Living in a material world

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KS2

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Introduction

This scheme of work describes four one-hour lessons that are based on the Year 5 statutory and non-statutory requirements for 'Properties and changes of materials' in the Science Programmes of Study, National Curriculum for England.

The emphasis is on the use of the body to *show* material properties and the changes that can happen to a material. The first three lessons are intended to *complement* classroom learning and experiments. The non-statutory guidance suggests that students 'should find out how chemists create new materials' and in the final lesson, students improvise a significant material-related invention – the sticky or Post-it note. In their exploration of the invention, they will learn how the invention came about because of a frustrating situation that led to a *real need* for reusable bookmarks and how the original material created by Spencer Silver was adapted for this purpose by a colleague also working at 3M. Therefore an important teaching point is that collaborative practices were key in the invention process.

Learning objectives

In this scheme of work, students will:

- Use their bodies to show properties of different materials
- Use their bodies to group and compare everyday materials based on their properties
- Use their bodies to show why some materials are more suited to certain purposes than others
- Use their bodies to show reversible/irreversible changes that occur in different materials
- Learn about the invention of the sticky note
- Work together to devise a play based on the invention of the sticky note.

Lesson 1: Show me a property!

Learning objectives

By the end of the lesson students will have learnt:

- How they can use their bodies to show material properties such as hardness, softness and conductivity
- How materials of similar properties can be grouped together
- That magnetic properties can either attract or repel.

Introduction: review of vocabulary for properties (5 mins)

Gather the students around, pick one flashcard at a time and ask them to call out the property on each flashcard as you show it. Remind them that these labels are *physical properties* objects might have, but are not the name of objects. Shuffle the flashcards and tell the class that you will pick one card at a time and they are to *quickly* show these properties with their bodies. Remind them that there is no need to make noises as the focus is on using their bodies to show the properties.

Showing the properties (20 mins)

Have them all find a space and call out one property at a time. Praise the students for using their bodies to respond quickly to each property.

When you have been through the flashcards, ask them to make a circle. Go through the cards again, but this time invite volunteers to go into the middle of the circle and show how they used their body to respond to each property. Comment on how well the volunteers are showing the properties of hardness, softness, elasticity, etc. For example, with the property of 'hard', make comments about the rigidity of the body shapes, the tight muscles and how the property of 'hard' can sometimes make an 'object' hard to push over or manipulate. (As the

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In planning this scheme of work, I found the STEM learning website very helpful in providing knowledge and resources that stimulated ideas for using the body to demonstrate material properties and the changes of materials. The website can be found at: https://www.stem.org.uk/

Resources

Flashcards with the following properties written on them:

- hard
- liquid
- strong
- tough
- magnetic
- soft
- elastic
- waterproof.

teacher you can pretend to unsuccessfully try to push the volunteer over, or make them bend.) Also, as the students show each property, ask them if they had any particular objects in mind. If not, ask the class for ideas on objects that have the different properties being shown.

Grouping the properties (10 mins)

Ask the students to decide on a property from the list, but not to tell anyone which one they have chosen. Ask them to move around the room in a way that suggests the property. Appeal for a volunteer to observe the 'properties' from the side and to start to make 'groups' of similar properties by placing them together in a space. Tell the students that even if they think they have been grouped 'incorrectly', to just go along with the grouping. Once everyone has been placed in a group, ask the volunteer to explain why they made the choices they did; what it was about the body shapes or the way the person moved that suggested to them what kind of property they were. Afterwards, if anyone was placed in the wrong group they can speak up and explain what property they were pretending to be.

Magnetic properties – opposites attract! (15 mins)

Class activity: Pick one student to be a giant magnet. Have the others spread around the room in role as metal paperclips (or iron filings). Ask the students what will happen as the 'magnet' comes close to each paperclip? Then have the class demonstrate how the big magnet will magnetise each paperclip in turn by having them one by one place their hands on the 'paperclip' in front of them that has just been magnetised by the giant magnet. Continue until the whole class is linked together.

Paired activity: Recap for the class that magnets have two ends called 'poles'; one is called the north pole and the other the south pole. Review how opposite poles attract (pull toward) and like poles repel (push away). Have the students find a partner and tell them they are both in role as magnets. Give them time to:

- Practise movements that demonstrate what it looks like when two magnets are attracting each other
- Practise movements that demonstrate what it looks like when two magnets are repelling each other
- Improvise two different conversations between the magnets – when they are attracting each other and when they are repelling each other. (Encourage the students to be humorous and really imaginative with this.)

Plenary (10 mins)

End the session with the students sharing their improvised conversations between the magnets attracting or repelling each other. They can then leave the room as if they are all magnetised with their hands on the shoulders of the person in front of them.

Lesson 2: Suitable or not?

Learning objectives

In this lesson the students will show:

- They understand why some materials have particular uses
- Why some materials are unsuitable for certain purposes
- An understanding that conductivity is a property of some materials
- An ability to make predictions about which materials make good conductors of electricity.

Introduction (10 mins)

Read out the poem 'Woolly Saucepan?'

Could I have
a woolly saucepan
a metal jumper
a glass chair
and a wooden window-pane please?

Er – sorry – I mean
a woolly chair
a glass jumper
a wooden saucepan
and a metal window-pane please?

Er – sorry – I mean
Oh – blow it!
You know what I mean,
don't you?

Discuss the poem and why it is humorous, focusing on the unsuitability of the materials for their purposes.

Group work based on the poem (20 mins)

Organise the students to work in groups of 3 – 4. Ask them to devise a scene based on one of the images from 'Woolly Saucepan?'. For example, a scene in a DIY shop where the shop assistant(s) are having to convince a customer that a wooden window-pane really isn't a good idea. Or hosting a VIP at a fancy event and giving them a glass chair to sit on …

When the students have had enough time to prepare, ask each group to share their scene. Praise them for their creativity and ask for any real life examples of trying to carry out a task using an unsuitable material. (You could reference the phrase 'as much use as a chocolate teapot'.)

Completing the circuit – or not? (20 mins)

Recap on Year 4 work on electrical circuits when they learned how energy was passed from a battery to a lightbulb through suitable conductor materials. Explain that this lesson will reinforce which materials are good conductors. Show or draw a simple diagram of a circuit and have some students take up positions as a switch, a battery and a light bulb. The student in role as a light bulb can hold a torch. Shout out the name of a material (see below) and have the students decide whether that material would conduct the electrons around the circuit or not. If the majority of the class says 'yes', the student holding the torch can switch it on. The teacher keeps a list of whether the class thinks yes or no. Here are some ideas for possible materials to call out:

- silver
- gold
- plastic
- copper
- graphite
- steel
- dry wood
- brass
- bronze
- glass
- aluminum foil
- rubber
- porcelain
- air

Resources

- The poem 'Woolly Saucepan?' by Michael Rosen can be found in his book *Centrally Heated Knickers* (Puffin Poetry)
- Flip chart paper and pen
- A list of materials (see below for suggestions)
- Torch
- The following website about materials and their conductivity: https://www.thoughtco.com/examples-of-conductors-and-insulators-608318

- pure water
- dry paper.

If the class decides that the material would not be a good conductor, the students who are not in the circuit find a partner and make the shape or act out something that it would be suitable for, e.g. for glass they could act out a scene where a football is kicked through a window and a neighbour reacts angrily.

Keep the list so that those materials deemed suitable for conducting can be tested in the classroom at a later date.

Plenary (10 mins)

Re-read the 'Woolly Saucepan?' poem again. Begin to brainstorm alternative ideas for a poem about totally unsuitable materials for specific purposes. These ideas could be recorded and followed up in a writing lesson when students can write their own poems based on the idea of unsuitable materials.

These poems could make a fantastic classroom display – especially if accompanied by drawings!

Lesson 3: To reverse or not?

Learning objectives

In this lesson the students will:

- Use their bodies to show the dissolving processes
- Use their bodies to show how a substance can be recovered from a solution
- Explore reversible changes
- Reinforce their understanding of vocabulary related to reversible and irreversible changes of materials
- Make predictions about changes in solutions.

Resources:

- A glass of water
- An effervescent tablet
- A teaspoon (or something that will make an audible sound when it hits the glass).

Introduction (10 mins)

Ask the students to close their eyes and listen to an effervescent tablet being dropped into a glass filled with water and fizzing. With their eyes still closed, ask them what they think just happened? Discuss how you began by holding a glass filled with liquid and a chemical compound (the tablet) but now you are left holding only a glass with liquid because the tablet *dissolved* to form a *solution*. Review *solubility* as a *chemical property* that some materials have. Compare with dropping a pencil in the glass to demonstrate the point that it is not made from a soluble material and therefore does not dissolve.

Demonstrating the dissolving process (15 mins)

Split the class into two groups. One group is to represent water molecules and those students are asked to spread out around the hall. They then spin in place and/or (gently) around the hall. The other group is the effervescent tablet. They are to form a 'clump' in the middle of the hall. Hit the glass you were holding earlier with something that is loud enough for everyone to hear. When the students in role as the tablet hear that sound, they separate from each other and blend in with the spinning water molecules by similarly spinning themselves. Hit the glass again as a signal for everyone to stop. Make the point that it is now impossible to distinguish the students who were the effervescent tablet from those who were the original water molecules because they now share the same property of 'solubility'.

Demonstrating a reversible process (25 mins)

Split the class into three groups. Have each group in role as one of the following:

- Warm water molecules
- Salt granules that dissolve
- Salt granules that do not dissolve.

First, set off the warm water molecules and have them spinning around the hall. Then make the clinking sound with the glass and have the first group of salt granules join the water molecules and show they have dissolved by spinning around with the water molecules. Then another clink of the glass is the signal for the next group of salt molecules to be added to the 'solution'. However, this group stays together and do not dissolve because the solution is now over saturated with salt granules. Another clink of the glass is the signal for everyone to stop and review what has just happened to the solution so far.

Ask the following question: What will happen if we leave the water to cool down? If this experiment has already been carried out in the classroom then this will be a review question but if not, the students can make predictions. To show what will happen, the students who are the water molecules evaporate over time

This activity was based on a science lesson 'Growing crystals' found on the STEM website referenced at the start of this scheme of work. Work on recovering a substance from a solution may have already taken place in the classroom and therefore this activity would review the concept of a supersaturated solution (a solution where so much solute has been added that no more dissolving can occur).

and they can do this by 'disappearing' from the solution and sitting down around the edge of the hall. Explain (or review) that if a paper clip is hung into the solution from a piece of thread, the solute molecules that have not evaporated will join up and grow into crystals around the paper clip. A student can 'stand tall' in the middle of the hall as if they are the paper clip and the students who are left as the 'solute molecules' can join together around the paper clip as if they are salt crystals.

A time-lapse camera could record images of this process. It would be fun to play the recording back to the class, and it would be a great way to show how using the body can be an effective way of 'mimicking' scientific processes. A short video of this would also be a great addition to a class webpage!

Plenary (10 mins)

Finish with a review of all the reversible changes they have demonstrated in the lesson (dissolving and evaporation) and ask them for examples of some changes that are irreversible (e.g. burning and rusting). Focus on *the students* as the ultimate example of a reversible change – ask them to review all the things they have pretended to be in this lesson. And now they are to reverse back to being themselves – until the next lesson when they will change into famous scientists!

Lesson 4: Stick it here

Learning objectives

By the end of the lesson students will:

- Learn how the invention of the sticky note came about
- Work collaboratively to devise a play based on the events that led to the invention of the sticky note
- Apply what can be learned from that invention to their own attitudes
- Contribute ideas to a discussion about what inventions are needed in 2017.

Resources

- A book stuffed full of bookmarks
- Information about the invention of the sticky note and Spencer Silver
- Sticky notes (enough for one for each student).

Introduction: Help! (15 mins)

Have the class seated in front of you and tell them excitedly that you have brought in a book that is very 'special' for you because it has lots of different poems/recipes/bits of information that you like to look at or refer to a lot. Have the book stuffed full of traditional bookmarks that you proudly show off as evidence of how much you use this book. As you lift the book up high tell them you cannot wait to read some of the contents to them, but then let the book fall out of your hand so that all the bookmarks are scattered and you are unable to find the material you wanted to share. Make a big deal out of being frustrated with what just happened and ask if anyone has any ideas how you could prevent this from happening again? Hopefully someone will suggest 'sticky notes' or 'post-it notes'.

Read to them information about the inventor Spencer Silver and how the idea of the sticky note came about because of an incident similar to the one that just happened .(Wikipedia is a great source here!) In recounting the story, emphasise that the original adhesive Silver invented wasn't a great success and it took a real-life need for his original idea to be adapted by a colleague (Arthur Fry) for a purpose that is now used by millions of people.

Devising in groups (15 mins)

Ask the students to work in groups of about 5 and to devise a short play based on the invention of the sticky note. The plays *could* include:

- Silver's frustration that his first adhesive wasn't very popular, despite his exuberance at trying to market it to 3M executives
- Fry attending one of Silver's seminars and only partly listening as Silver explained about his adhesive
- Fry's frustration during the choir rehearsal and how this resulted in him remembering Silver's adhesive idea and thinking this could be adapted to make reusable bookmarks
- Fry becoming as excited about the new idea as Silver was about the original adhesive but like Silver, he discovered that his idea wasn't welcomed at first
- Eventually everyone in his office is using the sticky notes
- Both Silver and Fry winning 3M's highest honours for research.

These devised plays could be recorded for a school website or a class webpage. Some of the plays could also be 'polished' and rehearsed further for a presentation during a science day/week or a class assembly.

Presentations of plays (20 mins)

Have each group present their plays to the rest of the class. Praise each group for their cooperation and creativity in showing how the invention came about.

Plenary (10 mins)

Give the students a sticky note each and ask them to write down something that we can learn from the background to this invention. Hopefully their ideas will

highlight attributes such as persistence and cooperation. You could also highlight that most inventions come about in response to a need or an accident, and therefore mistakes can be positive events rather than negative ones. Finish by asking them what inventions they think are needed in the world right now to make it a better place. Their ideas could be expanded upon in a writing session or PSHE lesson and accompanied by drawings for a class display.

Other organisations and websites that may prove helpful for the science content of this scheme of work include:

- The Association for Science Education: https://www.ase.org.uk
- Primary Science Teaching Trust: https://pstt.org.uk/