ROCKS

The rocks of the Earth's crust are grouped into three major classes: igneous, sedimentary, and metamorphic rocks.
Igneous rocks form when molten material from the Earth's interior cools and solidifies in the crust. Magma cooled slowly below the surface forms coarse-textured **intrusive** (plutonic) igneous rocks. Lava cooled rapidly at the surface forms fine-textured **extrusive** (volcanic) igneous rocks. Igneous rocks consist mainly of silicate minerals containing silicon, oxygen, and metallic elements. The type of present metallic elements determines the mineral density. Less dense **felsic** minerals dominate the igneous rocks of the upper crust, while more dense **mafic** and **ultramafic** minerals dominate those of the lower crust.

Sedimentary rock can form in one of the three ways. Most sedimentary rock, like sandstone, is made up of particles of other rocks and minerals that have been deposited in one place, usually by moving water, ice or wind. As layer builds upon layer, the bottom layers become pressed together by the weight of the layers above them. Elements in the water form cement that joins the particles of sediments together to form a solid. Some sedimentary rock, like limestone, is formed by the remains of organisms that were once alive. Other sedimentary rock (for example, rock salt and other kinds of limestone) is formed from minerals that were once dissolved in water, i.e. they are chemically precipitated. Newly-formed mineral crystals form on or settle to the bottom of the water and build up layers of sediment. So, if the rock is sedimentary, you know that the rock most likely formed beneath a body of water or from desert or seacoast sands.
A layer of sedimentary rock that is marked off above and below by surfaces that can be seen and is made up of material that is the same in all its parts is called a **bed**. A surface that is parallel to the original surface on which the sediment was deposited is referred to as a **bedding-plane**.

Metamorphic rock is formed when minerals and rocks are changed by very great heat from a nearby flow of magma or lava or from heat and pressure very deep below the surface of the earth.
Sometimes the atoms of minerals change position, and new minerals are formed. When this happens, certain mineral grains will sometimes grow larger. Other times minerals lose or gain atoms. In response to pressure, the minerals in most metamorphic rocks tend to form layers. In the rocks that have been under great pressure the layers may be noticeably bent or folded.

Answer these questions:

1. How are the rocks classified?
2. How do intrusive / extrusive rocks form?
3. What determines the mineral density of igneous rocks?
4. Where do mafic and ultramafic minerals dominate?
5. Describe the three ways of the formation of sedimentary rocks.
a)
b)
c)
6. How do particles of sediments solidify?
7. Where did sedimentary rocks most probably form?
8. How did metamorphic rocks form?
9. What caused noticeable folding of the metamorphosed layers?

The rock cycle

Task: Fill in the missing words with one of the words from the clue.

Clue: another apart as buried cycle dissolved either hardens nor undergo

The rocky face of the earth is constantly changing. Rocks and minerals are part of a huge recycling process.

Any class of rock can be changed into any other class of rock. An igneous rock, for example, can be [1]_____ and broken [2]_____ by weathering processes at the earth's surface. The products of weathering are [3]_____ particles of rock or dissolved salts. The particles of rock and the dissolved salts are deposited and built up [4]_____ layers of sediments that harden to become a sedimentary rock. The sedimentary rock can become deeply [5]_____ in the earth and changed into a metamorphic rock. The metamorphic rock can then be melted by heat within the earth and be changed into magma, which later cools and [6]_____ into an igneous rock. This process of change from one class of rock to another is called the rock [7]_____.

In the example you just read, the igneous rock at the beginning of the cycle would probably not be the same as the igneous rock at the end. The rock cycle is a cycling in the sense of a recycling.

It is a redistribution of elements and minerals from one rock type to [8]_____. The rock cycle is not the kind of cycle that returns to the same point or condition after a period of time. [9]_____ does the rock cycle always follow the same series of changes.

Two other processes are often very important parts of the rock cycle. Rocks buried deep in the earth must be raised to the surface and exposed before they can be broken down or dissolved by the weather. And rocks near the surface must be buried to great depths in order to be exposed to the pressure and heat needed to [10]_____ metamorphism or melting.

Task: *a) Find the opposites of* **together - , soften - , buried -**
Help: two of them are in the clue.

b) Find the synonyms of **transported to depth - , lifted - , solidify -**

Task: Look at the slide describing the rock cycle and explain:

1. How can a sedimentary or a metamorphic rock become igneous?
2. What are the processes that turn a sedimentary or igneous rock into a metamorphic rock?
3. What are the processes that turn an igneous or metamorphic rock into a sedimentary rock?

What to look for in a rock

Task: *Substitute the underlined words by one of these:* **significant, similar, mainly, if, so**

The first step in identifying a rock is to determine <u>whether</u> / _____ the rock is igneous, sedimentary, or metamorphic. This first step is very <u>important</u> / _____, but it is not always easy because some very different rocks may look <u>like each other</u> / _____.
And <u>thus</u> / _____ you have to examine a rock for certain physical properties.
<u>In particular</u>, _____ you need to consider a rock's texture and its mineral composition.

The **texture** of a rock is the pattern made by the size, shape, and arrangement of the particles that are in the rock. Six common rock textures are defined in the table below this text.
Though sometimes called by different names, those six textures will help you describe most any rock you find.

Task: *Look at the pictures of specimens (in the syllabus or in AW p.86-87). Considered as four pairs, each rock on the right is a metamorphic form of the rock on its left. Learn the names of these rocks.*

granite (A)= žula - **gneiss** [!nais] (B) = ortorula
sandstone (C) = pískovec - **quartzite** (D) = kvarcit
limestone (E) = vápenec - **marble** (F) = mramor
shale (G) = jílovitá břidlice - **schist** (H) = krystalická břidlice

Task: Fill in the missing words with one of the words from the box and translate the types.

at all **at least** **enough** **evenly** **throughout** **too**

Six Common Rock Textures

Type of Texture	Description of That Texture	Example Rocks of That Texture
coarse-grained texture	made up of mineral grains or crystals that are large _____ to be seen without using a microscope	granite marble sandstone
fine-grained texture	made up of mineral grains or crystals _____ small to be seen without a microscope	limestone basalt
mixed-grain texture	made up of _____ two very different-size grains	conglomerate
glassy texture	containing no mineral crystals _____; a natural glass	obsidian
layered texture	made of mineral crystals all lined up in the same direction; parallel grains distributed more or less _____ within the rock	slate schist sandstone
banded texture	made up of different minerals that are concentrated in different bands **rather than** distributed evenly _____ the rock	gneiss

Tasks:

1. *What is meant by the word texture? By defining it you may avoid misunderstanding.*
2. *How does the texture of granite differ from the texture of limestone?*
3. *Translate the description of a banded texture, mainly note "rather than".*
   *Does the phrase "*distributed **within** the rock" *in a layered texture differ from* "distributed **throughout** the rock" *in a banded texture?*
   If so, what is the difference?

The **mineral composition** of a rock is, as its name states, a list of the minerals that make up the rock. For a start, there are a few basic minerals to look for. Recognizing those minerals will help you to make an approximate identification, which is sometimes all that a person can make without special equipment.

Task: *Complete the text with one of the possibilities from the clue. Which are the linkers?*

amounts distinguish flakes grains identified surfaces whereas in contrast to

Most common rocks contain silicate minerals. Silicate minerals can sometimes be recognized merely by their color. Pink or red crystals are potassium feldspar like orthoclase. Glassy, gray to purple-gray [1] _____ are quartz. Green colors are usually amphibole, pyroxene, or olivine. The micas are little [2] _____. Biotite mica is black, [3] _____ muscovite mica, which is clear to tan. White crystals may be any of the feldspars. If feldspar has equal [4] _____ of sodium and calcium, it is usually gray. Silicate minerals can also be [5] _____ by other physical properties. To [6] _____ quartz from feldspar, for instance, hardness can be used. Quartz is a little harder than feldspar. It has a hardness of 7, while feldspar has a hardness of 6. Also, feldspar crystals often have flat cleavage [7] _____ or crystal faces, [8] _____ quartz usually looks like clear or gray glass filling in between other mineral grains.

Calcite is also a key mineral for you to be able to recognize in a rock. Limestone and marble, for instance, are made up almost totally of calcite. Calcite is easily distinguished from quartz and feldspar because calcite has a hardness of only 3.
Another easy test for calcite is one drop of dilute hydrochloric acid. Calcite will bubble readily in dilute hydrochloric acid. Calcite will also bubble in white vinegar, but it may take as long as fifteen minutes for the bubbles to form. In dilute hydrochloric acid, the bubbles form immediately.

Tasks:

1. Explain the underlined words. Use their synonyms, formulas, or describe them.
(merely, tan, dilute, vinegar, hydrochloric acid)
2. Find the synonym for the word immediately in the last paragraph.
3. What are the two most important physical properties to look at when identifying a rock?
4. How can you distinguish calcite from quartz in rocks?

LISTENING

Geologists say they have discovered some rocks in Canada that may be the oldest rock on Earth.
Task: Listen to an interview with a geologist J. O´Neil and answer the questions.
You will find the mp3 file in the syllabus in IS.

1) How old is the Earth supposed to be?
2) Why is it not easy to find the rock as old as that?
3) Where has the previously oldest-known rock that is thought to be 4 billion years old been found?
4) Do you know how the scientists determined the age of ancient rocks in the past?
5) Which university is a geologist Jonathan O´Neil at? What level is he?
6) What reaction on the finding of the oldest rock did a geologist Jonathan O´Neil suppose?
7) Where did he find the rock which he believes that might be the world´s oldest?
8) How does he get there?
9) How old is the rock he found there supposed to be?
10) Where did O´Neil and his colleagues present his evidence?
11) Why did O´Neil not use the "zircon technique" which was used until then?
12. What was his technique formally used for?
13) What may the finding of the earliest rock bring to science?

Oral Credit Task: Your presentation on rocks should describe the rock texture, composition, structure, occurrence and usage.

Text adapted from Fariel, R. - Hinds, R. - Berey,D.: Earth Science, Addison-Wesley 1987
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