AMBER
Advancing Materials for Impact

02

nano 0:10 WOW

scale

Introduction

This lesson focuses on scale from the very big... to the very, very small. It is important to understand that to learn about nanoscience, children must grasp that this science is on a scale so small that you cannot see it. Human hands are too large to handle nanomaterials and therefore very sophisticated tools are needed by nanoscientists to carry out their investigations. The lesson has an accompanying PowerPoint and activities to reinforce scale and why small is important when thinking about nanoscience.

ICT links

The link below is a wonderful resource to explain scale to children. The website allows the user to scroll out into space and then scroll down into the nanoscale. This website link is highly recommended
www.youtube.com/watch?v=uaGEjrADGPA

For the **Alka Seltzer experiment**, outlined later in this lesson, you can also build a rocket out of the film canisters/yogurt containers following the instructions and template here:
www.ohmycrafts.blogspot.ie/2011/06/alka-seltzer-rockets.html

Curriculum links

Science:
Strand: Materials
Strand Units: Properties and characteristics of materials, materials and change

Maths Strand:
Measures and numbers,
place values, operations, length

Maths Strand:
Measurement and operations

Cross curricular links

Geography: Space
Art: Drawing

WALT

- **Understand what scale means**
- **Discuss how keeping things to scale is important**
- **Identify appropriate tools for measuring different lengths**
- **Compare distances to outer space and to the nanoscale**
- **Understand that it would be impossible to work with nano size materials if we did not have the appropriate tools (high powered microscopes)**
- **Reflect on what we have learned about the nanoscale**
- **Understand the importance of scale, surface area and the properties of nanomaterials**

Background Information

All the necessary background information for this lesson can be found in the notes that accompany the PowerPoint. The activities can then be carried out to reinforce what the children have learned in the PowerPoint.

Why is scale and surface area so important to nanomaterials?
One of the main reasons why the properties of materials are different at the nanoscale is because there is more surface area of the material exposed which allows for greater reaction activity.

Explanation of surface area for the children
If you cover the entire outside of a full loaf of bread with butter, you have covered all of the bread's surface area, all of the surface that is exposed. However, if you cut the loaf into two halves, you can see more of the bread, you will need more butter to cover the new exposed parts, you have more surface area.

If you cut the bread into lots of slices, will you need more butter to cover the surface of all the bread? Yes, because you have exposed much more surface area. You would need a larger amount of butter to cover both sides of each slice and all of the crust too.

A HUGE amount of surface area will be exposed when we take materials and break them down into nano size pieces. These tiny pieces, that have lots of surface area, are one of the main reasons why the properties of the materials can behave differently at the nanoscale.

Journal suggestions

- Take photographs of the Alka seltzer activity for your nano journal.
- If a nanometre is the size of a football, then a football would be the size of the planet Earth. Illustrate this.
- Write a paragraph called 'Our School Tour into the Nano-World'.
- Give the children a photograph of themselves, working like nanoscientists using the alka-seltzer pop experiment, to put into their journals. Ask them to write a few lines explaining how they were working like a nanoscientist.

Extension Activity

Encourage the children to draw a picture out of scale. They could draw:

- A huge ant standing on a tiny planet.
- A massive mouse looking at a tiny elephant.
- A tiny boy/girl holding hands with a huge wasp/bee.
- An incorrect scale drawing of their own choice.

Teaching Tips

Teachers or parents are encouraged to allow time for the children to reflect on what they have learned in this lesson. Teachers will be able to assess if the children have grasped the main learning objectives of the lesson by asking questions such as:

- How small is the nanoscale?
- How were you working like a nanoscientist in this lesson?
- What special tools do nanoscientists need to work on the nanoscale?
- Why can they not use their hands?

Trigger questions

These can be used before the PowerPoint presentation to get a discussion on scale started or before the activities to reinforce what has been learned during the presentation.

- Name some measuring tools.
- How do we measure the length of a pencil?
- How do we measure the length of the classroom?
- How do we measure the length of the school yard?
- How would we measure the distance from Dublin to Galway? Cork to Derry?
- How would we measure the distance from Ireland to America?
- Identify three items in the classroom that could be measured using centimetres (cm). Estimate the items' lengths in cm. Measure the items.
- Identify three items in the classroom that should be measured using millimetres (mm). Estimate the items' lengths in mm. Measure the items.
- Examine the millimetre items under a light microscope or a magnifying glass.
- Can you see more detail?
- Do they look different?

Activity
Investigating outcomes when surface area is changed

Safety note:

In the Alka Seltzer activity, the lids of the yogurt bottles need to be placed on tightly and really quickly – this is to allow pressure to build up in the bottle and may need to be emphasized or demonstrated for the children. When the pressure in the containers builds up the lids can pop off with some force – children should be asked to stand well clear of the containers once the lids are in place and should be monitored at all times. Under no circumstances should the children hold the containers when the lids are on and if the container falls over when the lid is on children should move out of the path of the lid.

This activity allows children to see how materials act differently when they are broken into smaller pieces and to investigate reaction rates depending on size.

Equipment

Use small drinking yoghurt bottles (must have flip style lids, screw on lids will not work – Benecol drinking yogurt containers work well) or simply a sealed transparent plastic bag to view the different reactions.

- Two Alka Seltzer tablets per group
- One small mortar and pestle (or suitable implement to grind tablets)
- Clock/timer or watch with a second hand
- Water
- Small measuring beakers or transparent plastic cups (2 per group)

Method

- Grind one tablet into powder using the mortar and pestle.
- Place an uncrushed Alka Seltzer and a crushed Alka Seltzer into separate film canisters.
- NOTE: Each canister should contain Alka Seltzer before you proceed to the next step.
- Simultaneously fill each film canister half way with the same amount of water (do NOT fill completely) and immediately put their lids on tightly.
- Stand back.
- Compare the results – which reactions took place quicker? Why?

Intended outcome and explanation

The crushed tablets should react much faster as they have much more surface area exposed – they have a greater surface to volume ratio, more water can reach the active ingredient in the tablets in a faster time and the reaction, or fizzing, happens quicker. When the fizzing begins a gas (carbon dioxide) builds up inside the bottle and the pressure then blows the lid off.