

## Notes for teacher

One in seven people have cancelled hospital appointments because they are too scared to go, according to recent research asking 2,000 people about their attitudes to their health, hospitals and medical appointments.

In 2015 Siemens developed the MRI Scan Experience app to help reduce the fear of having an MRI scan. This free interactive app aims to ease fears following referral for an MRI scan and features in this lesson plan with suggestions for how it can be used to stimulate or reinforce learning activities. It is available on iTunes and Google Play. Find out more about this and other useful resources at: [www.siemens.co.uk/en/index/mri-scan-virtual-experience-app-to-ease-fears.htm](http://www.siemens.co.uk/en/index/mri-scan-virtual-experience-app-to-ease-fears.htm)

## Overview

### MRI Scan Experience

The purpose of this lesson is to encourage pupils to learn more about what MRI imaging is, what it does, why it is useful and what it's like to have a scan. The aims are to:

- Develop pupils' understanding of the purpose of medical imaging in general and MRI imaging in particular
- Develop a positive disposition towards MRI imaging, so that if pupils need to undergo such a procedure they are clearer about the purpose and the process, and more likely to undertake it.

The lesson plan provides ideas and outcomes to use around the app and supports teachers in using both the app and other Siemens Education resources to produce an engaging and effective lesson.

The lesson is divided into four episodes:

1. Introduction
2. Engagement activities
3. Development activities
4. Using the MRI Scan Experience.

It is designed to be adapted to work with students of a wide range of ages and therefore a choice of activities are offered for each of the episodes; these are shown as A, B and C. In most instances the later ones are for older students but the teacher has the flexibility to select according to the learning needs of the particular class.



### MRI scanning and relation to age of students

MRI scanning is a valuable and effective form of medical imaging that can be used to produce a range of high quality images and, in so doing, aid medical diagnosis. The technology used to produce the images is relatively sophisticated in relation to concepts met in school science and it is only at KS4 that students are likely to have encountered the underlying concepts that support a fuller understanding. However, younger students can be introduced to the idea that 'looking inside the body' can help doctors make more effective diagnoses.

The learning can also be put into a broader context. Some people find MRI scanners off-putting both in terms of the noise they make and the claustrophobic nature of being inside the machine. Although it is difficult for classroom activities to directly counter either of those reactions it is nevertheless quite possible to set them against the background of both:

- an understanding of the importance of imaging to aid diagnosis
- a broader sense of supporting one's own physical well-being by taking full advantage of a comprehensive and effective health service.

### How MRI scanning works

For the benefit of older students (and interested teachers), MRI scanning works as follows: the patient lays inside the MRI scanner, which generates a magnetic field which changes rapidly in strength. This oscillating field excites protons in tissues in the body that contain water molecules.

These protons emit radio signals which are detected by coils in the scanner and interpreted to produce images. Changing the magnetic field at different rates helps to identify the position of different tissues and it is these changes that cause the distinctive sound. Contrast between them shows up by the rate at which the excited particles return to their previous state; this may be enhanced by contrast agents which may be administered in a variety of ways.

MRI scans aren't the only way of producing images. However they do have a number of advantages. Unlike X-rays the radiation involved is far less dangerous and doesn't carry the same risks of radiation induced cancer (which also applies to CT scans). MRI scans take longer though, usually between 20 and 40 minutes, during which time the patient is inside the scanner.



## Curriculum Links

The lesson supports a number of specific objectives from the National Curriculum and GCSE subject criteria:

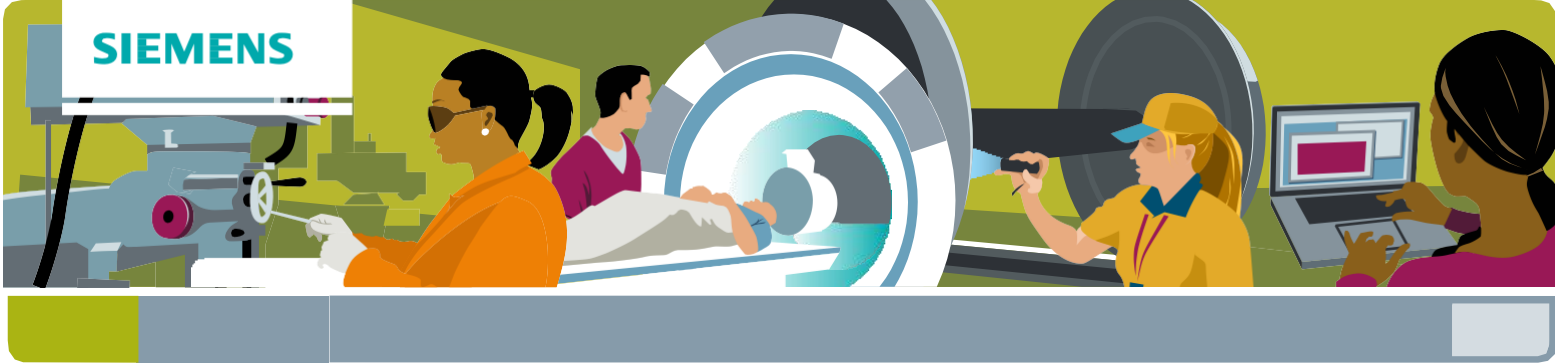
Science	
KS2	Pupils should be introduced to the main body parts associated with the skeleton and muscles, finding out how different parts of the body have special functions. Pupils should learn how to keep their bodies healthy and how their bodies might be damaged – including how some drugs and other substances can be harmful to the human body.
KS3	Pupils should be taught about: <ul style="list-style-type: none"> <li>the hierarchical organisation of multicellular organisms: from cells to tissues to organs to systems to organisms,</li> <li>the structure and functions of the human skeleton, to include support, protection, movement and making blood cells,</li> <li>the tissues and organs of the human digestive system</li> <li>how to interpret observations and data, including identifying patterns and using observations, measurements and data to draw conclusions.</li> </ul>
KS4 GCSE Physics	Students should be taught to: <ul style="list-style-type: none"> <li>explain, in qualitative terms, how the differences in velocity, absorption and reflection between different types of waves in solids and liquids can be used both for detection and for exploration of structures which are hidden from direct observation, notably in our bodies ...</li> <li>recall that different substances may absorb, transmit, refract, or reflect these waves in ways that vary with wavelength</li> <li>recall that radio waves can be produced by or can themselves induce oscillations in electrical circuits</li> <li>recall that changes in atoms and nuclei can also generate and absorb radiations over a wide frequency range</li> <li>give examples of some practical uses of electromagnetic waves in the radio, micro-wave, infra-red, visible, ultra-violet, X-ray and gamma-ray regions and describe how ultra-violet waves, X-rays and gamma-rays can have hazardous effects, notably on human bodily tissues.</li> <li>describe how to show that a current can create a magnetic effect and describe the directions of the magnetic field around a conducting wire</li> <li>recall that the strength of the field depends on the current and the distance from the conductor, and explain how solenoid arrangements can enhance the magnetic effect</li> </ul>



**PSHE (Personal Social Health Education Association Programme of Study)**

KS2	Pupils should deepen their understanding of risk by recognising, predicting and assessing risks in different situations and deciding how to manage them responsibly and to use this as an opportunity to build resilience
KS3	Pupils should be taught ways of recognising and reducing risk, minimising harm and getting help in emergency and risky situations
KS4	Pupils should learn about checking for cancer and other illnesses, including knowing what to do if they are feeling unwell and checking for signs of illness; and how to overcome worries about seeking help and being an assertive user of the NHS

It also provides links to resources which provide a more general introduction to MRI and other imaging technologies, (x-ray, fluoroscopy, and ultrasound), how they are used to help patients and explore some of the people (professions) that use them.



## Episode 1 Introduction

A. Ask students to consider questions such as:

- How do we know what's inside the body?
- How do we know how various organs function?
- How can we tell if they're not working?

The idea here is not to develop detailed and drawn out explanations but rather to set a few ideas running about how medical practitioners can gather evidence. Responses might include use of dead bodies, surgical operations, careful observation, X-rays/other imaging techniques.

B. Show the video on MRI scanners such as the one at:

[www.youtube.com/watch?v=AwXJNXNcLNsat](http://www.youtube.com/watch?v=AwXJNXNcLNsat) - shown at support slide 1\_and discuss with students what it is and what it does.

C. Show a picture of a scanner such as the one on support slide 2 and ask questions to stimulate discussion, such as:

- What it is?
- What does it do?
- How does it work?

The idea here is not to try and elicit a detailed explanation (though fine if one is offered) but rather to establish some outline points, such as: it's to scan a person, it produces images and the person goes inside it. If you add that the person mustn't have any metallic objects on them, this might prompt ideas about magnetism and waves.



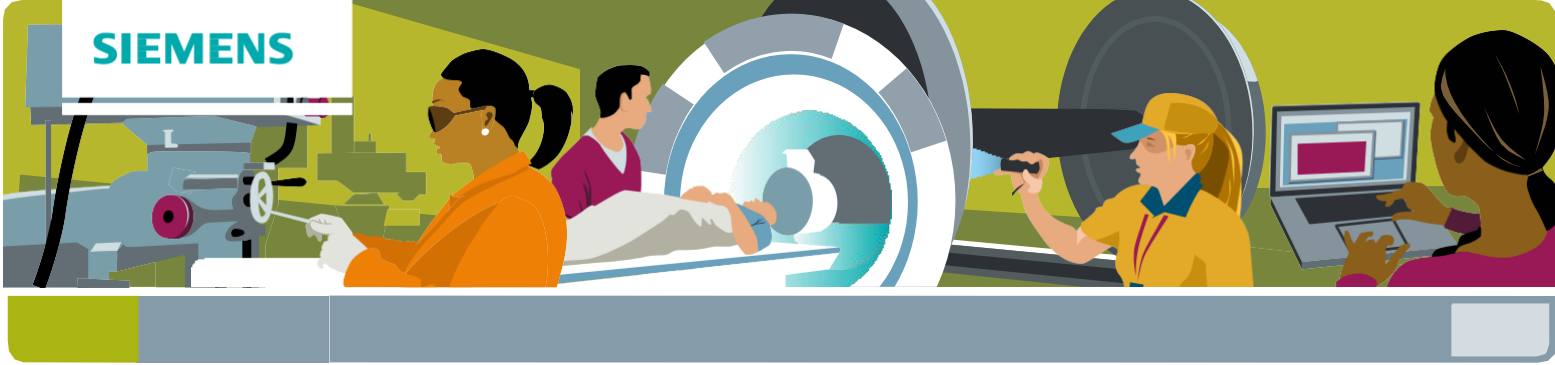
## Episode 2 Engagement activities

There are a number of ways of engaging students in the main ideas of the lesson. Several ideas are included here and although some may be more suitable than others for particular groups, most can be adapted in various ways for different age groups.

- A. **Feely bags:** the idea here is to challenge people to identify objects from touch alone, and with the sense of touch being limited with cloth. One of the ways of doing this is to ask for a volunteer, provide them with gloves to wear and then blindfold them. Make sure they are comfortable with what they are being asked to do and that they have no medical condition (such as a reaction to the type of glove being used) that would cause problems. The gloves could be woollen, fabric or washing up gloves – very thin plastic is not suitable as the sensation of touch will be less reduced. Then give them various objects to try to identify. Choose objects carefully and don't include ones that could cause injury. Possibilities might include a hand drill, a garlic press, Bunsen burner (without rubber tubing) and a car wheel brace. They shouldn't necessarily be items that will be recognised as such but suggestions as to material or application should be invited. Draw out the point that working with a limited range of senses makes it difficult to identify objects, especially if vision cannot be used. Point out that having a clear image is a great help in diagnosing situations.

- B. **Show an image:** have some medical images to display and discuss such as shown on support slide 3. These don't need to be MRI images – X ray images are good because they are often very clear. Include ones for example showing: a broken bone, a screwed joint, an odd object that has been swallowed and then ones that take more interpretation, such as the shadow in a cancerous lung. Draw out the point that images are a great help in forming a diagnosis of a situation.

- C. **Tell a story:** Hayley is 12 years old and suffers from headaches on a daily basis. They sometimes stop her from studying at school or spending time with her friends so her mother took her to see a doctor. She has now been asked to visit her local hospital for an MRI scan. She saw a specialist recently, who wants a brain scan to be taken. Hayley has seen pictures of an MRI scanner and realises that she'll have to lie inside the machine, very still, for quite a long time. She thinks she can manage this but a friend told her that her dad had one done and he was surprised how noisy it was. She has talked it through with her mother but is still rather nervous. It's clear that the specialist needs the brain scan to see what the problem is but Hayley finds the thought of being in the machine pretty frightening. The headaches are bad and she wants them to stop but the scan seems worrying as well. What should she do? What might you say to her to make her feel more positive?

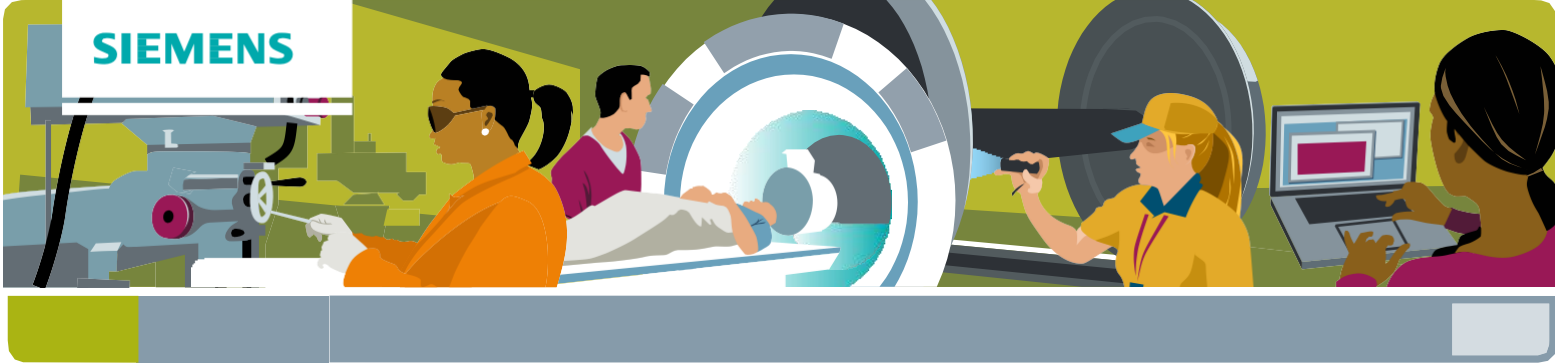


### Episode 3 Development activities

A. Work out what's in the body. Start off with a large sheet of paper (part of a roll of decorators' backing paper is suitable) and draw an outline, life size, of a pupil on it. Then ask various pupils in turn to draw on various internal organs, trying to get the size and position correct. Then ask the class to compare this with an anatomical diagram or model.

B. Use the internet to find out more about radiology at your local hospital and explore various features. This can either be done as a demonstration or with students working in pairs, depending on the class and technology available. Ask students to gather ideas from this and then ask for contributions on key points.

C. Finding out how a scanner works. Use a diagram of a scanner such as the one shown on support slide 4 and a description of its operation and ask students to use both to develop explanations. Students could do this in small groups; one group could then present an explanation to another group, who then have to provide feedback on the effective features and what could have been even better.



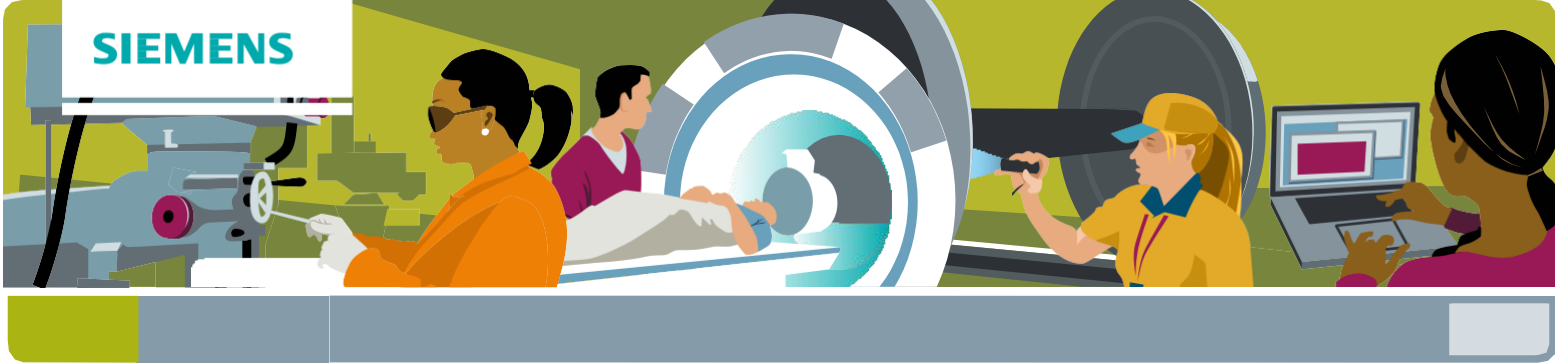
### Episode 4 Using the MRI Scan Experience App

This app for adults and children helps to ease fears following referral for an MRI scan. It enables the user to experience a 360° virtual MRI scan (complete with realistic sounds); scan items; find out more about the steps from referral to results; and have a wide range of questions answered about the technology and process. It's designed as an effective way of helping people of a wide range of ages find out in advance what it's like to have an MRI scan. With the sound turned on, the user lies down and leans back; they then move the tablet around to see what it's really like to have an MRI scan. (The app is available for Apple iPad and iPad mini, and Android tablets and phones.)

This can be used in the lesson in a variety of ways, depending upon the group and on the availability of technology. Possibilities include:

- In the 'kids' section:
  - A. Using the 360° view to see what it looks like inside the scanner
  - B. An explanation of how MRI scanning works
  - C. A comparison of the noise level with various domestic objects
  - D. Seeing what scans of various objects look like
- In the 'adults' section:
  - A. A video about the scanning procedure and how it works
  - B. Sample MRI scans (students could be asked to identify the parts of the body)





## Plenary activity

A. Using the Siemens '[Life without STEM](http://www.siemens.co.uk/education/en/students/interactives.htm)' resource. Go to: <http://www.siemens.co.uk/education/en/students/interactives.htm> and choose the Healthcare option. Show students various medical procedures and ask them to respond to the questions.

B. Using the '[Inside the Human Body](http://www.siemens.co.uk/education/en/students/interactives.htm)' resource. Go to: <http://www.siemens.co.uk/education/en/students/interactives.htm> and show the MRI video of the heart pumping in the Circulatory System section. Ask students to suggest what is happening in the video and why a doctor might find this useful for diagnosis.

C. Using the '[Inside the Human Body](http://www.siemens.co.uk/education/en/students/interactives.htm)' resource. Go to: <http://www.siemens.co.uk/education/en/students/interactives.htm> show the MRI video of the blood journey. Draw attention to the graphic (top right) that shows the scan position and ask students to interpret what is being shown and how this shows how effective a scanner is. Draw out that it is section views at different levels – showing cross sectional views at any level required.



## Extension activities

If students are interested in exploring more about ideas raised in this lesson, there is a range of assets they can explore freely online. These include:

- Exploring inside the human body: [The Human Body](http://www.siemens.co.uk/education/en/students/interactives.htm)  
<http://www.siemens.co.uk/education/en/students/interactives.htm>
- Finding out about the impact that technology has had on modern life: [Life without STEM](http://www.siemens.co.uk/education/en/students/interactives.htm)  
<http://www.siemens.co.uk/education/en/students/interactives.htm>
- Finding out more about radiology: [www.radiologyforkids.com](http://www.radiologyforkids.com)

## Other teaching resources

If you've found this resource engaging and useful and would like to explore other materials, go to the [Siemens Education](http://www.siemens.co.uk/education/en/) website at: [www.siemens.co.uk/education/en/](http://www.siemens.co.uk/education/en/).

Other materials relating to Healthcare issues include:

- **The Human Body 7-11 years**  
A series of activities to enable pupils to understand parts of the body and what they do.  
Part 1 explores the skeleton and muscles; encouraging pupils to think about how a skeleton does the different things it needs to.  
Part 2 explores digestion and how the body gets what it needs from food.  
Part 3 explores circulation and how this system works.  
All three sections are supported by the [Inside the Human Body](#) interactive learning tool.
- **Now Hear this - 12-16 years**  
Understand the process of hearing and the use of loudness and frequencies to compare sounds.
- **Picture This - 12-16 years**  
Helps students to develop a sense of scale and proportion with regard to measurement of frequency and understand concepts of sound and ultrasound with use of a wave model.
- **Medical Magnets Workshop - 12-16 years**  
Help students understand how engineers apply knowledge of physics and magnetism to develop MRI scanners. Students experiment with magnets to learn about resonance, and how this knowledge can be applied to real life-saving applications.
- **A Peep Inside – 14-16 years**  
Understand how MRI scanners produce images; apply their understanding of waves and particles to this application and describe typical uses of MRI images.