

Nanotechnology debate

This lesson should be carried out prior to visiting the 'Move over Einstein: the next generation is here!' exhibition. There are three activities in total:

- the pre-visit lesson
- visit information and
- the post-visit lesson.

Aim

To research controversial issues surrounding nanotechnology and to participate in a facilitated debate on the subject.

Objectives

- Students will become familiar with the principles of nanotechnology
- Students gain an appreciation for the nanoscale and its particular properties
- Students begin to explore applications of nanotechnology, and begin to classify these as present and future.

Curriculum links

Science, Citizenship, PSHE

Resources required

Research sources (print, web, etc), pens and paper

Teaching activities

Introduction

In order to become familiar with the topic, students can work in pairs or groups to research a series of topics. Each pair can research all of the topics, or the topics can be divided up among the groups. If the topics are divided up, each group can give a brief presentation to the rest of the class.

Questions are provided on the *Nanotechnology Research Sheet*.

Activities

Using the worksheet, students explore the following topics:

The nano scale

How small is a nanometre, and how does it compare to sizes we are familiar with?

Nanoscience versus nanotechnology

What is the difference between nanoscience and nanotechnology? What are some examples of each?

Existing Applications

What things are found in nature at the nano scale? What has already been created or manipulated at the nano scale?

Classification

Have the students find current news articles (in print or online) about proposed applications of nanotechnology. Create a large chart in the classroom and divide the articles into Medical, Industrial, Transport, Military, and Personal Use.

Viewpoints

A possible extension or homework activity. Collect a series of opinions on nanotechnology and divide them into “for”, “against” and “opinion unclear” piles. These opinions may be articles in a newspaper, magazine or website, images or public service announcements, broadcasts, or advertisements.

Plenary

Review the answers to the questions, the classification and if completed, the viewpoints. After the research stage the students should be able to demonstrate a general understanding of the major principles of nanotechnology.

Suggested homework

Find a newspaper or magazine article about a nanotechnology application or a scientist doing research in the area and bring it to school.

Nanotechnology debate

Objectives

- Students become increasingly familiar with the principles of nanotechnology
- Students understand the principles of chemical carriers
- Students begin to identify existing versus potential or assumed information
- Students apply social and ethical questions to scientific scenarios.

Curriculum links

Science, Citizenship, PSHE

Resources required

Move over Einstein: the next generation is here! exhibition, pens, large piece of paper with three spaces: risks, gains and still to know, post-it notes

Teaching activities

At the exhibition students have the opportunity to explore interactive displays on a number of exciting and emerging scientific topics. This lesson plan provides the resources for a group activity while at the exhibit that focuses on the nanotechnology application, chemical carriers. By examining one potential nanotechnology application in detail students gain a deeper understanding of the opposing issues surrounding the field.

When visiting the exhibition ask students to make sure they visit and read about the exhibition focusing on chemical carriers. Students can read the panels and try the hands-on exhibits. During the visit, gather the group together for a short exercise where students share information and opinions about chemical carriers. Distribute a series of post-it notes for contributions to a large chart that has three spaces: risks, gains, and still to know. Using the information from the exhibit, and the pre-visit research, students can work together to complete the chart by sticking on a series of suggestions. Encourage students to ask questions, and include their own concerns about the technology on the chart. Where possible, relate the discussion to the principles of nanotechnology covered before the visit.

Suggested homework

Prepare a survey with three questions about chemical carriers. Conduct the survey with at least 10 people you know. Choose a way to present your results. Make sure you describe how the application works to your volunteers before you start your survey!

Nanotechnology debate

In this lesson students have the opportunity to use their knowledge to develop and describe their own opinions on nanotechnology. The class participates in a facilitated debate that centres on the question of how the precautionary principle applies to nanotechnology research.

Objectives

- Students become increasingly familiar with the principles of nanotechnology
- Students will gain an understanding of the precautionary principle and the major viewpoints in the nanotechnology debate
- Students will develop skills in participatory learning and active citizenship including collecting and assimilating opposing information and views, expressing an opinion and listening to others.

Curriculum links

Science, Citizenship, PSHE

Resources required

None

Teaching activities

After researching the background of nanotechnology and some of the potential applications, students should be ready to debate the progress of nanotechnology. Much of the debate in the media and scientific community centres around what is known as the “Precautionary Principle” and this is a question that students can take sides on in the classroom.

The precautionary principle (in its strict definition) states that inaction is required when actions presents a risk. In terms of nanotechnology, this would mean: “since there might be bad results, we shouldn’t do it at all”.

Students may feel comfortable having a group discussion and expressing their views. Alternatively, some of the following strategies may assist the students in defining and expressing their views:

Plenary

Ask each group of students to summarise the views of their group.

Possible discussion strategies

Simulations

The group can be artificially divided into “sides” and have a debate where each side must give the arguments of the side they have been assigned.

For: “Well, I think that we should continue to develop nanotechnology because there are some great potential applications that could really help people. We have to keep progressing science even if we don’t know what’s going to happen”

Moderate: “Hmm...I think that nanotechnology sounds like it has some amazing applications, but it’s hard to know what to do when we have no idea how some materials could react or affect our health. I think that we should develop nanotechnology very slowly, and stop if problems start to arise.”

Against: “The risks of nanotechnology are too great, and we should not create problems we might have to face later. I think that science and technology are progressing along fine without the nano scale, and we should stop developing nanotechnology.”

Physical Opinions

Students can express their views by physically placing themselves along a line. The line is marked **For** at one end and **Against** at another, and students stand as close to either end as they like to show how strong they agree or disagree to a series of statements. After each question ask different students standing at different points on the line why they voted the way that they did.

Sample statements:

- nanotechnology is a very important field of research
- only certain types of nanotechnology research should be paid for
- medicine is the most important application for nanotechnology
- scientists need to be careful about nanotechnology
- most people understand nanotechnology
- nanoscience is different to other types of science.

Visual Opinions

Students can express their views by creating a series of illustrations depicting how they or various people in the debate may feel.

For example, these people might have different views:

- research scientists working on a nanotechnology project
- research scientists working on a different type of project
- doctors
- cancer patient
- factory owner
- pilot
- students.



*Move over Einstein:
the next generation is here!*

nanotechnology research

Use books, magazines or the internet to answer the following questions. If you can, ask a scientist or engineer for help.

The nano scale

How small is a nanometre?

What are the units of a nanometre?

How many nanometres thick is a penny?

How does a nanometre compare to other sizes we are familiar with?

Nanoscience and nanotechnology

What is the difference between science and technology? Can you give one example of each?

Write down a definition for nanoscience.

Write down a definition for nanotechnology.

Existing applications

Describe something that occurs in nature at the nano scale.

Describe something that has been created by scientists at the nano scale.

Nanoparticles have a large surface area compared to their volume. Can you find out why this is important?

What other types of things could scientists do with nanotechnology? Be creative!