

Science lessons for Grade 5

Lessons in this section

Life science

- 1 Classifying vertebrates

Earth and space

- 2 Comparing different rocks

Physical processes

- 3 Air resistance
- 4 Static electricity

Resource sheets for the lessons

Using these lesson plans

These sample lessons for Grade 5 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 5. 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. 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. One of the lessons in this grade, lesson 5.3 ‘Air resistance’, offers a good opportunity for this and also illustrates a procedure for assessing mastery of the skill of planning an investigation.

5.1

Classifying vertebrates

Objectives

- Recognise the main distinguishing features of the vertebrate groups (fish, amphibian, reptile, bird, mammal) and know how vertebrates differ from invertebrates.
- Classify observations according to shared characteristics and make generalised conclusions from them.

Preparation

You will need to make a collection of pictures (or drawings) of various vertebrate and invertebrate animals and mount these onto cards. This may need to be done over a period of time before the lesson by selecting appropriate pictures from magazines and other sources. Pictures should be sorted into a sufficient number of packets so that each group of four students will have a packet with a variety of animals. Make sure that you know the names of the animals and whether they are vertebrates or invertebrates. Be able to assign vertebrates to a group. You could number each picture and note the name and taxonomic group of the animal portrayed. You can enhance the lesson by a display of additional pictures and posters of a wide variety of animals. Collections could be displayed on large sheets of paper with animals arranged by taxonomic group, by habitat, size, etc. Alternatively, they could be left unorganised.

Introduction

Vocabulary list

amphibian
backbone
bird
classification
fish
invertebrate
mammal
reptile
skeleton
vertebrate

Describing similarities and differences

Start this lesson by showing pictures of a camel, an Arabian oryx and a cat. Ask the class about the animals:

Q What is different about these animals?

You will get a variety of answers, such as overall size, shape, length of legs, colour. Write these in the top half of the left side of the board. You will also get answers that are not obvious from the pictures, such as where they live, what they eat and how they smell. Do not reject these answers but write them in the top right side of the board. The point to bring out here is that these animals have many differences, some of which are easily seen but others which are not and come from a deeper knowledge of the animal. Now ask:

Q What is the same about these animals?

Again students are likely to provide a variety of answers. Arrange these on the left and right sides of the bottom section of the board.

Making reference to your lists on the board, discuss what is different about the animals and what they have in common. Try to involve all students. Establish that among other common characteristics they have four legs and a body with a covering of fur or hair.

Conclude the introduction by explaining that there is a great variety of animals in the world and they have similarities and differences. Just as a stamp collector or a soccer card collector has a system for organising a collection by things such as

country or club, so we need a system to organise animals. Tell the students that we do this by arranging them by their similarities and differences, just as a stamp collector might organise a collection by colour or shape. Write the word *classification* on the board and explain what it means. Tell the class that by the end of the lesson they will know about the classification system of an important group of animals. Do not at this point introduce any terminology such as *vertebrate* or *mammal*.

Main activity

Resources (per group)

Packet of pictures
Resource 5.1

More similarities and differences

Continue the lesson by showing a picture of a falcon. Ask:

Q What are the similarities and differences between a falcon and a camel?

Students are more likely to provide differences than similarities. Some will say that a falcon is a bird. In response to this you should ask how a bird is different from a camel. Again, you should use the board to record similarities and differences. Bring out the observation that the falcon has wings and legs and the body is covered in feathers. Now ask:

Q What can you tell me about the young of a camel and a falcon?

Discuss the answers and follow up with the question:

Q How do the young of the camel and the falcon develop?

Discuss the answers and stress that the young falcon hatches from an egg and needs to be brought food by the parent birds whereas the young camel develops inside its mother and after birth feeds on its mother's milk. You should now continue questioning to establish if the class know that a camel and a falcon have an internal skeleton. You could ask:

Q What do you think is inside a camel and a falcon?

You will get a variety of answers but to establish that both have an internal skeleton of bones you may need to probe further:

Q What is left of a camel or a falcon that dies in the desert?

Some pupils will know that all that is left is the bones of a skeleton. You should now make the point that the camel, the oryx, the cat and the falcon all have an internal skeleton made of bones. Write the word *vertebrate* on the board and explain that having an internal skeleton with a backbone is the common feature of an important group of animals: the vertebrates. Tell students that animals with no internal skeleton of bone are called *invertebrates*. Write this word on the board. Show students a human skeleton or a chart or picture of a human skeleton, point out the backbone and ask:

Q Are human beings vertebrates or invertebrates?

Ask for a show of hands. Students should realise that they are vertebrates.

Vertebrates and invertebrates

Divide the class into groups of four. Give each group a packet containing pictures of animals, both vertebrates and invertebrates. Ask students to discuss what they observe about the animals and to divide the pictures into three groups: vertebrates, invertebrates and uncertain. Get the student groups of four to combine to form groups of eight. Each four should explain their picture classifications to the other.

Student discussion could result in modifications to the original classifications of the pictures.

The outcomes of this exercise will be specific to the pictures in the packets and the levels of knowledge of the students. The points to make are that:

- there is a great diversity of animals;
- there is a diversity of vertebrates and invertebrates
- it can be difficult to determine if an animal is a vertebrate from just its appearance.

The groups of vertebrates

At this stage of the lesson you need to introduce the groups of vertebrates. You could start by referring back to the camel and the falcon. While both are vertebrates, they have distinct differences and are classified into different groups of vertebrates. Write a table on the board with headings as follows:

Vertebrate group	Examples of the group	Features of the group

Write in the names of the main groups of vertebrates (fish, amphibians, reptiles, birds and mammals). Check whether the class are familiar with these names and if they know any examples. Write in any appropriate local examples offered by the class. Show the class examples of each group as specimens, photographs or drawings. If you have made a wall display, refer to this. Use the third column of the table to describe the characteristics of each group in terms of body covering, limbs, reproductive system and care of young, and whether they maintain a constant body temperature. Make the point that while we can use the appearance of an animal to help with its classification, we also need to know more about it before we can be sure of its place in a particular group. You should also point out that some characteristics and behaviours of vertebrates can lead to misclassification. You could mention that not all birds fly, both bats and falcons have wings, whales live in the sea and camels on land.

What is it?

Organise the class back into group of four students. Provide each group with a copy of **Resource 5.1** and ask them to determine which group of vertebrates each of the mystery animals belongs to. When they have completed the exercise, discuss their answers. The point to bring out is that to be sure of a classification we must look at a range of evidence and that sometimes that evidence is not available.

Consolidation

Prepare five slips of paper. Write the names of one of the groups of vertebrates on each of the slips. Fold the slips so that the name cannot be read. Ask for five volunteers to come to the front of the class. Ask each volunteer to pick a slip. Each volunteer in turn must pretend to be an animal in that group and either act out that animal or tell the class about themselves as that animal. The class must then decide the group of vertebrates to which each belongs.

Other tasks

You could give more able students information about the major groups of invertebrates and ask them to try to classify a number of invertebrates portrayed on sets of pictures.

Summary for students

- Animals are classified into groups according to their characteristics.
- Animals with an internal skeleton and backbone are classified as vertebrates and those without as invertebrates.
- Vertebrates are further classified as fish, amphibians, reptiles, birds and mammals.
- The classification of vertebrates into groups is based on their body covering, limbs, reproductive system and care of young, and whether or not they maintain a constant body temperature.

Notes

Students should be given opportunities to see live animals wherever possible.

The mystery animals described on the resource sheet are:

- A bird;
- B amphibian;
- C fish;
- D mammal;
- E reptile;
- F reptile;
- G mammal.

5.2

Comparing different rocks

Objectives

- Compare different rocks and group them according to readily observable characteristics (such as hardness, colour and porosity).
 - Plan investigations with an understanding of the importance of controlling variables and of collecting an appropriate range of evidence.
 - Classify observations according to shared characteristics and make generalised conclusions from them.
 - Adapt everyday items to help carry out scientific investigations.
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Preparation

Collect a variety of rocks that differ in type, colour, porosity and hardness. If possible, be able to name them. Display them in the classroom a few days before the lesson.

Collect several pieces of concrete or bricks. They must have a flat top surface.

Collect jam jar lids.

Introduction

This is the introductory lesson to rocks. Before the lesson ask students if they have any rocks at home that they can bring in to show the class and to test.

Ask questions designed to bring out any observations that students may have made about rocks. Start with simple questions about obvious features and move on to more complex ones:

Q Are all rocks the same colour? Is one particular rock the same colour all over?

Q Are rocks any particular shape? Do they all have sharp corners?

Q Do some rocks feel heavier than others? (strictly you mean 'denser' here, but it is useful to keep the language simple even if not very exact)

Q Do some rocks break more easily than others?

Q Are some rocks harder than others?

Q What happens when you put water on rocks?

This questioning should establish the fact that rocks differ from each other in many ways, such as appearance, hardness and ability to absorb water. The next part of the lesson requires students to develop ways of classifying rocks according to observable characteristics.

Main activity

Sorting rocks into groups

Resources (per group)

Access to rock samples
Hand lens
Jam jar lids
Access to a flat piece of concrete
Access to water

Students should work in groups.

Ask students to think of different ways of classifying rocks using the ideas already mentioned in the introduction. They should have access to samples of rocks, preferably named.

Ask groups to discuss among themselves and decide which of the ways rocks differ they are going to investigate. Tell them they must think up a fair test that they can do with all the rock samples. Tell them to write down the results of the investigation in a table. Ask them to report to you what they would like to do before they start.

Circulate among the groups and give advice, particularly directing them to problems related to the control of variables. For example, someone might suggest finding out which sample absorbed more water by weighing samples before and after wetting, without realising that this would only be fair if all the rocks were the same weight to start with.

Tests students might suggest include:

- a comparison of colour;
- a comparison of structure (using a hand lens to seek evidence of structure);
- a comparison of smoothness;
- a comparison of hardness using a ‘rubbing test’ to see how easily they wear when they are rubbed against a concrete surface;
- an absorbency test to see how readily they absorb water from a jam jar lid.

In all cases they would have to devise a fair test so that the comparisons give differences that are real. How many times will they rub the rock sample to determine hardness. How long will they leave a rock standing in the water and how will they make an estimate of absorbency?

Once they have finished the tests, they must draw conclusions from them. This may mean arranging them in an order (of hardness, say) or grouping them (e.g. into those with visible crystals in them and those without).

Consolidation

Bring the class together to share results. You could do this by questioning the whole class but it is better to give each group a short time to tell the class what they have found out. The reporting time can be shortened by asking groups (a) only to report one thing and (b) not to report anything that has already been reported by another group.

After they have reported, ask questions that draw out generalised observations and conclusions:

Q Could you see crystals with the hand lens in all the samples?

Q What else did you see in several rocks when you looked carefully at them?

Some may have observed ‘lines’ in many rock samples. These observations will distinguish between igneous rocks on the one hand and sedimentary and metamorphic rocks on the other – an observation that will be useful later.

Further observations may show that the rocks with ‘lines’ were also the ones that absorbed water the best and that they were often among the softer rocks.

Other tasks

Students will have grouped rocks or placed them in order. At this point, hand out one or two new rocks and ask them to group them or place them in the order.

For homework you can ask students to place a rock that they find near their home in their groups or order.

Summary for students

- There are many different types of rock.
- Rocks differ in properties such as colour, texture, structure, hardness and ability to absorb water.

5.3

Air resistance

Objectives

- Know that air resistance slows an object down when it moves through air and that the shape of an object affects the size of this resistance.
- Plan investigations with an understanding of the importance of controlling variables and of collecting an appropriate range of evidence, observations and relevant data in a systematic manner.
- Make accurate measurements of time.

Preparation

Collect sheets of used A4 paper so that you have a supply of several hundred by the day of the lesson.

Safety

This lesson may involve children working in groups by themselves outside the classroom in the school building or grounds when they will not be fully supervised. It is important that they are trained in advance to understand and obey the rules of safe conduct in such circumstances. Students who have shown that they cannot be relied upon to obey the rules should not be allowed out of your sight.

If you do the demonstration of the rate of fall of a piece of paper in a glass tube suggested at the end of this lesson plan, take appropriate safety precautions when evacuating the glass vessel.

Introduction

Vocabulary

accuracy
average
gravity
variable

Resources (per group)

4 half-sheets of used A4 paper

The main objective of this lesson is to plan and execute a scientific investigation; learning about air resistance is a secondary consideration. The structure and content of the lesson will reflect this.

An introduction recalling earlier work is unnecessary. Present them with a very simple problem, which you should write on the board:

How long does it take for a piece of paper to fall to the ground?

Give out some half-sheets of used A4 paper and tell students to work in groups of about four and think about the problem. Allow 5 to 10 minutes for this, depending on how involved the groups get. Do not stop the discussion early if it appears to be productive.

Call the class to attention and ask for comments on the task. Most students will have realised that the task is not a simple one and they will probably respond that it will depend on variables such as how far it is dropped, how big it is and perhaps how it is folded. Write a list on the board of all the variables suggested as they are mentioned. Write the title 'Variables' at the top of the list and explain that the word means anything that we can change when we are carrying out an experiment. Ask questions leading to a conclusion about the need to control variables in the investigation:

Q If we want to find out how long it takes some paper to fall, how can we make our test fair?

This should lead to ideas such as always using the same sized sheet of paper, always dropping it from the same height and always folding it in the same way.

Explain that this process has a name: it is called ‘controlling the variables’ in the experiment.

Now question the class on their proposed experimental method.

Q How will you measure the time for the paper to fall?

Students will have some simple suggestions, such as using a watch or a stopwatch. Question them on how accurate they think it will be and how the accuracy might be improved. If you have stopwatches, have them ready. Some students will probably have a stopwatch function on their watches.

Q How long will a piece of paper take to fall? Did you try it?

Q Can you measure this very short time accurately?

Some will have tried it in the classroom and will realise that it falls in very few seconds and cannot be accurately measured.

Q How can you improve on the accuracy of your time measurement?

It is possible that someone may suggest dropping the paper a longer distance but you may have to suggest this. Follow this with questions designed to query the reliability and reproducibility of the measurement.

Q Does the paper always take the same time to fall?

The answer will be that it probably does not.

Q How can you find out if the paper always takes the same time to fall?

Students will suggest dropping it many times.

Q Which result is the correct one?

This may lead to the suggestion like ‘the middle one’. Good mathematicians may suggest and be able to work out an average measurement. Do not insist on this unless students understand the method fully. The suggestion of the ‘middle one’, in which they will probably select the mode, is adequate.

Main activity

Resources (per group)

- 6 half-sheets of used A4 paper
- 6 paper clips
- More sheets of paper should be available
- Stopwatch (not essential)

Comparing the time taken by different objects to fall

Students should work in groups of about four. Time: 30 minutes.

Now set the class the main problem. Give each group some half-sheets of A4 paper and challenge them to find out how fast they can make a sheet plus a paper clip drop and how slow they can make a sheet plus a paper clip drop. The paper clip must be attached to the paper sheet all the time during the fall.

Remind the class that they must control all the variables except the shape of the sheet of paper.

Allow the class to test the falling paper in a hall or stairwell if they wish, so that they can drop the paper from a greater height. Do not *suggest* this to them, however; it is an idea that they should come up with themselves.

They should write down their results in an appropriate table that shows all necessary details.

During this time you should circulate around the groups but do not offer assistance or advice. Check that students are putting all necessary information in the table, including such details as how to keep all variables except shape constant and any mechanisms used to achieve accurate time measurements.

Consolidation

Bring the class together to consider two aspects of the work.

Considering the solutions to the challenge

Ask a member of each group to explain briefly, with demonstrations, to the rest of the class what they did and how they made the paper drop fast and then slowly. Reporting groups should not repeat what others have said, but only add extra details or ideas. Note particularly any way in which the paper clip was used to speed up or slow down the fall. It may have been used to speed up the fall by weighting a streamlined folded paper so that it fell the correct way. It may have been used to slow down the fall by weighting a piece of paper folded like a helicopter wing, so that it always remained the correct way up, causing the wing to spin and so slow the descent.

Each student should hand in their table of results, which can be assessed.

If nobody discovered a helicopter method of slowing down the descent of the paper, you could demonstrate it now.

Explaining the results

Ask questions designed to elicit an understanding of the part played by air resistance in explaining the differences in the time taken for the paper to fall. For example:

- Q What shape fell the fastest / slowest?
- Q Why did this shape affect the time taken for the paper to fall?
- Q What is stopping the paper falling?
- Q How did you overcome the effect of air resistance to make the paper fall faster?

Finally, make a display on the board of photographs of objects that use air resistance to stop them falling to earth. Students can be asked to help with this by bringing pictures from home or downloading them from the Internet. They should include birds and insects, seeds with mechanisms to allow them to be carried by the wind as well as objects such as parachutes, kites, aeroplanes and helicopters.

Other tasks

If time allows, and if the equipment is available, demonstrate the rate of fall of a piece of paper in a glass tube before and after evacuating it. Take appropriate safety precautions when evacuating a glass vessel.

Summary for students

- The shape of a falling object will affect how fast it will fall.
- The resistance of the air slows down the speed of falling objects.

Notes

The enquiry skill on planning the investigation can be assessed. A criterion-based assessment scheme with a total of 5 marks, such as the following, could be used:

- 1 mark Height dropped held constant.
- 1 mark A large distance for dropping the paper is chosen.
- 1 mark Several drops are timed and the mode or mean time taken as the result.
- 2 marks Thought and ingenuity in folding the paper to achieve the fastest and slowest fall.

5.4

Static electricity

Objectives

- Know that electrostatic charge is generated by friction when an insulator is rubbed.
- Recognise that two kinds of charge can be created by friction.
- Know that unlike charges attract each other and like charges repel.
- Identify patterns in observations and draw appropriate conclusions.

Preparation

This activity is best carried out when the humidity is low. Plan the scheme of work to do this topic in the coolest driest season. Try the experiments beforehand to ensure that they will work. Drying the materials immediately before use with a hair drier will make them easier to charge.

Introduction

Vocabulary

acrylic
attract
plastic
polythene
repel

This is the introductory lesson in the study of static electricity. Students are allowed to experiment widely, rubbing different plastics with different materials. They will find that sometimes the plastics will attract each other and sometimes they will repel each other. Initially you should give little guidance except to encourage a wide variety of experimentation. Gradually, through the lesson, you must guide students to the conclusion that only when two different plastics are used, or when the plastics have been rubbed with different materials, do they attract each other.

Without questioning or talking to the class, take two strips of thin polythene cut from a shopping bag, hold them together at the top in one hand and quickly stroke them both between your thumb and forefinger several times. The two strips will fly apart (if they do not, try rubbing them with some wool fabric). Do not discuss this result or try to explain it. Ask the class if they want to try it and give out strips to them. Ask them to talk to each other about what they think is happening.

Main activity

Resources (per group)

Plastic ruler
Plastic pen
Plastic comb
2 old CDs, one suspended from a stand by a thread
Access to a variety of cloth materials for rubbing plastics (e.g. wool, cotton, silk)
2 strips of paper
Small pieces of paper
2 balloons inflated and attached to each other by a piece of cotton about 60 cm long
Plastic wrap

Finding out about electrostatic attraction and repulsion

Students should work in groups of two to four. Time: about 15 minutes

Gradually give out materials to groups of students and encourage them to experiment with them. This can be done either by addressing the whole class and asking them to come and get the materials and suggesting some of the ideas to them, or you can circulate and attend to each group independently. It is not necessary for all groups to have the same items. Do not hand out the balloons yet.

Give students some ideas in the form of questions:

- Q Does charged polythene stick to the wall?
- Q Can you make paper strips repel each other like the polythene?
- Q What happens to a plastic ruler or CD if you rub it with some material?
- Q Is polythene attracted to a rubbed CD (or ruler) or repelled by it?
- Q Does one CD repel or attract the other one when they are rubbed?
- Q If you rub the CD with different material, does it make a difference?

Q Will the plastic objects that you have rubbed pick up bits of paper?

After allowing students some time to investigate in an unsystematic way, ask each group to start making two lists headed ‘Things that attract each other’ and ‘Things that repel each other’. Write these two column headings on the board and put ‘two polythene strips rubbed with the fingers’ in the ‘repel’ column.

Give out the balloons. Ask the groups to hang the balloons over the stand so that they are suspended and touching each other. Then ask them to rub the balloons with the same cloth and note what happens. They should fly apart.

Ask the groups to rub one balloon with wool and the other with plastic wrap and note what happens now. They should stick together. Students should write the balloon experiment results in their table.

Consolidation

Bring the class together and ask them for observations that can be put in the table on the board. Draw conclusions from the class by asking them questions. Start with general open questions and move gradually to more specific closed ones:

Q What differences can you see between the two columns?

Q What kinds of thing always repel each other?

Q What kinds of thing often attract each other?

Q Do the same things rubbed in the same way attract or repel each other?

Also ask general questions about the phenomenon to provide an opportunity to introduce the phrases ‘static electricity’ and ‘charged objects’.

Q Do you know what causes rubbed objects to attract or repel each other?

Some students may be able to answer correctly, but tell them if nobody answers. Write the words ‘static electricity’ on the board.

The questions on the observations should provide some generalised conclusions. Two important ones are:

- two pieces of the same plastic treated in the same way always repel each other;
- objects attract each other only when they are different or have been treated in a different way.

Tell students that there are two kinds of static electricity and we call them positive and negative. Introduce the phrases ‘positive charge’ and ‘negative charge’ to describe the kind of electricity on the objects.

Tell them the important rule that they can see from their work: that objects charged with the same electrical charge always repel each other and objects charged with the opposite kind of electrical charge always attract each other.

Another conclusion that should emerge is that both negatively and positively charged objects are attracted to uncharged ones, such as the wall or the bits of paper.

Other tasks

Resources (per group)

Acrylic strip
Polythene strip
Stand
Cloth
Resource 5.2

If the equipment is available, attraction and repulsion between positive and negative strips can be demonstrated or be done by the groups. See **Resource 5.2**.

In this experiment the two strips are rubbed with a cloth. The polythene strip will be negatively charged and the acrylic strip positively charged. The conclusions from the main part of the lesson can be confirmed.

Summary for students

- Materials such as plastics can be given an electrostatic charge by rubbing them.
- There are two kinds of charge: positive and negative.
- Objects given the same charge repel each other. Objects given opposite charges attract each other.
- Charged objects often attract uncharged objects.

