Ask them to be as specific as possible by naming magazines, newspapers (with dates if possible) film titles, video games, etc. After the students have had a couple of minutes to write their thoughts down the teacher can ask each student to read off their list. The teacher can list the sources on the board and put a hash mark next to a source that is listed multiple times. (it is sometimes helpful during this process to have a student copy down anything that is written on the board) Once all of the sources are up on the board the teacher can start asking the students what is the definition of nanotechnology that is provided by each source. This may or may not be explicitly stated in each source and students may need to be asked more probing questions in order for the student to come up with what they think is the definition presented. Questions like, what is the technology used for, can it make things, does it have medical applications, is it used to destroy things, is it used as a weapon etc. All audiences negotiate media differently so there may be multiple definitions for once source. These definitions can be written on the board and by the note taker.

Students are then asked to identify some of the similarities and differences between the definitions. At some point during this process a student may ask, “Is it possible/real?” If the students raise this question the teacher can then turn the question back to the students and inform them that they will be doing research on line to determine if the definitions presented to

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them in the media are possible. If the students do not raise the question, the teacher can raise it him/herself.

## **Step 2**

### **Looking At Media Sources**

Students will receive a section of Prey by Michael Crichton (Pages 183-207). This can be read for homework along with a handout with questions to answer. The questions can be discussed in class the next day.

Students will watch a clip of the film *I Robot*. The DVD is divided into chapters. Chapters 26 and 27 are recommended for this activity. In these chapters, the characters mention the use of “microscopic robots designed to wipe out artificial synapses” that are called nanites. Students who have reviewed the prefixes of the metric system can distinguish between the micro and nano scale. Is a microscopic machine nanotechnology? The other thing to notice in the scene is that once the nanites are injected into the robot’s brain, the brain turns black. Students can be made aware of the connotations of this color. The teacher can ask why they think the director choose to use it. What does the color black signify? These observations can fuel a discussion on how the technology is portrayed in this scene whether it is positive, negative, or neutral. (See student handout)

It may be useful to show the clip once then distribute the handout and show the clip again. If students request to view it again, it can be shown again and then their answers to the handout can be discussed.

## **Step 3**

### **Internet Source Evaluation and Search or All Sources Are Not Created Equal**

The question “is this possible” has been raised. Now it is up to the students to do some Internet research to determine if the definitions proposed by the media are correct/accurate. Students will go on line to search for current research on nanotechnology. Some of the following sources may be useful:

[www.discoverNANO.northwestern.edu](http://www.discoverNANO.northwestern.edu)

[www.sciencemuseum.org/uk/antenna/nano](http://www.sciencemuseum.org/uk/antenna/nano)

[www.nanotechnology/northwestern.edu/news.htm](http://www.nanotechnology/northwestern.edu/news.htm)

[www.web.mit.edu/isn/aboutisn/whatisnano.html](http://www.web.mit.edu/isn/aboutisn/whatisnano.html)

[www.nano.gov](http://www.nano.gov)

[www.nsf.gov/discoveries/index.jsp?prio\\_area=10](http://www.nsf.gov/discoveries/index.jsp?prio_area=10)

[www.lbl.gov/nanohigh/nanoscience\\_links.html](http://www.lbl.gov/nanohigh/nanoscience_links.html)

[http://science.nasa.gov/headlines/y2005/27jul\\_nanotech.htm?list128964](http://science.nasa.gov/headlines/y2005/27jul_nanotech.htm?list128964)

<http://www.ipt.arc.nasa.gov/index.html>

[http://science.nasa.gov/headlines/y2000/ast07sep\\_1.htm](http://science.nasa.gov/headlines/y2000/ast07sep_1.htm)

[http://science.nasa.gov/headlines/y2002/15jan\\_nano.htm](http://science.nasa.gov/headlines/y2002/15jan_nano.htm)

Students will have to collect five sources. For each source they will have a handout to complete that asks them to summarize the information on the source, if the source is reliable, and to compare the source definition of nanotechnology with the media definitions discussed earlier in class. These sources will be the basis for an imovie that presents the scientific view of nanotechnology or debunks common misunderstanding of nanotechnology. (*See student handout*)

#### **Step 4**

##### **Media Production**

Students have now completed their research and can work in groups of up to four to produce an imovie that defines nanotechnology based on their research. The teacher can lead a class discussion of who the audience is, how best to communicate the message to that audience, and what techniques would be appropriate for an imovie. This discussion will help provide students with an “awareness of the visual and narrative customs and conventions of the media”<sup>1</sup> that allows them to be able to use the conventions in their own media product. This is a principle of media

The teacher can also lead a discussion in which students themselves develop the rubric for their imovies. The rubric can cover general content as well as techniques. All groups have to produce a storyboard or script. After the first draft is completed students can switch storyboards/scripts with other groups for a peer edit process and then create the second draft.

#### **References**

D.Considine and G. Haley, Visual Messages: Integrating Imagery into Instruction Teacher Ideas Press, Englewood, Colorado, 1999.

## Student Activity

### **Nanoscale Modeling and Nanotechnology in the Media**

Developed by: Joanna Marshall, Buffalo Grove High School

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#### **Nanoscale Modeling Part I**

##### **Step 1: Metric Prefixes**

Remember the metric system? You have probably used it in other science classes to make measurements. All scientists use the *Système Internationale d'Unités* or SI. The meter is the SI base unit used to measure length. Adding a prefix can modify a base unit. Prefixes are used to make the numbers more manageable. All prefixes are in units of ten and this makes converting from one unit to another simple

Complete the chart below:

Prefix	Meaning	How many in one meter?
deci (d)		
centi (c)		
milli (m)		
micro ( $\mu$ )		

What do you think the prefix "nano" means?

##### **Step 2: What is a nanometer?**

How many nanometers in one meter? \_\_\_\_\_

How many nanometers in one centimeter? \_\_\_\_\_

How many nanometers in one millimeter? \_\_\_\_\_

How many nanometers in one micrometer? \_\_\_\_\_

Show your work:


## Nanoscale Modeling *Student Handout*

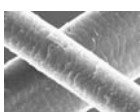
### Part 2: Picking Your Scale

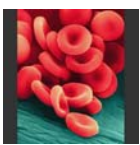
Now that you know how many nanometers are in one micrometer, look at the list of objects below and create a scale that will allow you to build models of all the items on the list. What scale will you use to build your models? Discuss this with your group and get your teacher's approval before building your models.

Example Scale: 1 cm = 10 nm or 1 mm = 500 nm

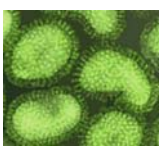
#### Scale I will use:


Dust mite-200  $\mu\text{m}$   scale size \_\_\_\_\_

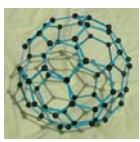
Human hair-60  $\mu\text{m}$   scale size \_\_\_\_\_

Red blood cells- 5  $\mu\text{m}$   scale size \_\_\_\_\_

Bacteria diameter -1  $\mu\text{m}$   scale size \_\_\_\_\_

Flu virus diameter-100 nm  scale size \_\_\_\_\_

DNA diameter-2 nm  scale size \_\_\_\_\_

Carbon buckyball diameter-1 nm  scale size \_\_\_\_\_

## Internet Source Evaluation and Search or All Sources Are Not Created Equal

-Student Handout

URL:[http://](#)\_\_\_\_\_

Title of Web Page \_\_\_\_\_

What does the URL tell you about the site? \_\_\_\_\_

Who is the author of the site? \_\_\_\_\_

What are the qualifications the author has to publish information on this?  
subject? \_\_\_\_\_

When was the site last updated? \_\_\_\_\_

Does this site include links that verify its content? Please list some of the links.

\_\_\_\_\_  
\_\_\_\_\_

Is this site reliable? Why or why not? \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_

Briefly summarize in your own words the information/ research you read about on the website.

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

What is the definition of nanotechnology offered by the web site?

\_\_\_\_\_

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Compare the definition from your website with the definition that was discussed in class. Are they similar? Different? Be specific

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**PREY BY MICHAEL CRICHTON PGS 183-207**  
**DISCUSSION QUESTIONS *STUDENT HANDOUT***

***Directions:***

After you have read the passage from Prey answer the following questions using **COMPLETE SENTENCES**.

1. What is the definition for an “assembler” given in the passage?
2. What happened to the rabbit?
3. How does the swarm get its power?
4. Why are bacteria needed?
5. Based on the description in the book, draw an assembler.
6. How does Ricky explain why the containments were vented?
7. Make a prediction about what you think will happen next.
8. Based on this passage, how do you think the author defines nanotechnology?
9. How is technology portrayed in this passage? Positively? Negatively? Neutrally?  
Give specific quotes from the passage to support your answer.

**DISCUSSION QUESTIONS FOR *I ROBOT***  
**STUDENT HANDOUT**

1. In the clip Dr. Calvin says that she will use “microscopic robots designed to wipe out artificial synapses”. Sonny calls these robots nanites. Is this the proper name? Why or why not? (*Hint: what do the prefixes micro and nano mean*)
2. How do you think this clip defines nanotechnology?
3. Is it a positive, negative or neutral definition? What is the attitude the film takes toward nanotechnology?
4. What color does the robot brain turn after being injected with nanites? Why do you think the director chose this color?