

Teacher's Preparatory Guide

Help or Hype: The Ethics of Bio-nanotechnology

Purpose: This lesson explores the ethical concerns related to bio-nanotechnology. Bio-nanotechnology is the application of nanotechnology to living things. This ranges from the creation of pharmaceuticals to medical devices. While scientists have created many life-saving treatments ethical concerns, such as privacy, can arise from such technological advances.

Time required: 60-90 min

Level: Middle and High School, Community College

Big Ideas in Nanoscale Science: Science, Technology, and Society

Teacher Background:

Ethics is an important subject that is often not discussed in science. Ethics asks the question, “Just because we can should we?” While many breakthroughs in bio-nanotechnology have increased and improved human, plant, and animal wellbeing and longevity, investigating ethics is necessary to determine how science should be applied. Many topics in bio-nanotechnology such as cloning, stem cells, silver nanoparticle use, and personalized medicine have been the subject of several controversies^{1,2}.

Some ethical concerns include privacy, discrimination, environmental impact, and equal access. Privacy concerns include the release of medical records to unauthorized parties. Discrimination is the result of unfair treatment of an individual based on information or prejudice. Environmental impact requires scientist to consider the impact of their technology, such as genetically modified crops or silver nanoparticles, on the environment. Equal access to medical treatment and pharmaceuticals is another ethical concern. For example, if someone undergoes genomic testing to determine their predisposition to certain diseases, they may be concerned about others finding out and being barred from obtaining a job or health insurance. If the person later is diagnosed with a disease, they may not have access to life saving drugs due to cost.

In this lesson, you will discuss many topics in bio-nanotechnology with your students. Remember that there is not right or wrong answer to ethics and everyone's perspective is based on their situation, life experience, and knowledge.

Materials: PowerPoint presentation *Help or Hype* included with this lesson

Advance Preparation:

Teachers should read about some famous US science ethical cases, such as the Tuskegee Syphilis Experiment (<http://www.cdc.gov/tuskegee/timeline.htm>). Read about the history of

informed consent and its impact on bio- and nanotechnology. Before starting the activity have the students also read <http://www.cdc.gov/tuskegee/timeline.htm> about the Tuskegee Syphilis Study and discuss the ethical concerns.

Below are suggested websites

<http://www.scu.edu/ethics/publications/submitted/mclean/biotechframework.html>

http://www.aahperd.org/aahe/publications/iejhe/upload/01_H_Osman.pdf

Tuskegee---

http://www.tuskegee.edu/about_us/centers_of_excellence/bioethics_center/about_the_usphs_syphilis_study.aspx

http://en.wikipedia.org/wiki/Tuskegee_syphilis_experiment

<http://www.cdc.gov/tuskegee/timeline.htm>

HeLa

<http://en.wikipedia.org/wiki/HeLa>

<http://www.smithsonianmag.com/science-nature/Henrietta-Lacks-Immortal-Cells.html>

<http://www.nih.gov/news/health/aug2013/nih-07.htm>

http://www.tuskegee.edu/about_us/centers_of_excellence/bioethics_center/about_the_usphs_syphilis_study.aspx

Safety Information:

None

Directions for the Activity:

1. Explain ethics and its importance in science. Explain ethical concerns such as privacy, discrimination, environmental impact, and lack of access.
2. Show each slide and explain the content. The slides will have a question to help generate class discussion.
3. Ask the students about their opinion on the topic shown in each slide. Note: Ethics can be a sensitive subject with no clear-cut answer. Be careful to monitor the conversations so that they do not get heated or out of hand.
4. Have your students research an ethical concern related to a scientific topic of interest. They will create either a poster or a PowerPoint on this research to either present in class or turn in as a homework assignment. Use the rubric on the last page as a guide for grading.

Cleanup: No cleanup needed.

Assessment: Have students write down their response to every scenario.

Resources:

1. <http://www.scu.edu/ethics/publications/ethicalperspectives/personalized-medicine.html>

2. <http://stemcells.nih.gov/info/pages/ethics.aspx>

<http://www.scu.edu/ethics/publications/submitted/mclean/biotechframework.html>

Next Generation Standards

National Nanotechnology Infrastructure Network

www.nnin.org

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Developed by Samantha Andrews

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NNIN Document: NNIN-1361

Rev: 10/2013

- MS-LS2-1. Analyze and interpret data to provide evidence for the effects of resource availability on organisms and populations of organisms in an ecosystem.
- MS-LS2-2. Construct an explanation that predicts patterns of interactions among organisms across multiple ecosystems.
- MS-LS2-4. Construct an argument supported by empirical evidence that changes to physical or biological components of an ecosystem affect populations.
- 3-LS3-1. Analyze and interpret data to provide evidence that plants and animals have traits inherited from parents and that variation of these traits exists in a group of similar organisms.
- HS-LS4-3. Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
- HS-LS4-6. Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.*

Grading Rubric

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	Topic	Excellent	Good	Poor	Points earned
	Presentation (media)	Slides are easy to read and free of errors. Limited use of animation. Slides are not wordy.	Slides are somewhat wordy and contain no more than 3 errors. Citations are provided.	Excessive use of animation. Slides are too wordy and contains more than 3 errors. No citations of references.	
Points		20	15	10	
	Presentation (delivery)	All group members are participating in the presentation delivery. Members are prepared to answer questions and are well versed in the topic. Very limited use filler of words. Presentation does not run over the allotted time.	Limited use of filler words. Some of the group members are participating in the presentation. Some of the group members are reading directly from the slides. Presentation runs over the allotted time.	Participants are reading directly from the slides. Excessive use of filler words (like, um, basically, etc) often. Not prepared to answer questions or about knowledge on the topic. Only one or two members are participating in the presentation. Presentation runs over the allotted time.	
Points		20	15	10	
	Topic	Topic narrowed and focused. It is well researched and easy to understand. The references are credible.	Topic is slightly narrowed and requires more research. There is need for more explanation. References are cited and credible.	Topic is too broad and not based on scientific fact. The topic is not well explained. The sources used are not credible (such as wikipedia).	
Points		20	15	10	
	Report	No use of wikipedia or other unreliable sources. Length no longer than 2 pages. Very few spelling and grammatical errors. The references are properly cited.	No use of wikipedia or other unreliable sources. Length no longer than 2 pages. Less than 5 spelling and grammatical errors. The references are properly cited.	Use of wikipedia or other unreliable sources. Length longer than 2 pages. Excessive spelling and grammatical errors. The references are not properly cited.	
Points		20	15	10	
	Group Participation*	Participated with the group. Attended group meetings and helped with all aspects of the project. Contributions should be listed.	Helped with some of the group work. Absent on the day of the presentation without a valid excuse. Contributions should be listed	Did not help with the group work or participate in the presentation. If you fall in this category, you will automatically receive a 0 for your grade.	
		10	5	0 (for the project)	
Attendance		Present	Absent with a valid excuse or late	Absent with no excuse	
Points		10	5	0	
Max Points	100				