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Discusssion / Activity 1 Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete.
If studying independently, please use these questions to check your comprehension before moving on.

Structure of the Earth

Student Name .....

1. Outline how we think the Sun & planets formed.

The solar system formed from a cloud of gas & dust. Part of the cloud collapsed under gravity to form the Sun. The planets formed by accretion of small lumps of material swirling in orbit around the early Sun.

2. Outline how the force of gravity and different densities of substances resulted in the layered structure of the Earth.

As accretion made the early Earth grow in size, gravity compacted the material into a sphere. Rammed hard together by gravity, the materials became hot enough to melt. While liquid, higher density matter sank towards the centre, while low-density matter floated to the surface.

3. Discuss briefly how we know about the layered structure of the Earth, from:

a) Seismology.

Earthquake shock waves spread throughout the Earth's interior. The waves travel at different speeds in different density rocks & may refract & reflect if they strike a layer of different composition & density. The study of these waves for over 100 years has convinced scientist that there are definite layers. This is the main source of our knowledge of Earth structure.

b) magnetism & overall density of the Earth.

The overall density of the whole Earth was calculated over 200 years ago. It was found to be much higher than the average rocks. This suggested that there must be a zone or layer of much higher density material inside the Earth. The Earth's magnetic field pointed strongly to there being a large amount of iron somewhere. Even before seismology, this was evidence that there is a layer or core rich in iron.

c) meteorites.

Meteorites are believed to be "left-overs" from the Solar System's formation, and therefore that the Earth must have been made from similar materials to meteorites. Studies show that most are made of rock-like minerals, but a significant % are made of iron. This is corroborating evidence for the Earth having an iron core surrounded by rock.

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Discusssion / Activity 2 Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete.
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Minerals & Rocks

Student Name .....

1. Outline the difference between a “rock” and a “mineral”.
Minerals are pure, crystalline compounds. A rock is (usually) a mixture of various minerals.

2.
a) What is quartz, chemically?
Silicon dioxide, SiO_2, also known as “silica”.
b) What is meant by a “silicate” mineral?
Silicates are silica in which other atoms (e.g. iron, aluminium, etc) are included within the crystal structure. This changes colour, crystal shape, hardness, etc.
c) Name a common non-silicate mineral and describe it chemically.
Calcite, which is calcium carbonate, $CaCO_3$.

3.
a) In general terms, how do igneous rocks form?
From molten minerals (lava or magma) which has cooled & solidified.
b) Some igneous rocks have large, visible crystals, while others are fine-grained with microscopic crystals. Explain why. If the molten minerals cool quickly (eg lava at or near the surface) there is not time for mineral crystals to grow in size, so the rock is fine-grained. If magma cools slowly deep underground there is time for the crystals to grow bigger before the rock solidifies.
c) Explain the distinction between “mafic” & “felsic” igneous rocks, in terms of their mineral content.
Mafic igneous rocks are relatively low in silica & rich in dense, dark-coloured iron & magnesium silicates. Felsic rocks are high in silica & richer in light-coloured, lower density “feldspar” silicates with aluminium, potassium, etc.

4. Outline how Sedimentary rocks are formed.
By compression and cementing of sediments, such as silt, sand or pebbles.
5. Outline how Metamorphic rocks are formed.
These are formed when other, pre-existing rocks are changed into new forms by heat and/or pressure.

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Discusssion / Activity 3 Suggested Answers

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Soils

Student Name .....

1.

a) What is "weathering" and which part of a soil does it produce?

Weathering is the breakdown of rock. This forms the mineral part of a soil.

b) Outline the difference between "physical" and "chemical" weathering.

Physical weathering simply breaks the rock & its minerals into smaller fragments. (eg quartz forms sand grains) Chemical weathering alters the crystal structure of minerals to form new substances. (eg silicate minerals form "clay".

c) What is "humus"?

Humus is rotted plant remains and animal wastes.

d) What is "leaching" of soil? Is it good or bad?

Leaching is when water seeping through soil dissolves and washes substances from the soil. It can be good (removing salt) or bad (removing plant nutrients).

2. Outline the basic technique for measuring:

a) soil moisture content.

Weigh a soil sample, then dry it gently in an oven. Re-weigh to see how much water has been lost.

b) organic content of a soil.

Heat a dried soil sample strongly. This burns-off the organic chemicals as gases. The change of weight allows calculation of % organic material.

3. Give an example of how the bedrock underlying the soil could have a major effect on its moisture & organic content. If the bedrock is sandstone, the soil will be sandy. This drains well and does not hold water, so it may have low moisture. This may mean fewer plants can grow, so less humus accumulates. This means organic content (humus) could be low as well.

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Discusssion / Activity 4 Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete.
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Radiometric Dating

Student Name .....

1. List the 3 types of radiation associated with “radioactivity”.
Alpha, beta & gamma rays.

2.
a) What are isotopes?
Different atoms of the same element. They have the same number of protons & electrons, (so are the same chemical element) but have different number of neutrons

b) What is a radioisotope?
These are isotopes of an element which have an unstable nucleus & spontaneously undergo nuclear reactions releasing radiation.

c) What is meant by the “half-life” of a radioisotope?
It is a measure of the rate of decay of a radioisotope. Half-life is the period of time in which half of the atoms in a sample of a radioisotope will have undergone decay. Each radioisotope has its own characteristic value. Values range from fractions of a second, up to billions of years.

3. Outline the basic technique of radiometric dating.
Small amounts of natural radioisotopes with very long half-lives occur naturally in rocks & minerals. The tiny amount in a rock sample can be measured accurately from the radiation levels. It is also possible to figure out how much was present in the sample when the rock/mineral was formed. Knowledge of the half-life allows calculation of the time elapsed since the rock formed.

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Discusssion / Activity 5 Suggested Answers

The following activity might be for class discussion, or there may be paper copies for you to complete.
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Geological Resources

Student Name .....

1. Two "buzz words" of modern times are "renewable" and "sustainable".

a) Is a renewable resource always sustainable? Outline with examples.

Not necessarily. For example, a supply of fish is a renewable food resource. However, if the fish are caught at a rate faster than the fish can breed, then their population will decline & become unsustainable.

b) Is a non-renewable resource automatically unsustainable? Outline with examples.

All geological resources are non-renewable & for many, the current rate of extraction is unsustainable. However, if extraction rates are very low (as for pre-European Aboriginies) then the resource can be extracted over such immense time-frames that it will last essentially for ever... sustainable.

2. Outline some examples to illustrate that Australia is a leading producer of geological resources.

Australia's production of vital geological resources such as iron ore, bauxite, copper, uranium, diamonds & petroleum gas ranks in the top 5 in world production.

3. Briefly outline one technology used to collect "geophysical data" important for locating deposits of geological resources.

"Seismic technologies" involve exploding small charges in the ground & studying the shock waves as they reflect & refract from rock formations underground. This can identify different rock layers, faults & folds in the rocks, etc. This gives geologists clues about possible "traps" were oil may have collected, or where seams of valuable minerals are located.

4. List & briefly describe the 3 main techniques for extracting (mining) resources.

Drilling, to place a pipeline for extracting liquid or gas petroleum resources.

Pit or Open-Cut mining is suitable for wide-spread deposits which are near the surface. This allows the resource (eg iron ore or coal) to be simply scooped or excavated like the quarrying of rock.

Underground mining is used for deeper deposits. Shafts are sunk down to the mineral seams, then tunnels or "rooms" are excavated following the deposit seams or layers.