Worksheet: The geological time scale

Activity 1: Reading and comprehension

Scientists have studied Earth to find water, to search for oil or coal, or to find out when to expect earthquakes, landslides or floods. The Earth is constantly changing, for example, the rocks on top of a mountain may once have been at the bottom of the sea. In order to understand how this all happens we need to learn about the Earth’s history. Time as we know it is measured in seconds, minutes, hours, days, weeks, months, decades, centuries and millenia. When scientists talk about the history of Earth it is measured in millions and billions of years. When studying the past, historians use dates to put events in their proper order.

However, geologists have developed the geological time scale, which divides the Earth’s history into eons that are subdivided into eras, which are further divided into periods and then into epochs. Examples of some of these subdivisions are Paleozoic or Cenozoic. The words “paleo” means ancient, “meso” means middle, and “ceno” means recent, while “zoic” refers to animal life, so ‘Paleozoic’ means ancient life.

Fossils are the remains or evidence of prehistoric plants and animals that have fossilized. Fossils were used as markers when building up the geologic time scale. The names of most of the eons and eras end in “zoic”, because these time periods were recognised by the animal life present at the time. Rocks formed during the Proterozoic Eon have fossil evidence of simple organisms, such as bacteria, algae, and wormlike animals. In the Phanerozoic Eon, the rocks formed have fossils of animals and plants such as dinosaurs, mammals, and trees.
Scientists who study fossils are called palaeontologists. They, with the help of geologists, study the record of past events that is preserved in the rocks and fossils. Sedimentary rocks are the most common rocks at the Earth’s surface. They are made up of pieces of other rocks, and matter like sand, clay and mud that settled in layers at the bottom of rivers, lakes and oceans and then was compacted, and hardened over time to form sedimentary rock. Examples of sedimentary rocks are limestone, shale and sandstone. Sometimes plants, bones, sea shells, leaves, pollen and other bits of living things got caught between the layers of sediment. These buried plant and animal remains eventually fossilize within the layers of sedimentary rock, preserving a record of the animals and plants present at the time the rock was forming.

<table>
<thead>
<tr>
<th>Period</th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Cenozoic</td>
<td>Quaternary</td>
<td>Tertiary</td>
<td>Cretaceous</td>
<td>Jurassic</td>
<td>Triassic</td>
<td>Permian</td>
<td>Carboniferous</td>
<td>Paleozoic</td>
<td>Pre-Paleozoic</td>
</tr>
<tr>
<td>Time (mya)</td>
<td>0</td>
<td>65</td>
<td>138</td>
<td>145</td>
<td>208</td>
<td>252</td>
<td>360</td>
<td>543</td>
<td>606</td>
</tr>
<tr>
<td>Events</td>
<td>evolution of humans</td>
<td>mammal diversity</td>
<td>extinction of dinosaurs</td>
<td>first primates</td>
<td>first flowering plants</td>
<td>first birds</td>
<td>dinosaurs diversity</td>
<td>first mammals</td>
<td>first dinosaurs</td>
</tr>
</tbody>
</table>
Questions:

1. Explain the difference between "relative dating" and "absolute dating".

2. Explain the structure of the geologic time scale.

3. What is a palaeontologist?

4. The layers of rocks can be compared with the pages of a history book. Explain what you understand by this statement in the context of the Earth's history.

5. What are sedimentary rocks?

6. What is the Law of Superposition and why is it essential to our interpretation of Earth's history?

Activity 2: Design a game

Design a game to teach the geological time scale. The example below will help you get your creative juices going.
Teacher notes

Activity 1:

1. **Relative dating**
   Relative dating methods are used to indicate the general age of a fossil. This kind of dating is used when it is not possible to directly date a fossil. This can be done in a number of ways, for example, the sediments containing the fossil may be dated, or a rough date may be obtained in some other way. For example, some groups of animals such as elephants and pigs underwent fairly rapid evolution, and the appearance of certain species in a fossil site can be used to indicate a rough age for the site or sediments containing those species. The use of animals for dating fossil-bearing horizons is called biostratigraphy or biochronology.

2. **Absolute dating**
   Absolute dating is used when the sediments or fossil can be directly dated. There are numerous dating methods available, using a range of elements and isotopes. For example, radiometric dating studies the rate of decay of certain radioactive isotopes within a bone, tooth or sediment. Isotopes are one or more forms of an element differing from each other in atomic weight and in nucleas, but not in chemical properties.

2. The geologic time scale is the “calendar” for events in Earth’s history. It subdivides all time since the end of the Earth’s formative period as a planet (nearly 4 billion years ago) into named units of abstract time: in descending order of duration, are eons, eras, periods and epochs. The geologic time scale provides a system of chronologic measurement relating stratigraphy to time that is used by geologists, palaeontologists and other Earth scientists to describe the timing and relationships between events that have occurred during the history of the Earth. The detailed studies made of rocks throughout the world have allowed geologists to correlate rock units globally, and break them into time units. The result is the Geologic Time Scale, usually presented in a chart like from with the oldest event and time unit at the bottom and the youngest at the top.

3. A palaeontologist studies the history of life on Earth, mainly through the examination and study of fossils, which are evidence of ancient life, most often found in sedimentary rock. Palaeontologists can do a number of things depending on their interests. They may do lab work - cleaning, identifying, and sorting fossil bones; chemically analyzing material, re-assembling fossil structures, preparing exhibits. They can also do field work involving the discovery of new fossils. They may also prepare scientific papers and come up with new scientific theories based on new, or previously published, information. Finally, some palaeontologists can make a living with a career in teaching.
4. Geologists are able to reconstruct the sequence of events that has shaped the Earth’s surface from the study of petrology, stratigraphy and palaeontology. Geologists have come up with a geological time scale, which divides the history of Earth into eons.

Each rock can tell us something about the conditions in which it formed, and sedimentary rocks may contain clues as to the environment which existed when the sedimentary layers were laid down. Fossils found in sedimentary rocks may provide information on past life. The rocks record the history of the Earth, just like a book - even if we are missing some pages!

5. Sedimentary rocks are the most common rocks at the Earth’s surface. Over millions of years, little pieces of rock and other matter, including sand, clay and mud, become broken down and worn away by wind and water. These bits of Earth settle in layers at the bottom of rivers, lakes and oceans. Over time, these layers get pressed down until the bottom layers slowly turn into rock known as sedimentary rock.

Examples of sedimentary rocks are limestone, shale and sandstone. Sometimes plants, bones, seashells, leaves, pollen and other bits of living things get caught between the layers of sediment. These buried plant and animal remains eventually fossilize within the layers of sedimentary rock.

6. The law of superposition states that in any undisturbed sequence of rocks deposited in layers, the youngest layer is on top and the oldest on the bottom, each layer being younger than the one beneath it and older than the one above it. Note that tectonic activity may reverse rock layers, so that the inverse situation holds true!

Activity 2:
Learners own answer.