25SCHOOLS
FREE LEARNING NOTES FOR ZAMBIA

FORM 1

Physics

Geophysics: the structure of the Earth

Lesson notes for learners · Competence-Based Curriculum

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Geophysics looks inside the Earth. It is the study of the Earth's inside and of the physical processes that go on there, such as earthquakes, gravity and magnetic fields. This note describes the layers of the Earth and the ideas used to study them.

AFTER THESE NOTES YOU SHOULD BE ABLE TO

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

KEY WORDS

geophysics	the study of the Earth's internal structure, composition and physical processes
crust	the outermost layer of the Earth, made of solid rock
mantle	the thick layer of hot, semi-solid rock below the crust
outer core	the liquid layer of molten iron and nickel
inner core	a dense solid sphere of iron and nickel at the centre
seismic waves	waves of energy that travel through the Earth
thermal gradient	the rate at which temperature changes with distance in a direction
density	mass per unit volume of a substance

1 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.

This note deals with the first sub-topic: the structure and composition of the Earth. The Earth is made of different layers, and each layer has its own job and its own make-up.

2 The layers of the Earth

The Earth is made of four main layers: the crust, the mantle, the outer core and the inner core.

The crust is the outermost layer. It is made of solid rocks and is divided into continental and oceanic crust. The mantle lies below the crust. It is much thicker, and is made of hot, semi-solid rock that flows slowly over time.

The outer core lies beneath the mantle. It 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 at the centre. It is a dense, solid sphere of iron and nickel.

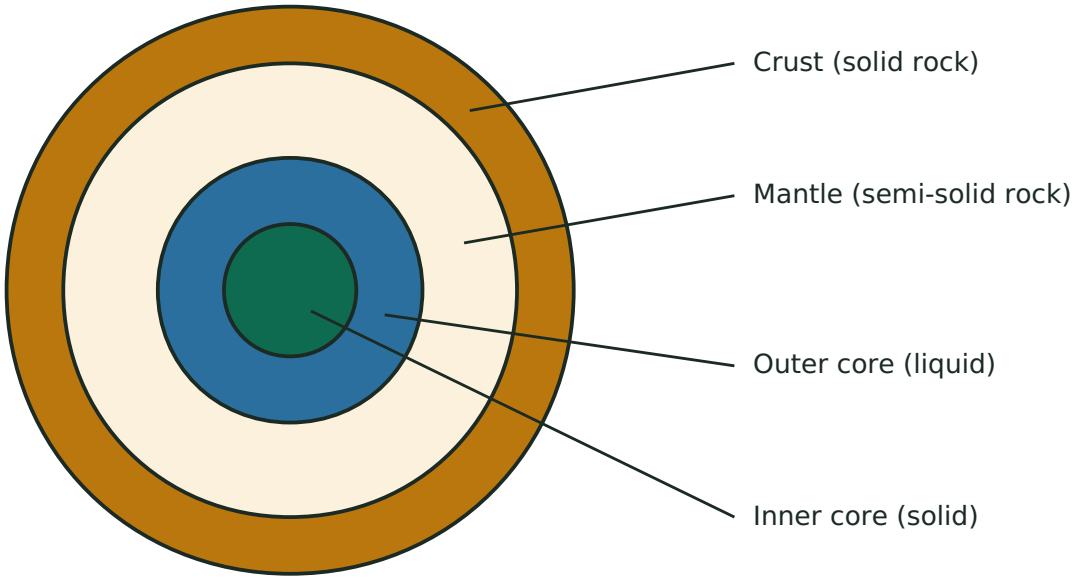

Figure 1. The four layers of the Earth

3 Ideas used to study the layers

Several ideas help us to study the Earth's layers: density and gravity, seismic waves, thermal gradient, magnetic fields and temperature.

Seismic waves are waves of energy that travel through the Earth and have properties like those of sound, water and light waves. 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, for example with depth in the Earth. Temperature is the average kinetic energy of the particles in a substance, and shows how hot or cold it is.

Term	Meaning
Density	Mass per unit volume
Gravity	Force that attracts a body towards the Earth
Magnetic field	Region where magnetic materials feel a force
Thermal gradient	Rate of temperature change with distance
Seismic waves	Waves of energy travelling through the Earth

Figure 2. Key terms for studying the Earth

4 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.

To learn about the layers, learners simulate them 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 of the layers and build a scale model of the crust, mantle, outer core and inner core.

WORKED EXAMPLE

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

TRY THIS

In small groups, use clay, stones, seeds or cardboard to build a scale model of the Earth's layers: the crust, mantle, outer core and inner core. Draw a well labelled diagram of the same layers. Present your model to the class and explain how the layers differ and why.

REMEMBER

- Geophysics studies the Earth's internal structure, composition and processes.
- The Earth has four layers: crust, mantle, outer core and inner core.
- The crust is solid rock; the mantle is hot semi-solid rock that flows slowly.
- The outer core is liquid iron and nickel and helps to produce the magnetic field.
- The inner core is a dense solid sphere of iron and nickel.
- Seismic waves, density, gravity, thermal gradient and magnetic fields are used to study the layers.

? Check yourself

1. How many layers does the Earth have, and what are they?
2. What is the crust made of?
3. Why is the mantle described as semi-solid?
4. What is density?
5. What is the inner core made of?
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.
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.

ANSWERS

1. Four: the crust, the mantle, the outer core and the inner core.
2. Solid rocks. It is divided into continental and oceanic crust.
3. It is hot rock that flows slowly over time.
4. Mass per unit volume of a substance.
5. A dense, solid sphere of iron and nickel.
6. (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) 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.

Written by 25Schools to follow the Form 1 Physics syllabus of the Zambian competence-based curriculum. Free for learners to read, download and share. More notes and quizzes at 25schools.com.