# Science lessons for Grade 3

## Lessons in this section

**Life science**

1 Exercise and pulse rate

**Materials**

2 Why don't we make bottles out of paper?

3 How much water can things soak up?

**Physical processes**

4 Magnetism

Resource sheets for the lessons

## Using these lesson plans

These sample lessons for Grade 3 are suitable for use with a whole class. The lessons are single examples to illustrate different teaching and learning activities. They are not intended to be taught as a sequence. They are drawn from different topics and points in the teaching year to show spread rather than sequence.

The objectives for the lessons are drawn from the standards for Grade 3. The relevant standards are shown in the lesson plans.

The lesson plans indicate any safety issues relevant to the lessons. They also provide equipment lists and any short- and long-term preparation required by the lessons. Some of the plans include notes that provide additional information relevant to the teaching of the lesson that may not be readily accessible elsewhere.

Most of the lessons are organised in three parts: an introduction to the lesson, a main activity, and a final phase to help students to reflect on the lesson and consolidate their learning. As part of the introduction, you should outline the purpose of the lesson, drawing out for students what they will learn and how this builds on previous work. In the final part of the lesson, you will need to establish the key learning points, what students need to remember and what they will go on to learn next. There is no expectation that students should copy out the key learning points in their exercise books.

The lesson plans do not include homework tasks because the lessons are single examples taken out of sequence. If your school's policy is to provide homework for Grade 3, you will need to provide this, since homework is an important part of a lesson.

Each lesson plan has enough material to support about 45 minutes of teaching. You may need to supplement the activities with simpler or more challenging tasks if the students in your class have a range of attainment. You could choose from activities in textbooks or from your own resources. If you wish, different tasks can be given to different groups of students, according to their needs.

For some classes there may be too much material in the lesson plan for 45 minutes. In this case, you could designate one of the activities in the lesson as homework, or carry it forward to the next lesson. Be selective about which activity to cut – it does not have to be the last one merely because it comes at the end.

Most lessons will involve the teaching of scientific enquiry standards as well content standards. The lessons in this grade offer particularly good opportunities for this and one of them, lesson 3.3 ‘How much water can things soak up?’, also illustrates a procedure for assessing mastery of a scientific enquiry skill: devising a fair test.

# 3.1 Exercise and pulse rate

## Objectives

- Know that the heart pumps blood around the body in blood vessels.
- Know how exercise affects heart rate.
- Use appropriate equipment to measure time.
- Make systematic observations and identify patterns.

## Preparation

The practical aspects of this lesson could be done outdoors or in the school hall. You will need to make appropriate arrangements for this. If you stay in the classroom, warn other teachers that the class may make some noise as they do exercises.

For the consolidation section of the lesson, prepare a set of large cards, each with one of the following words or phrases written on it:

| | | |
|---|---|---|
| pulse rate | heart rate | stays the same |
| increases | decreases | exercise |
| resting pulse rate | pulse rate after exercise | returns to resting pulse rate |
| food and oxygen | work | energy |
| blood system | muscles | |

## Safety

In this lesson you will ask students to do some physical exercise. It is important that you know of any student for whom this would be inappropriate medically. Make sure also that no student feels forced into doing exercise or would be embarrassed by doing so. Exercises could be running (outside or in the hall), running on the spot, bending and stretching the body, arm or leg lifts. Whatever is done must not put anyone in danger of injury. Running up and down stairs or in corridors is NOT recommended. While this exercise should be vigorous it should not be strenuous. It must be appropriate to the individuals and not put them or anyone else in danger

## Introduction

**Vocabulary**

artery
blood vessels
energy
exercise
heart
pulse rate
stopwatch
timer
vein
work

### Telling the time

Ask the class about telling the time, leading the questioning to ways of measuring a period of time:

Q **What time is it?** (most students should be able to answer by reading the wall clock)

Q **How many minutes have passed since the lesson started?** (some may know this but the main points here are that (1) they need to know when the lesson started and (2) they need to subtract)

Q **If I wanted to know how long it took to do something, what could I do?** (note the time at the start and at the end of the event and find the difference)

Q **How could I make timing easier to do?**

If necessary, put the above question into context by referring to sports events in which the time to complete a run or swim is measured with great accuracy.

Discuss students' responses, establishing the value of using a stopwatch or timer that is set to zero at the start of an activity and stopped at the end. The display shows the time period with a high degree of accuracy.

This would be a good time to show a stopwatch or timer, demonstrate its operation and tell students that they are going to use one in the lesson. For the main activity students will be grouped into fours and this would be a good time to establish the groups and allow them to practise with a stopwatch or timer (see notes below).

## Main activity

## Measuring pulse rate before and after exercise

**Resources**

Stopwatch or timer per group

Resource 3.1 (one per student)

### Activity 1 Establishing resting pulse rate

In this part of the lesson students may need to work in small groups to share apparatus and help one another to measure their pulse rates before and after exercise.

Introduce the concept of pulse rate and demonstrate how to detect this.

Ask students to look at their forearms and to clench their fists. This should make the blood vessels on their arms more prominent.

**Q What are the blue lines you see in your arms?** (blood vessels)

Write the words *blood vessels* on the board and explain that these are connected tubes that run all over their bodies. Encourage students to tell you about any other parts of their bodies where they have seen blood vessels.

**Q What substance flows in the blood vessels?**

Stress that blood vessels are part of our blood system and take blood to all parts of the body.

**Q What makes blood flow?** (the heart pumps blood round the body through the blood system)

Ask students to feel their heart beat by placing their hand on their chest (you may have to direct them to the position of their heart left of centre of their chest). Check that all students know that the heart pumps blood, then say that measuring how quickly the heart beats tells us how fast the heart is pumping blood round the body.

Explain that measuring heart beat is not easy or convenient to do but that we can take other measures of how quickly blood is being pumped round the body. Ask:

**Q Does anyone know another way of measuring how quickly blood is being pumped round the body?**

Check whether students know about pulse. For example, students may have had their pulse taken by a nurse or doctor but may not have realised that this provides an indication of blood flow round the body. It is important that this link is made.

In the next part of the lesson you need to establish the concept of pulse rate. Explain that rate is the speed at which something happens. Draw parallels with the speed of cars. While the speed of cars is measured in miles or kilometres per hour, pulse is measured in beats per minute – hence the need to measure a minute accurately with a stopwatch or timer.

Give out **Resource 3.1** and show students how to locate their pulse, count the beats and calculate the rate. The best places to locate a pulse are on the forearm and neck. Pulse should be detected with the forefinger and not the thumb.

Allow students time to locate and practise counting their pulse. Some students may have difficulty in locating a pulse; they could pair up and take the pulse of a partner.

Once students are confident about detecting and counting pulse, ask them to sit quietly for two minutes, count their pulse for 30 seconds, and note this on the resource sheet. They should be asked to double this to get their pulse rate per minute. Some students may wish to do this several times; higher attaining students should be encouraged to do so and to select or calculate a value to report.

Draw the following table on the board and collect the pulse rates of students.

| Range of pulse rate | Number of students |
|---|---|
| less than 60 | |
| 60 to 64 | |
| 65 to 69 | |
| 70 to 74 | |
| 75 to 80 | |
| over 80 | |

Reassure students that if their pulse rate does not fall into the range in the table, or if it is not in the largest group, that does not mean they are unusual. The most likely explanation is that they are inexperienced at measuring pulse rate.

### Activity 2 Measuring pulse rate after exercise

Having established their resting pulse rate students should now be instructed to do some appropriate exercise for about 5 to 10 minutes. While this should be vigorous it should not be strenuous. It must be appropriate to the individuals and not put them or anyone else in danger.

Immediately after the exercise, ask students to count their pulse for 30 seconds, calculate their pulse rate in beats per minute and record this. Gather class results on the board in a simple table.

| Change in pulse rate after exercise | Number of students |
|---|---|
| lower | |
| no change | |
| higher | |

You could discuss the actual changes in pulse rate and get students to try to account for these in terms of the nature of the exercise taken, the vigour of engagement, the length of the exercise period and the fitness of the individual, but the main point to establish is that exercise results in an increased pulse rate.

Round off this section of the lesson by asking students to measure their pulse rate again. They should find that it has decreased and, depending of the length of time since the exercise, may have returned to its resting level.

## Consolidation

**Resources**

Large vocabulary cards (see 'Preparation')

In the final section of the lesson reinforce the conclusions that exercise results in a rise in the resting pulse rate and that this higher rate eventually returns to the resting rate. The length of time it takes for the exercise rate to return to the resting rate is an indicator of fitness.

Encourage students to consider why their pulse rate rises with exercise by asking questions such as:

**Q What is the effect of an increase in your pulse rate?**

**Q How does the rate of blood flow relate to your pulse rate?**

**Q What is in the blood that may be needed when you do exercise?**

**Q What parts of your body need a better supply of blood when you do exercise?**

**Q Why do parts of your body need more of what is being carried in the blood when you exercise?**

Discuss students' responses. Clarify their understanding that during exercise the muscles do more work than when you are resting and consequently need a better supply of food and oxygen. This food and oxygen is pumped to the muscles in the blood system. A higher heart rate is required to get the food and oxygen to the muscle faster. The higher heart rate is reflected in a higher pulse rate.

Involve as much of the class as possible in a final consolidation activity using the cards you prepared earlier. Ask students to work together to sequence the cards on the wall or board to describe and explain situations of: (1) rest; (2) during exercise; (3) immediately after exercise; (4) some time after exercise.

## Other tasks

As a homework activity students could be asked to determine if the pulse rates of adults are different from those of students of their age.

### Summary for students

- Exercise increases your pulse rate.
- An increased pulse rate means your heart is beating faster.
- Your heart beats faster to pump more blood to your muscles.
- Your muscles need to do more work when you exercise.
- Blood carries food and oxygen to your muscles.
- Your muscles need food and oxygen to provide energy to work.
- The more work done, the more energy your muscles require.

## Notes

If you do not have access to stopwatches or timers, use a large analogue wall clock with a second hand that can be seen by all the class; alternatively, ask students with their own wristwatches to use these. Neither method should be relied on to produce accurate results. If no stopwatches or timers are available, the lesson plan will need to be modified. If you have just one watch or small clock, then you may have to do the timing and tell students when to start and stop counting their pulse beats.

# 3.2 Why don't we make bottles out of paper?

## Objectives

- Classify simple materials in various ways on the basis of their physical properties
- Identify and recall a range of common materials such as different cloths, plastics, paper, ceramics and construction materials.
- Know that the use we make of materials depends on their properties.
- Classify data according to shared characteristics and identify trends and patterns.
- Display data and observations in tables.

## Preparation

At the beginning of this unit, an exhibition of common and/or interesting household objects will have been set up with the help of the students, who may have brought things from home. Much of the work of the unit, including this lesson, makes use of this exhibition. Students will already have classified the objects according to the use we make of them and also according to the material from which they are made. This lesson links properties of materials to the use we make of them. Two products of this work will be word boards: one a list of the names of objects and a second a list of the names of different materials. These will be needed for this lesson.

Note that, as for all science lessons, the seating arrangement is important. Students should be sitting in groups around tables or desks that have been placed together. Group sizes can range from about four to ten.

## Introduction

**Vocabulary**

cheap, expensive
flexible, rigid
hard, soft
light, heavy
strong, weak
warm, cold

Ask the class some questions about some of the objects in the exhibition, or some common objects around the classroom. The questions should start them thinking about the suitability of the material to the purpose for which it is being used. Examples might be:

**Q Why is this cup made of pottery and not paper?**

**Q Why is this shopping bag not made out of concrete?**

**Q Why are your clothes not made out of wood?**

The answers are fairly clear. Now ask questions about the desirable properties of materials for a particular purpose. At this point you should start writing down some key words that describe useful properties of materials. This should be on a word board and the list can be added to throughout this and subsequent lessons when a new property is mentioned. The words could be put together in pairs of opposites.

**Q Why is paper a useful material to make books out of?**

**Q Why are cups made out of pottery / spoons made out of metal / clothes made out of cotton / etc.?**

These ideas are then developed in the main activity.

## Main activity

**Resources**

Objects from the exhibition

## Relating materials to their use

*Students should work individually but collaboratively. Time: 20 minutes.*

Place a variety of objects in the centre of each group. Ask students to make a table with three columns in their books. The first column should be headed 'Object', the second 'Made of' and the third 'Why?'.

Students should take one of the objects from the centre of the table (or objects around the class) and write its name in column 1. Alternatively, they could sketch a picture of the object. In column 2 they should write the *main* material from which the object is made. In column 3 they should write some words (or a short sentence) that describe why the object is made of this material. An example is shown here.

| Object | Made of | Why? |
|---|---|---|
| Nail | Metal | hard, strong, cheap |
| Window | Glass | transparent, hard, cheap |

Faster students should be encouraged to add more properties to the last column. In this case they might add something like 'metals do not bend easily' or 'metals can be sharpened to a point'. Faster students may also wish to introduce some further classifications, such as different kinds of plastics or different kinds of metals. They should be encouraged and helped.

Circulate around the groups, assisting groups with new words that describe the properties of materials (e.g. 'transparent') and individuals with difficulties they may be having. New words should be added to the word board.

## Consolidation

Bring the class together and ask individuals for some of their results. Write them on the board. By questioning the rest of the class, try to expand on what is written in the third column. An example might be that shopping bags are made from plastic because it is cheap, light and flexible. You could add that it is strong and can stretch but does not easily tear or break.

Another example might be a brick. Students will say that it is used in building because it is strong. However, it can be easily broken if you try to knock off a corner, but it is not easily broken by standing on it. It can be described by a sentence such as 'strong when you press on it' (do not use phrases like 'high compressive strength' at this stage)

A third example might be a saucepan. One reason why saucepans are made of metal is that metals conduct heat well (you can talk about how easily the heat gets through the saucepan to the food). However, the handle is often made of wood or plastic because these materials do *not* conduct heat well, so the handle does not become hot when the saucepan is used.

Add some phrases such as those used above to the word board and invite students to write them in their tables.

## Other tasks

**Resources**

Resource 3.2

Students can be encouraged to think back to work in Grade 2 about the differences between materials that are natural and those that are manufactured, and about the well-known manufacturing processes that they studied, such as the firing of clay. They will realise that very few materials are natural (wood, wool, cotton, leather) and most have been manufactured. They will recall that even cotton and wool have been changed by spinning and weaving and leather has often been made softer by

beating it. Students could add an extra column to their table called 'Natural or synthetic?', and complete it appropriately. If they know about the manufacturing process, they can write a few words about it.

**Resource 3.2** will help students with both their science and their language. It is particularly useful for students studying science using English as the language of instruction. The work can be done at home.

**Summary for students**

- Materials can be classified according to the use we make of them.
- The use we make of materials depends on their properties.

Notes

## Crossword answers

*Across*

1 fire

4 soft

5 clay

6 light

7 thread

8 strong

*Down*

1 flexible

2 metal

3 polythene

4 cotton

# 3.3 How much water can things soak up?

## Objectives

- Know the use we make of materials depends on their properties and devise tests to find out how appropriate they are for the use made of them.
- Display data and observations in a table.
- Devise a fair test or comparison and recognise when conclusions are justified.
- Make systematic observations.

Note that an important objective of this lesson is to provide experiences in a variety of scientific techniques rather than teaching a specific content item.

## Preparation

Collect a good supply of waste or used materials, such as bits of cloth made of different fibres, plastic bags, cotton wool, dishcloths, various newspapers or magazines for waste paper.

Cut the materials into suitable sizes that are approximately the same mass.

## Introduction

This is one of a number of lessons investigating the properties of different materials so that judgements can be made about their suitability for the purpose for which they are used. This lesson is concerned with how much water materials will absorb.

Open the lesson with questions about what we use a dishcloth for and why. Hold up a dishcloth and ask:

**Q What do we use this for?**

**Q Why do we use it in this way?**

This questioning should lead to the fact that a dishcloth is good for mopping up water spills. This can be demonstrated to the class. Ask more questions to show why we use a dishcloth and not other materials:

**Q Why do we not use a plastic bag for soaking up water?**

**Q Why is a cloth good for cleaning up water?**

**Q Is paper good for cleaning up water?**

Then come to the key question:

**Q How can we find out how good something is for mopping up water?**

This will lead to many ideas. Direct the suggestions towards how to make the test fair. Hold up a small piece of paper and a large dishcloth and ask:

**Q Which will mop up most water?**

**Q How can we make the test fair?**

This should lead to the idea of using the same size (mass) of material in each experiment? (See the notes below for other ideas.) Then direct the suggestions towards measuring water quantity:

**Q How do we know how much water the cloth has soaked up?**

This will lead to a number of suggestions. Direct the suggestions to some kind of calibrated container for the water, such as a glass jar with marks on it. (See the notes below for other possibilities.)

## Main activity

## Testing how much water materials will soak up

**Resources**

Glass jars
Kitchen scales
Ruler
Pieces of different material
Paper of different kinds
Plastic bags
Cotton wool
Dishcloths
Kitchen roll
Access to water

*Students should work in groups of up to four. Time: 20 minutes.*

There are no instructions for this work. Each group must first discuss the problem and make a plan to compare three different materials. The materials provided should already be cut into suitable sizes that are approximately the same mass.

The groups should be encouraged to do some preliminary testing to help develop their ideas. Assist them with this process with questions such as:

**Q How will you measure the amount of water absorbed?**

**Q How will you make sure that you always use the same amount of material?**

It is important, however, that the tests should be designed by the students and do not come from you. (See the notes below for a further discussion of this.)

Students may need to be shown how to use the kitchen scales.

Students will carry out the tests and take results. Encourage them to think about how they might improve the tests; they can then, if time permits, refine the work and obtain better results.

The results will be a collection of observations and measurements that should be displayed in a table. If the results are numerical, they can be displayed in the form of a block graph or in a pictogram. Students could be encouraged to make a public display on a pinboard that shows the materials used and how much water they absorbed.

## Consolidation

Bring the class together to talk about their experiences. Ask someone from each group (or from selected groups) to report briefly on what they did and why, what was the main difficulty they encountered, and what they found out:

**Q Tell us what you did?**

**Q Which piece of material soaked up most water?**

**Q How did you measure how much water the material soaked up?**

Ask students randomly how they tried to make their test fair:

**Q Did you use the same amount of materials each time?**

**Q How did you measure the amount of material you used?**

Ask questions about how they could improve the test:

**Q What was the biggest problem that you came across in your experiment?**

**Q If you did the work again, what changes would you make?**

Finally come to a conclusion:

**Q Which material is best for soaking up water?**

**Q Why do you say this one is best?**

**Summary for students**

- Different materials can absorb different amounts of water.
- Devising a fair test for absorbency means that the same mass of each material must be compared and a method must be developed for measuring how much water has been absorbed.

**Notes**

## Problems that students are likely to encounter

**How to make the test fair and use the same amount of material**

Should the pieces be the same area, or volume, or mass? Encourage students to use the same mass.

**How to find out how much water different fabrics will absorb**

An easy way is to fill a jar up to a mark with water. Put in the material and leave it to absorb water. Take it out slowly and allow it to drip into the jar for a short time. How long? Measure with a ruler the depth of water that has been absorbed.

More advanced students might see the value of calibrating the jar in volume units. You could have one or two calibrated jars ready.

Some students may decide to measure the increase in mass of the cloth by weighing it before and after it is dipped in water.

Some students may decide to use a constant amount of water and see how much of each material is needed to absorb it all.

**How to decide when a fabric has absorbed all it can absorb**

One fabric may be dripping water when the measurement is taken but another may not. They must be in a similar state when the measurement is made. One way is to squeeze them all lightly so that they no longer drip or to leave them until the drips have almost stopped.

Students should be encouraged to think about these problems themselves and to try to solve them themselves. At the end of the lesson they can share ideas. You should not give students the solutions, but you can ask questions that may lead to the solution of the problems.

## Displaying the results

A simple way to display the results is to pin up the materials on a board and underneath write whatever measurement was used to compare them. It may be the drop in the water level in the jar. This could be displayed as a bar graph with the name of the fabric under each bar.

## Assessing skills

This work involves a number of skills. Skills should be assessed from time to time. They should be assessed using clear assessment criteria that can be justified. It is not easy to write criteria for 10 marks; a simple method is to mark out of 5 and have defined criteria for 1, 3 and 5 marks. The intervening 2 or 4 marks can be awarded when there is doubt that the solution fully justifies the criteria for 3 or 5 marks. An example is shown below.

*Skill: Devising a fair test*

| | |
|---|---|
| 1 mark | None of the problems below had been solved but one had been identified. |
| 3 marks | Only one of the problems below had been solved satisfactorily but the others had been identified. |
| 5 marks | Devised satisfactory solutions to the problems of ensuring that the material pieces had the same mass or volume, for dealing with the drips, and for making quantitative comparisons. |

# 3.4 Magnetism

## Objectives

- Know that some metal objects are attracted to a magnet.
- Devise a fair test or comparison and recognise when conclusions are justified.
- Use a variety of methods to record and communicate observations and data collected.

## Preparation

Before you start any of the lessons on magnetism, you will need to collect a selection of magnets from various sources, such as small motors, broken radios, fridge magnets.

## Introduction

**Vocabulary**

magnet
metal
steel

**Resources**

Collection of magnets
Collection of small steel objects
Boxes of paper clips

Students will be familiar with magnets from an earlier lesson. They will know that magnets can attract and repel each other and can pick up small items made of steel, but not items made of most other metals. This lesson considers the size of the force of attraction they exert on objects.

Show students the collection of magnets that they have used in an earlier lesson and ask:

**Q Are all these magnets the same strength?**

**Q Which magnets are the strongest ones?**

They will have noticed in the earlier lesson that some are stronger than others and will be able to identify them. Show them one magnet and ask them:

**Q How strong is this magnet?**

They will not be able to give a sensible answer, so ask the related question:

**Q OK, how can we find out how strong this magnet is?**

Some students will probably suggest something like find out how many objects it can pick up. Ask what kind of objects? Show a mixture of different objects. Some students may suggest weighing the objects that the magnet can pick up. Demonstrate the difficulty with this by adding objects to a magnet. The number of objects will depend on the arrangement of the objects on the magnet. It may depend more on how *big* the magnet is than on how *strong* it is. It may also depend on the *shape* of the magnet. Explain that the test will not be fair.

Pick up some paper clips on a magnet and ask:

**Q Could we use paper clips to show which magnets are the strongest?**

This will produce some ideas. Ask students to criticise their own ideas to arrive at the best solution that will make the comparison fair. Direct them towards the idea of picking up a single string of paper clips, one hanging beneath the other. The paper clips should be held magnetically, they should not be hooked onto each other.

## Main activity

**Resources (per group)**

1 magnet attached to a suitable stand
10 paper clips (more if the magnet is strong)
Strips of card about 10 cm by 80 cm

# How many paper clips can a magnet pick up?

*Students should work in groups of up to four (groups may have to be larger if there are not enough magnets).*

Each group should be given a magnet that is clamped or tied so that paper clips can be suspended underneath it. An inverted chair could be used for this. Each magnet should be labelled differently, perhaps with different letters written on them with a marker pen or correction fluid.

Ask students to see how many paper clips they can hang underneath it in a single string. Count the number.

Ask each group to draw a picture of the magnet and the clips in their book. Tell them that they must make all the clips the same size. Correct this when walking around the class. Draw a magnet with its attached paper clips on a strip of card as an example.

Change the magnets around so that each group has used at least two (preferably more) different magnets. Ask them to draw the second magnet with its paper clips in their book next to the first. Draw a second example illustration on a strip of card. As students draw more magnets, the drawings will become a graphical display of the results in their books.

## Consolidation

**Vocabulary**

*Comparison words*
bigger, smaller
biggest, smallest
longer, shorter
more than, less than
most, least / fewest
strong, weak

Draw, on strips of card, pictures of all the magnets with the paper clips hanging underneath them. Each strip should show one magnet. All the paper clips must be drawn the same size. Pin them up on the board or wall.

Discuss the results.

**Q How many paper clips did magnet A have?**

There will be an answer from one group.

**Q Do all the groups that tested magnet A agree with this?**

If they do not agree, discuss which answer you should put on the board. The fairest strategy is to write down the biggest. Alternatively, you could try it in front of the class to see if the result is reproducible. Repeat this process with all results.

Ask questions that lead to some conclusions. Draw attention to the words of comparison that are used.

**Q Which magnet could hold the most paper clips?**

**Q Which magnet held the fewest paper clips?**

**Q Which is the stronger magnet, A or B?**

Arrange the card strips showing the magnets in order of their strength. Pin them to the display board. Pin cards with words such as ‘strongest’ and ‘weakest’ next to the ends of the display.

### Summary for students

- Magnets attract steel objects.
- Some magnets are stronger than others.
- Tests can be devised to compare the strengths of different magnets.