Pathfinder Honour:

Trainer's Notes

Geology 1

Instructions to Trainers / Instructors of this Honour

Thankyou for being involved with this Honour. These notes have been developed to assist in teaching / instructing this honour. We recognise that there is much more information available and we are grateful that you should share your expertise.

Please remember that Honours are designed to develop our Pathfinders in many ways; their interests, their knowledge and their relationship with their Saviour and Creator. Your enthusiasm and creativity will have a huge impact on those doing the honour.

To complete an Honour, the following (where applicable) must be completed satisfactorily:

- Physical and Practical Requirements.
- Honour Workbook.
- Honour Assessment Sheet. *(On SPD Honour Website but Leader's level access is required)*

Additional Reference Material

Acknowledgements

Unless stated otherwise, these notes have been based on the following excellent site:
http://en.wikibooks.org/wiki/Adventist_Youth_Honors_Answer_Book/Nature/Geology

Please be aware that any material on this site and any other site is beyond the control of the SPD.

Geology1 Honour

REQUIREMENT 1: Give the geological meaning and examples of the following words:

a. Delta

A delta is a landform where the mouth of a river flows into an ocean, sea, desert, estuary or lake.

Well known deltas are the Nile Delta (pictured), the Mekong delta and the Ganges Delta

Picture: Satellite image of the Nile River Delta
http://en.wikibooks.org/w/index.php?title=File:Nile_River_and_delta_from_orbit.jpg&filetimestamp=20041129224727

b. Sand spit

Sand spits are formed by the movement of sediment (typically sand) along a shore

An excellent example is Farewell Spit, a narrow sand spit situated at the northern end of the South Island of New Zealand. It runs eastwards from Cape Farewell, the island's northernmost point.

It is the longest sand spit in New Zealand, stretching for about 26 km above sea level and another 6 km underwater. The spit runs in from west to east, and is made from fine golden sand.

Picture: Farewell Spit, North New Zealand
http://en.wikipedia.org/wiki/Farewell_Spit

c. Sinkhole

A sinkhole is a natural depression or hole in the surface topography caused by the removal of soil or bedrock, often both, by water.

Sinkholes may vary in size from less than a meter to several hundred meters in diameter and depth, and vary in form from soil-lined bowls to bedrock-edged chasms. They may be formed gradually or suddenly, and are found worldwide.

Picture: Sinkholes near the Dead Sea
http://en.wikibooks.org/w/index.php?title=File:DeadSeaSinkhole.jpg&filetimestamp=20070115215328

d. Oxbow lake (ie billabong)

An oxbow lake is a type of lake which is formed when a wide meander from a stream or a river is cut off to form a lake.

They are called oxbow lakes due to the distinctive curved shape that results from this process. In Australia, an oxbow lake is called a billabong.

Picture: Map of Oxbow lake
http://en.wikibooks.org/w/index.php?title=File:Oxbow_lake.jpg&filetimestamp=20061217072155

e. Moraine

Moraine is a French word that refers to any glacially formed accumulation of unconsolidated debris. This debris may be plucked off the valley floor as a glacier advances or fallen off the valley walls as a result of frost wedging.

Moraine may be comprised of silt like glacial flour to large boulders. The debris is typically angular. Moraine may be on the glacier's surface or deposited as piles or sheets of debris where the glacier has melted. Moraine may also occur when rocks fall in the sea.

Picture: Moraine, glacier and lake of Arsine, Écrins National Parc, French Alps
http://en.wikibooks.org/w/index.php?title=File:Moraine_mediane_Arsine.JPG&filetimestamp=20070319091604

f. Cirque

A cirque is an amphitheatre-like valley of glacial origin, formed by glacial erosion at the head of the glacier.

Cirques are typically partially surrounded by steep cliffs. The highest cliff is often called a headwall.

They are also known as a cwm in Wales, a coomb or coombe in England, and a corrie in Scotland and Ireland.

Picture: Iceberg Cirque, Glacier National Park, USA
http://en.wikibooks.org/w/index.php?title=File:Iceberg_Cirque.jpg&filetimestamp=20050519082757

g. Mesa

A mesa (Spanish and Portuguese for "table") is an elevated area of land with a flat top and sides that are usually steep cliffs.

It takes its name from its characteristic table-top shape. It is a characteristic landform of arid environments, particularly the south-western United States.

Many examples are also found in Spain, North and South Africa, Zimbabwe, Arabia, India, Australia and the Colorado regions of North America.

Picture: Mesa at Ray Mine (Arizona, USA)
http://en.wikibooks.org/w/index.php?title=File:Mesa_raymine.jpg&filetimestamp=20060625140805

h. Alluvial fan

An alluvial fan is a fan-shaped deposit formed where a fast flowing stream flattens, slows, and spreads typically at the exit of a canyon onto a flatter plain.

Picture: A small alluvial fan.
http://en.wikibooks.org/w/index.php?title=File:Mini_Alluvial_Fan_Imprinted_with_Footprints.jpg&filetimestamp=20051123065112

i. Anticline

An anticline is an upward-curving fold, with layers that rise from the centre of the structure.

j. Syncline

A syncline is a downward-curving fold, with layers that dip toward the centre of the structure. It's easy to remember which is an anticline and which is a syncline, because the syncline "sinks" in the middle.

Pictured: An anticline on the left, a syncline on the right
http://en.wikibooks.org/w/index.php?title=File:Anticline.jpg&filetimestamp=20060412114237

REQUIREMENT 2: Describe the following:

a. A shield volcano as compared to a composite volcano.

A shield volcano is a large volcano with shallowly-sloping sides. Shield volcanoes are formed by lava flows of low viscosity — lava that flows easily. Consequently, a volcanic mountain having a broad profile is built up over time by flow after flow of relatively fluid lava issuing from vents or fissures on the surface of the volcano. Many of the largest volcanoes on Earth are shield volcanoes. The largest is Mauna Loa in Hawaii.

Pictured: Skjaldbreiður", an Icelandic shield volcano whose name means "broad shield."
http://en.wikibooks.org/w/index.php?title=File:Skjaldbreidur_Herbst_2004.jpg&filetimestamp=20050125145925

A composite volcano is a tall, conical volcano composed of many layers of hardened lava, tephra, and volcanic ash. These volcanoes are characterized by a steep profile and periodic, explosive eruptions. The lava that flows from them is viscous, and cools and hardens before spreading very far. Mount St. Helens in Washington, USA, Popocatépetl in Mexico, and Krakatoa in Indonesia are composite volcanos.

Pictured:
Top - Mount St. Helens USA on May 17, 1980, one day before the devastating eruption.
http://en.wikibooks.org/w/index.php?title=File:Sthelens1.jpg&filetimestamp=20070205184004

Bottom - Mount St. Helens just after the eruption
http://en.wikibooks.org/w/index.php?title=File:Volcano.jpeg&filetimestamp=20041209041336

b. How a glacier moves and what evidences it leaves behind.

Ice behaves like an easily breaking solid until its thickness exceeds about 50 meters (160 ft). The pressure on ice deeper than that depth causes plastic flow. The glacial ice is made up of layers of molecules stacked on top of each other, with relatively weak bonds between the layers. When the stress of the layer above exceeds the inter-layer binding strength, it moves faster than the layer below.

Another type of movement is basal sliding. In this process, the whole glacier moves over the terrain on which it sits, lubricated by melt water. As the pressure increases toward the base of the glacier, the melting point of water decreases, and the ice melts. Friction between ice and rock and geothermal heat from the Earth's interior also contribute to thawing. This type of movement is dominant in temperate glaciers. The geothermal heat flux becomes more important the thicker a glacier becomes.

Before glaciation, mountain valleys have a characteristic "V" shape, produced by downward erosion by water. However, during glaciation, these valleys widen and deepen, which creates a "U"-shaped glacial valley. Besides the deepening and widening of the valley, the glacier also smooths the valley due to erosion.

At the 'start' of a classic valley glacier is the cirque, which has a bowl shape with escarped walls on three sides, but open on the side that descends into the valley. In the cirque, an accumulation of ice is formed. These begin as irregularities on the side of the mountain, which are later augmented in size by the coining of the ice. After the glacier melts, these corries are usually occupied by small mountain lakes called tarns.

c. How sediments are laid down by water.

Sediment is any particulate matter that can be transported by fluid flow and which eventually is deposited as a layer of solid particles on the bed or bottom of a body of water or other liquid. Sedimentation is the deposition by settling of a suspended material.

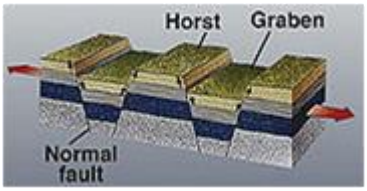
When water flows over a stream bed, it picks up sediments. The faster the water flows, the larger particles it can transport. As the water slows, the particles are dropped, forming a sediment. Because the water speed slows gradually, the particles are sorted by size as they are dropped.

d. The different types of mountains.

Fold Mountains

The compression forces in continental collisions may cause the compressed region to thicken, so the upper surface is forced upwards. In order to balance the weight, much of the compressed rock is forced downwards, producing deep "mountain roots". Mountains therefore form downwards as well as upwards. However, in some continental collisions part of one continent may simply override part of the others, crumpling in the process.

Block or Fault-block Mountains



Block mountains are created when large areas are widely broken up by faults creating large vertical displacements. This occurrence is fairly common. The uplifted blocks are block mountains (ie *horsts*). The intervening dropped blocks are termed *graben*: these can be small or form extensive rift valley systems. This form of landscape can be seen in East Africa, the Vosges, the Basin and Range province of Western North America and the Rhine valley.

Pictured: Block Mountains (uplifted blocks or *horsts*); dropped blocks termed *graben*
http://en.wikibooks.org/w/index.php?title=File:Horst_graben.jpg&filetimestamp=20081206132923

Dome Mountains

In geology, a dome is a deformational feature consisting of symmetrically-dipping anticlines; their general outline on a geologic map is circular or oval.

The strata in a dome are up-warped in the centre; if the top of a dome is eroded off, the result will be a series of concentric strata that grow progressively older from the outside-in, with the oldest rocks exposed at the centre.

Many geologic domes are too large to be appreciated from the surface, and are readily apparent only in maps. Well-known regional structural domes include the Llano Uplift and the Ozark Dome.

Pictured: Enchanted Rock, a dome mountain just west of the Hill Country of central Texas.
http://en.wikibooks.org/w/index.php?title=File:Enchanted_rock_2006.jpg&filetimestamp=20070424020439

Volcanic Mountains (See Requirement 2a - Mount St. Helens)
A volcano is an opening (or rupture) in the Earth's surface or crust, which allows hot, molten rock, ash and gases to escape from deep below the surface.

Volcanic activity involving the extrusion of rock tends to form mountains or features like mountains over a period of time.

e. Why a river or stream bank often keeps caving in on the outside of a bend.
When a river reaches a low-lying plain in its final course to the sea or a lake, it meanders widely. Sediments are deposited on the inside (convex) bank because the current there slows. In contrast, both lateral erosion and undercutting occur on the outside (concave) bank where the stream's speed is the highest. The faster current on the outside of a bend is able to pick up sediments and transport them further downstream.

REQUIREMENT 3: Know what category (sedimentary, metamorphic, or igneous) the following rocks are and give locations or examples:

Sedimentary rock: Formed when sediments carried by wind or water settle and turn to stone.

Metamorphic rock: Formed when rock is transformed by great heat and pressure.

Igneous rock: Formed when lava cools and solidifies.

The following are from Australia. Why not try to collect some examples of these rocks!

	Rock	Category	Locations / Examples
a.	Granite	Igneous	Bald Rock near Tenterfield, North NSW.
b.	Sandstone	Sedimentary	Uluru, also called Ayers Rock, Northern Territory
c.	Conglomerate	Sedimentary	Kata Tjuta (ie the Olgas), northern Territory
d.	Slate	Metamorphic	Willunga & Mintaro, South Australia
e.	Shale	Sedimentary	Stuart oil shale, near Gladstone Queensland
f.	Marble	Metamorphic	Chillagoe, North Queensland (see Cairns marble)
g.	Lava	Igneous	Undara Volcanic National Park, North Queensland
h.	Limestone	Sedimentary	The Pinnacles, S W Western Australia
i.	Basalt	Igneous	Bruny Island, South-East of Hobart, Tasmania
j.	Gneiss	Metamorphic	Jack Hills approx 800 km North of Perth W Aust

Geology1 Honour

REQUIREMENT 4: Take a picture, download a picture from the intenet or make a sketch of each of the following geological features:

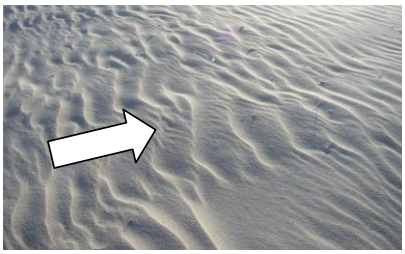
a. A bed of sediment that is coarser at the bottom and finer toward the top. (This is called normal graded bedding).

The size of a particle that a stream can transport depends on the stream's speed as well as the size and density of the particle.

In general, the faster the current, the larger the particle that can be transported. As a stream slows, it drops the largest particles first. As it slows more, it continues to drop finer and finer particles. When the current stops, all sediments are deposited. This means that the sediment at the top is much finer than the sediment at the bottom.

b. Ripple marks in sand or mud. (Show with an arrow the current direction if possible).

In this photo, the wind was blowing from left to right.



The left sides of the ripples have gentler slopes, while the right sides have steeper slopes.

As the wind breaks over the top of the ripples, it forms eddy currents (circulating wind) which make the lee side steeper than the windward side.

http://en.wikibooks.org/w/index.php?title=File:Sand_Norderney.jpg&filetimestamp=20060403204057

c. Gulley erosion

A gully is a landform created by running water eroding sharply into soil, typically on a hillside. Gullies resemble large ditches or small valleys, but are meters to tens of meters in depth and width.

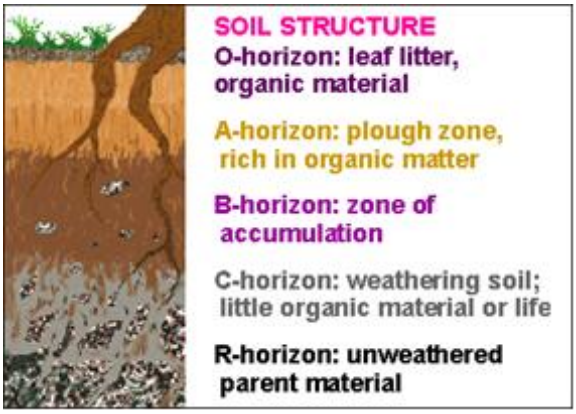
d. Mud cracks.

These can usually be found after a heavy rain or flood when mud starts to dry.

e. Soil profile along a stream bank or road cut.

Based on 'Soil geology' by Dr J Floor Anthoni (2000) http://www.seafriends.org.nz/enviro/soil/geosoil.htm

A basic soil profile consists of zones called horizons. A summary is as follows:



O-horizon: Organic matter; a thin litter layer of plant residues, relatively undecomposed.

A-horizon: Where most plant roots and all soil organisms are found. Its nutrients have been used by plants or leached downward, so it is relatively poor in nutrients, but rich in life.

B-horizon: Where new material from below and nutrients from above accumulate.

C-horizon: Contains the recently weathered and still weathering soil. It may be rich in nutrients which have passed through horizon-B.

R-horizon: Contains unweathered parent material (ie the base rock).

f. A sand bar.

Sand bars can be found in streams, rivers or along the ocean. Sandbars are especially noticeable at low tide.

REQUIREMENT 5: Describe / photograph / sketch a local geological feature and explain its significance.

There are numerous geological features to choose from. As a starting point, check out the features described in previous requirements for inspiration.

The geology honour is a great one to do on a campout and a theme can be constructed around it.

Come to think of it, every feature on land is a geological feature in some way. Enjoy!