

Toxic socks: nanotechnology, ethics and society

This resource accompanies the article **Help your students understand ethics in science**, part of **Teaching science skills** in *Education in Chemistry* which can be viewed at: rsc.li/3Y2IDkX

Learning objectives

- 1 Practise discussing and debating issues and expressing an opinion.
- 2 Listen to or defend a point of view that may be different to your own.
- 3 Understand more of the technical, physiological, social and ethical issues around nanoparticles.

Learners will consider social, ethical and factual issues in an integrated way. They are encouraged to think about different points of view and learn to back up their opinions with facts.

Introduction

This activity offers a structured practice debate on a controversial topic. The different rounds of the debate help learners think through the issues and reconsider their opinions. The structure also shows them how to build a discussion and back up their opinions with facts.

Tips

- Ensure learners know there is no right or wrong answer.
- Listening is as important as speaking.
- Be observant of learners who want to speak and are not getting a chance.
- Encourage learners to give a reason for their opinions.

Scaffolding

You can use all eight characters, or fewer, as you wish. A minimum is four characters, two for and two against (use Dr Smith, Sol, Dr Foster and Stevie).

For groups who may need extra support you can provide the following sentence starters:

'I think we should/shouldn't use silver nanoparticles in socks because...'

'I agree with your point of view, and I'd like to add...'

'I think ... is the most important point to think about.'

'As I understand your point, you are saying... but have you thought of...'

Lesson plan

The different rounds of the debate help learners think through the issues and reconsider their opinions. The structure also shows them how to build a discussion and back up their opinions with facts.

Starter: 5 minutes.

Ask the class: What do they know about nanoparticles? Why are they used? How are they used? What are the benefits of and/or concerns about using nanoparticles?

Main Activity: 35 minutes.

1. For a whole-class debate: split learners into eight groups, one character per group. OR for group debates: split learners into groups of eight, one character per learner.
2. Give the learners their character cards and give them a few minutes to read them.
3. Get one learner in each group to read out their first section **background** to the rest of the class. What are the class's initial thoughts? Is there one position they identify with or reject?
4. Then take it in turns to read out their character's **fact**. Does this change the way they think?
5. Next, take turns to read out their character's **issue**. Any different feelings?
6. Each character can now ask their question to one other character of their choice.

Support: To help learners, you can put the sentence starters, provided above, on the board.

The task can be extended by asking more than one character to respond to a question or the class can write their own questions to ask.

Plenary: 10 minutes.

Vote for which position they agree with most (if there is one).

Why? Which arguments were the most persuasive?

Note Learners can stay in roles all the way through the debate or only for the first round if you prefer. If it's all the way through, give them a chance to express their own opinion at the end and in the plenary.

For groups who are not confident at class discussion, it might help to begin with a Think, Pair, Share activity:

1. Give learners time to read their character's question and/or their position.
2. Ask learners to find a partner with the same character card to discuss the question and/or position in pairs.
3. Then group together all the learners with the same character to compare notes and build their arguments.

This allows the learners to rehearse some of what they want to say before having to defend the position in a debate.

Background information

Silver nanoparticles are added to products from socks, to bandages, to washing machines because of their antibacterial and odour-fighting properties.

It is the nanoparticles' size that gives them their special properties. For example, silver nanoparticles have longer-lasting antibacterial properties than bigger particles of silver. That's why they can be used in socks to kill bacteria and prevent bad smells.

But scientists are recommending a closer examination of the unforeseen environmental and health consequences of nanosilver. If sufficient nanosilver leeches out of these socks and escapes wastewater treatment systems into nearby lakes, rivers and streams, it could damage aquatic ecosystems. Ionic silver, the dissolved form of the element, does not just attack odour-causing bacteria. The ionic silver particles interfere with chemical processes essential for life in other microbes and aquatic animals. Ionic silver particles can get into the gills of fish and kill them. We don't know the effects of the bioaccumulation of these particles in the food chain. There are also organisations looking at the sustainable development and use of nanotechnology.

Read more

If you are interested in reading more about nanotechnology and socks the article **Silver nanoparticles lost in the first wash** from *Chemistry World* (bit.ly/3YgY3AI) gives more information and links to research and scientists in this field.