Geophysics: the structure of the Earth

Lesson plan and teacher's notes · Form 1 Physics · 1 period of 40 minutes

School	(write school name)	**Teacher**	(write name)
Date	(date)	**Class**	Form 1
Subject	Physics	**Enrolment**	Boys ___ Girls ___ Total ___
Time	40 minutes	**Topic**	Geophysics: the structure of the Earth

Learners say what geophysics studies, name the four layers of the Earth and describe each one, explain key terms used to study the layers, and draw a labelled diagram or build a scale model of the layers using natural or artificial materials.

Specific outcomes

By the end of the lesson, learners should be able to:

1. Say what geophysics studies
2. Name the four layers of the Earth and describe each one
3. Explain key terms such as seismic waves, density and thermal gradient
4. Draw a labelled diagram or build a scale model of the Earth's layers

Prior knowledge

- The Earth is a planet
- Solid, liquid and gas as states of matter
- Drawing and labelling a simple diagram

Teaching and learning materials

- chalk and board
- clay or plasticine of four colours
- stones and seeds
- cardboard, scissors and markers
- exercise books

References

Ministry of Education (CDC) Form 1 Physics syllabus and module; 25Schools learners' note: Geophysics: the structure of the Earth.

Lesson development

Stage and time	Teacher activities	Learner activities
Introduction 5 min	Ask learners what they think is under their feet if they could dig for ever. Write geophysics on the board and give its meaning.	Suggest what lies under the ground and copy the meaning of geophysics.
Development: the four layers 12 min	Describe the crust, mantle, outer core and inner core in order from the outside, and what each is made of. Mention continental and oceanic crust.	Copy the table of layers and say which layer is solid, which is semi-solid and which is liquid.
Development: key terms 8 min	Explain seismic waves, density, gravity, magnetic field, thermal gradient and temperature, with one example each.	Match each key term with its meaning.
Development: model of the layers 12 min	Show how to build a scale model of the four layers using clay or cardboard, and how to label a diagram. Mention convection currents in the mantle.	In groups, build the model or draw a well labelled diagram.
Conclusion 3 min	Ask which layer helps to produce the magnetic field. Set the homework.	Answer and copy the homework.

Teacher's content notes

Read these before the lesson. They are what you need to know, not what to copy onto the board.

What geophysics studies

Geophysics is the study of the Earth's internal structure, its composition and its physical processes. These include earthquakes, gravity, magnetic fields and the Earth's thermal properties.

The layers of the Earth

The Earth is made of four main layers. The crust is the outermost layer, made of solid rocks and divided into continental and oceanic crust. The mantle is much thicker, made of hot, semi-solid rock that flows slowly over time. The outer core is a liquid layer made mainly of molten iron and nickel, and it helps to produce the Earth's magnetic field. The inner core is a dense, solid sphere of iron and nickel at the centre.

Ideas used to study the layers

Seismic waves are waves of energy that travel through the Earth. Density is mass per unit volume. Gravity is the force that attracts a body towards the Earth. A magnetic field is a region where magnetic materials feel a magnetic force. A thermal gradient is the rate of change of temperature with distance. Temperature is the average kinetic energy of the particles in a substance.

Movement inside the Earth

The Earth's interior is not still. Convection currents in the mantle drive plate tectonics. Interactions between the core and the mantle influence the magnetic field and the Earth's rotation. Heat moves by conduction, convection and radiation.

Modelling the layers

Learners simulate the layers in groups using natural materials such as clay, stones and seeds, or artificial materials such as cardboard, scissors and markers. They draw a well labelled diagram and build a scale model of the crust, mantle, outer core and inner core.

Questions to ask during the lesson

Question	Expected answer
A learner digs a hole and asks what geophysics studies about the Earth. (a) State what geophysics studies. (b) Name two physical processes it includes. (c) Name one thing it studies about the Earth's inside.	(a) The Earth's internal structure, composition and physical processes. (b) For example earthquakes and gravity. (c) Its internal structure and composition.
A learner is told that the crust is the outermost layer of the Earth. (a) State what the crust is made of. (b) Name the two kinds of crust. (c) Say how it differs from the mantle in thickness.	(a) Solid rocks. (b) Continental and oceanic crust. (c) The mantle is much thicker.
A group says the mantle is liquid and the outer core is solid. (a) Say what is wrong. (b) Describe the mantle. (c) Describe the outer core.	(a) They have swapped the states. (b) Hot, semi-solid rock that flows slowly over time. (c) A liquid layer of molten iron and nickel.
A learner asks why the inner core is not liquid at the centre of the Earth. (a) Say what the inner core is. (b) Name its materials. (c) Give its position.	(a) A dense, solid sphere. (b) Iron and nickel. (c) At the centre of the Earth.

Worked examples for the board

Example 1: the magnetic field

Which layer helps to produce the Earth's magnetic field, and what is it made of? The outer core helps to produce the magnetic field. It is a liquid layer. It is made mainly of molten iron and nickel.

Example 2: describing the layers

The crust is solid rock. The mantle is hot, semi-solid rock that flows slowly. The outer core is liquid iron and nickel. The inner core is a dense solid sphere of iron and nickel.

Example 3: building the model

A group takes clay of four colours. It makes a small ball for the inner core, wraps a layer for the outer core, a thicker layer for the mantle and a thin layer for the crust. It cuts the ball in half and labels each layer.

Board plan

Write the title. Left: the meaning of geophysics. Centre: the table of the four layers with what each is made of. Right: key terms with their meanings, then the steps for the model.

Layer	State	Made of
Crust	Solid	Solid rocks, continental and oceanic
Mantle	Hot, semi-solid	Hot rock that flows slowly over time
Outer core	Liquid	Mainly molten iron and nickel
Inner core	Dense solid sphere	Iron and nickel

The four layers of the Earth, from the outside

Mistakes to expect

Learners often think	Put it right
The inside of the Earth is the same all the way down.	The Earth has four main layers, the crust, the mantle, the outer core and the inner core, and each has its own make-up.
The mantle is a liquid like the outer core.	The mantle is hot, semi-solid rock that flows slowly over time. The outer core is the liquid layer.
The inner core is liquid because it is the hottest part.	The inner core is a dense, solid sphere of iron and nickel.
Seismic waves are not like other waves.	Seismic waves are waves of energy that travel through the Earth and have properties like those of sound, water and light waves.

Differentiation

Learners who struggle

Give learners a card with the four layers in order and a colour for each, and let them build the model one layer at a time from the centre outwards. Read the key terms aloud with them.

Learners who finish early

Ask learners who finish early to explain how convection currents in the mantle are linked to plate tectonics and how heat moves by conduction, convection and radiation.

Hearing or visual impairment

For learners with visual impairment, build the model with materials of different textures so that each layer can be felt, and describe each layer aloud. For learners with hearing impairment, write each key term and meaning on the board and point to the layer on the model while explaining.

No projector, no printing

Use natural materials such as clay, stones and seeds, or paper and cardboard cut into circles, for the model. Draw the labelled diagram on the board and in exercise books.

If time is short

Teach the four layers and what each is made of, then the labelled diagram. Leave the key terms and the movement inside the Earth for the next lesson.

Evaluation

Question or task	A correct answer shows
A visitor asks a learner how many layers the Earth has and what they are. (a) State the number of layers. (b) Name them in order from the outside. (c) Say which one is the outermost layer.	(a) Four. (b) The crust, the mantle, the outer core and the inner core. (c) The crust.
A group building a model must decide which layer helps to produce the Earth's magnetic field. (a) Name the layer. (b) State its state of matter. (c) Say what it is made of.	(a) The outer core. (b) Liquid. (c) Mainly molten iron and nickel.
A learner reads that a thermal gradient and density help scientists to study the Earth. (a) Give the meaning of density. (b) Give the meaning of thermal gradient with an example. (c) Say what seismic waves are.	(a) Mass per unit volume. (b) The rate of change of temperature with distance, for example with depth in the Earth. (c) Waves of energy that travel through the Earth.

Homework

A learner wants to show her family the inside of the Earth using materials found at home. (a) Name the four layers in order. (b) Say what material she could use for each layer. (c) Describe one way she will label the model.

Extra practice with answers

Question	Answer
1. A learner finds a word in her book and wants to know its meaning. (a) Give the meaning of density. (b) Give the meaning of seismic waves. (c) Give the meaning of thermal gradient.	(a) Mass per unit volume. (b) Waves of energy that travel through the Earth. (c) The rate at which temperature changes with distance in a direction.
2. A learner lists the layers of the Earth in the wrong order in her book. (a) Give the correct order from the outside. (b) State which layers are solid. (c) State which layer is liquid.	(a) Crust, mantle, outer core, inner core. (b) The crust and the inner core. (c) The outer core.
3. A class studies heat inside the Earth. (a) Name three ways heat moves. (b) Say what drives plate tectonics. (c) Say where those currents are.	(a) Conduction, convection and radiation. (b) Convection currents. (c) In the mantle.

4. A group has clay, stones, seeds, cardboard and markers. (a) Say which are natural materials. (b) Say which are artificial materials. (c) Describe how to make the model show four layers.	(a) Clay, stones and seeds. (b) Cardboard, scissors and markers. (c) Use a different material for each layer in order and label them.
5. A learner says temperature and thermal gradient mean the same thing. (a) Give the meaning of temperature. (b) Say what it shows. (c) Say how it is different from a thermal gradient.	(a) The average kinetic energy of the particles in a substance. (b) How hot or cold it is. (c) A thermal gradient is the rate of change of temperature with distance, for example with depth.

Answers to the learners' check-yourself questions

1. How many layers does the Earth have, and what are they?
   Four: the crust, the mantle, the outer core and the inner core.
2. What is the crust made of?
   Solid rocks. It is divided into continental and oceanic crust.
3. Why is the mantle described as semi-solid?
   It is hot rock that flows slowly over time.
4. What is density?
   Mass per unit volume of a substance.
5. What is the inner core made of?
   A dense, solid sphere of iron and nickel.
6. Your class is making a scale model of the Earth's layers from clay, stones and seeds for the school science fair. (a) Name the four layers, in order from the outside to the centre. (b) Say which two layers are made of iron and nickel. (c) Explain how the outer core is different from the inner core.
   (a) Crust, mantle, outer core, inner core. (b) The outer core and the inner core. (c) The outer core is liquid, made of molten iron and nickel, while the inner core is a dense solid sphere of iron and nickel.
7. A learner says that the whole inside of the Earth is solid rock. (a) Do you agree? (b) Describe the state of the mantle and the outer core. (c) Name the layer that helps to produce the Earth's magnetic field.
   (a) No. (b) The mantle is hot, semi-solid rock that flows slowly, and the outer core is a liquid of molten iron and nickel. (c) The outer core.

Teacher's reflection

What went well:

What I will change next time:

Learners who need follow-up: