GEOLOGY TRAINING ACTIVITY

LEADER'S GUIDE
Evolution of relief

WORKING DOCUMENT

centre de développement pédagogique
pour la formation générale en science et technologie

ANIMATION GUIDE

You will find several documents associated to this activity. We suggest a sequence of animation here, but it can be adapted according to your needs. The activity was conceived to allow you to become familiar with the Earth and Space World concepts, to approach the main stages of the formation of relief and to consolidate the knowledge acquired in the activity on crystallisation. We suggest that you approach the cycle of rock formation previous to starting this activity.

You will find a document on types of rocks. This document may be used during the integration phase of the activity on crystallization and may also serve during the preparatory phase of the current activity.

An overview is proposed, but it constitutes an example of what this activity could become with students from the first cycle of secondary school. A four level, descriptive evaluation grid for certain criteria of disciplinary competency 2 will be added to the activity shortly.

PROPOSED SEQUENCE

1) Distribute the « evo_relief_problem » document and allow time for all participants to read the global context.
2) In large groups, brainstorm what is known (rock formation and characteristics of different types of rocks) and what will be necessary to the realization of the proposed task.
3) Present the proposed activities and resources accompanying them, to allow the participants to develop the necessary expertise:
    - Scales of geological time – resources: websites, manuals and training notes. (Required documents: evo_relief_table, evo_relief_events, evo_relief_resources).
    - Information quest in *The Earth* animation – resources: distributed documents and *The Earth* animation (Required documents: *The Earth* animation, available on the CDP website, as well as evo_relief_earth).
4) Once the acquisition activities are completed, summarise each of these in large groups. You will find the complete scale of geological times at the end of this document.
5) Come back to the original problem and build the explanation in large groups (suggested explanations on the following page.)
6) Summarise with participants on possible transfers towards the students and modifications to be brought in such a case. Note: The activity can also serve as a mold for local relief. You would then need to change the starting diagram.

Your explanations:

Initially, there was probably a cooling of the magma (forming the igneous rock in zone 5). Then, erosion due to wind, rain, ice and vegetal cover generated the superposition of sedimentary layers. As the layers accumulated, the weight and pressure increased with depth (the weight of the superior layers working on the lower layers) promoting the formation of sedimentary rocks (superior layer of zone 6) and their transformation into metamorphic rock (inferior layer of zone 6). The lower layers are thus much more ancient than the upper ones.

Next, an intrusion of magma penetrated the encompassing rock and slowly cooled within the layers, generating the formation of intrusive igneous rocks – the large crystals allow one to conclude a slow cooling of magma since they had time to grow (zone 1). A part of the layer of rocks that covered this intrusion has probably disappeared with erosion. The greater resistance to wear of the intrusive rocks (hardness) explains their appearance at the surface. As well, we notice zones of rocks transformed by and submitted to intense heat close to the intrusion. This allows us to assume that the layers were already present at the time of the intrusion. The igneous rocks were transformed into metamorphic rocks (zone 4) as well as the sedimentary ands metamorphic rocks of zone 2.

The layer containing fossils (zone 3) suggests a marine transgression after the intrusion of the igneous rock, since the rocks near the intrusion are not transformed. Finally, a marine transgression could have been caused by a period of glaciations, explaining the disappearance of large quantities of sediments (layers of worn rocks carried away by a glacier) and the appearance of a butte of igneous rock in the midst of layers of friable rock.

NOTE: Formation of the Eastern Townships hills.

Extract from M. Prichonnet's animation document
at the November 20th -23rd session.

GEOLOGICAL TIMES				EVOLUTION OF LIFE	EVOLUTION OF LANDSCAPES
Era	**Period**	**Epoch**	**Age in millions of years**		
CENOZOIC	Quaternary	Holocene		Disappearance of mammoths	Current landscape
		Pleistocene	(10,000 years)		Champlain Sea on lowlands of the Saint Lawrence The great glaciations over Canada, the northern U.S., Europe. etc.
	Neogene	Pliocene	1.6		
		Miocene	5	Appearance of man	
	Palaeogene	Oligocene	25	Appearance of the great apes REIGN OF MAMMALS AND BIRDS	
		Eocene	37		
		Palaeocene	55	Appearance of primates	
MESOZOIC	Cretaceous		65	Disappearance of dinosaurs and marine reptiles	Beginning of the formation of the Rocky Mountains Intrusion of Eastern Township hills (Mounts Royal, Saint-Bruno, etc.)
	Jurassic		135	REIGN OF DINOSAURS AND MARINE REPTILES	Opening of the Atlantic Ocean
	Triassic		205		
PALEOZOIC	Permian		225	Great extinction of marine beings	Last Appalachian folds
	Carboniferous • Pennsylvanian • Mississippian		280 345	Great accumulations of terrestrial plants (future carbon layers) REIGN OF AMPHIBIANS	
	Devonian		400		Continuation of formation of Appalachians
	Silurian		430	REIGN OF MARINE INVERTEBRATES (trilobites, brachiopods, molluscs, corals)	
	Ordovician		500	First terrestrial plants	Beginning of formation of Appalachians
	Cambrian				Marine invasion or transgression over Quebec and Eastern continent
PRECAMBRIAN	Proterozoic		545	Appearance and diversification of invertebrates	
			1000		The Laurentians
	Archeozoic (Archaean)		2500	Marine "Algae" (stromatolites) First fossils (cells)	First relief of Canadian Shield
			3900 4600		First sedimentary rocks Birth of the planet Earth