

Fieldwork: Applying 'the present is the key to the past'

An outdoor activity to apply the present to the past - using Earth science-thinking in reverse

This five-phase outdoor activity is used to explain how Earth scientists use the Principle of Uniformitarianism, often simply stated as 'the present is the key to the past', by considering the present environment and thinking how it might be preserved geologically.

Phase 1: What is happening now?

This activity can be run anywhere outside, but probably works best near a tree with some bare soil exposed underneath, like this one.



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Ask the group 'What processes are happening now or have happened in the past few hours?', and give as an example 'The wind is blowing'. You could ask them, singly or in groups to write down as many things as they can – then add to their list during discussion. Answers might include:

• Wind blowing	• Birds flying
• Clouds moving	• Weathering
• Temperature changing	• Erosion
• Evaporation	• Ground being compacted
• Raining	• Sun radiating visible light
• Humidity changing	• Sun's rays scattering making the sky blue
• Air pressure changing	• Sun radiating heat
• Growth	• Sun radiating ultraviolet light
• Photosynthesis	• We are receiving ionising radiation (eg. gamma rays)
• Respiration	• We are receiving microwaves/radio waves
• Digestion	• Cosmic dust is raining down
• Transpiration	• Neutrinos are passing through us
• Leaves falling	
• Decay	
• Nitrogen is being fixed	
• Soil forming	
• Worms burrowing	
• People walking	
• Insects crawling	
• Birds singing	

• Cars driving	• We are receiving sound pollution
• We are receiving chemical pollution	• Ground vibrating

Phase 2: What evidence is there for what is happening now?

Ask the group what evidence they can sense for the processes that are happening, and give as an example something like, 'The wind is blowing your hair and I can feel it on my face'. They could add examples of evidence to their previous list. There are fewer examples in this list, including:

• Wind blowing	You can feel/see it
• Clouds moving	You can see them
• Temperature changing	'I'm feeling cold'
• Evaporation	Cracks in the soil
• Raining	Rain pits in the soil or 'I can feel it'
• Growth	Buds; small and large examples of the same species
• Photosynthesis	Because things are green they must be photosynthesising – but rather a second-hand argument
• Respiration	We are here and we're respiring – second-hand
• Digestion	We can hear our stomachs
• Leaves falling	Leaves on the ground
• Decay	Leaves turning brown
• Worms burrowing	Worm casts
• People walking	We can see them
• Insects crawling	We can see them
• Birds singing	We can hear them
• Birds flying	We can see them
• Erosion	Our footprints are eroding the ground
• Ground being compacted	We are compacting the ground – second-hand
• Sun radiating visible light	We can see
• Sun radiating heat	We can feel the warmth
• Cars driving	We can see them
• We are receiving chemical pollution	We can smell/taste it
• We are receiving sound pollution	We can hear it

Phase 3: What evidence could be preserved by a thick blanket of volcanic ash?

Ask them which examples from their evidence list would be preserved if there were a huge volcanic eruption nearby and everything were buried under a thick blanket of cold volcanic ash. There are fewer potential answers here too, which include:

• Wind blowing	Piles of wind-blown leaves may be preserved
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• Evaporation	Soil cracks could be preserved
• Raining	Rain pits could be preserved
• Growth	Buds; small and large examples of the same species could all be preserved
• Photosynthesis	Because plants are preserved, they must have been photosynthesising – but rather a second-hand argument
• Respiration	Our bodies are here and so we must have been respiring – second-hand
• Digestion	Our bodies are here and so we must have been able to digest – second-hand
• Leaves falling	Leaves preserved
• Worms burrowing	Worm casts could be preserved
• People walking	Human bodies are preserved – so they must have been able to walk
• Insects crawling	Insects could be preserved
• Erosion	Footprints could be preserved
• Cars driving	Cars could be preserved

Phase 4: What evidence could be preserved after 200 million years?

Ask what evidence might be preserved under the volcanic ash 200 million years later. Only the following four examples might be preserved (unless there is exceptional preservation or second-hand evidence is included, as for the examples in italics below).

• Evaporation	Soil cracks could be preserved
• Raining	Rain pits could be preserved
<i>Growth</i>	<i>Exceptionally: buds; small and large examples of the same species could all be preserved</i>
<i>Photosynthesis</i>	<i>Exceptionally: because plants are preserved, they must have been photosynthesising – but rather a second-hand argument</i>
<i>Respiration</i>	<i>Exceptionally: Our bones, teeth, metal zips, etc are here and so we must have been respiring – second-hand</i>
<i>Digestion</i>	<i>As above</i>
<i>Leaves falling</i>	<i>Exceptionally: leaves preserved</i>
• Worms burrowing	Worm casts could be preserved
<i>People walking</i>	<i>Exceptionally: Human remains are preserved – so</i>

	<i>they must have been able to walk</i>
• Erosion	Footprints could be preserved
<i>Cars driving</i>	<i>Exceptionally: cars preserved</i>

Note that, at each phase, fewer and fewer examples are preserved – evidence is lost progressively through the preservation processes.

Explain that this outdoor thinking exercise, of applying the present as the key to the past, is the way an Earth scientist works, in reverse.

Phase 5: Building a picture of the past from the evidence preserved

Show how an Earth scientist uses the Principle of Uniformitarianism to work out what the past was like by referring to a nearby sedimentary rock (in an exposure or building stone) or taking a rock or fossil out of your pocket and asking what we can tell about the past from this example.



A dinosaur Theropod footprint (a trace fossil).

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For the example of a small plaster cast or photo of a dinosaur footprint we can tell:

• On land	Dinosaur was walking
• Muddy	Footprint preserved
• Some water	To make mud and for dinosaurs to drink
• Clouds	To give rain
• Plants photosynthesising	Dinosaurs ate plants, or ate animals that ate plants; plants photosynthesised
• Plants were green	Photosynthesis possible due to green chlorophyll
• Sky was blue	Sun's rays and scattering
• Chemical pollution	Dinosaur digestion produced methane
• Sound pollution	Dinosaurs were noisy
• Etc.	Many more processes from the first list

The picture of the past was very similar to the picture today, but with different organisms, many of which are now extinct.

The back up

Title: Fieldwork: Applying 'the present is the key to the past'

Subtitle: An outdoor activity to apply the present to the past - using Earth science-thinking in reverse

Topic: An outdoor-based thought experiment to show how Earth scientists use evidence from rock sequences to understand past environments.

Age range of pupils: 10-18 years

Time needed to complete activity: 20 minutes

Pupil learning outcomes: Pupils can:

- explain how Earth scientists use the present as the key to the past through the Principle of Uniformitarianism;
- describe a range of physical, chemical and biological processes that act out of doors;
- explain the evidence for some of these processes;
- explain how the evidence for Earth processes can be preserved geologically.

Context:

Pupils use an outdoor thought experiment to develop their understanding of the Principle of Uniformitarianism (the present is the key to the past), first developed by scientists in the late 1700s.

Following up the activity:

The final phase of the activity can be applied to a range of sedimentary rocks and fossils.

Underlying principles:

- All the processes happening on Earth today also operated in the geological past (even though they may have operated somewhat differently in the early Earth, especially before life developed)
- Earth scientists apply their understanding of present day processes to interpret evidence from the past, preserved in rock sequences.

Thinking skill development:

Pupils use the pattern of today's processes (construction) to picture past environments (further construction); discussion may produce differing views (cognitive conflict) and explanation (metacognition) whilst the whole activity involves bridging from one phase to the next. Creativity and imagination are also required.

Resource list:

- either a nearby sedimentary rock or building stone or a pocket-sized rock, fossil, plaster-cast or photo of a fossil

Source: Devised by Chris King of the Earthlearningidea Team.

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