Video question script: Applying 'the present is the key to the past'

Question/Activity	Likely response	Rationale
In teaching about the Earth we can use thought experiments to help us explore Earth processes. This example explores Earth science principles studied in the school grounds through the Earthlearningidea: 'Applying 'the present is the key to the past''		
Take the pupils to an area of the schoolgrounds with some bare soil exposed		
Explain that we are going to show how 'the present is the key to the past' otherwise called the Principle of Uniformitarianism through a five-phase activity		An introduction to why this exercise is being carried out, and that it has five phases
Phase 1: Ask them 'What processes are happening now or have happened in the past few hours?' and to write down as many of these as they can, at least six. Give them an example to start them off, such as, 'The wind is blowing'. Follow this with a discussion to try to elicit as many answers as possible.	Likely responses are shown in Table 1 below	Construction of the overall picture of outdoor processes including elements of biology, chemistry and physics
Phase 2: Ask them to use all their senses to answer: 'What <u>evidence</u> is there for what is happening now?' An example is useful here too, such as 'The wind is blowing your hair and I can feel it on my face'.	Likely responses are shown in Table 1 below	Focussing on elements of the picture constructed, using evidence
Phase 3: Now ask: 'What evidence could be <u>preserved</u> by a thick blanket of cold volcanic ash?' – following a huge volcanic eruption	Likely responses are shown in Table 1 below	Focussing on elements of the constructed picture that could be preserved Cognitive conflict is involved in considering the preservation potential of the evidence in Phase 2
Phase 4: Ask: 'What evidence could be preserved after <u>200 million years</u>?'	Likely responses are shown in Table 1 below	
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.		Introduction to thinking like and Earth scientist
Phase 5: Show how we can: <u>Build a picture of the past</u> from the evidence preserved' 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. Two possible examples are given in Tables 2 and 3 below.	Questions and likely responses are given in examples Tables 2 and 3 below.	Bridging of the activity to examples from the geological past

Table 1. For Phases 1 – 4 of the activity.

What processes are happening now or have happened in the past few hours?	What <u>evidence</u> is there for what is happening now?	What evidence could be preserved by a thick blanket of cold volcanic ash (maybe 10m thick)?	What evidence could be preserved after <u>200 million years</u>?
Sun is shining	We can see the Sun (but do not look at it with the naked eye); we can feel the warmth; we can see shadows	Not preserved	Not preserved
Clouds are moving	We can see them	Not preserved	Not preserved

Wind is blowing	We can feel wind; our hair is blowing; leaves are moving	Leaves may be ponded up behind tree stumps (inferred)	Fossilised eaves may be ponded up behind tree stumps (inferred)
Temperature is changing	We are feeling warm/cool	Not preserved	Not preserved
Evaporation is happening	Areas drying; cracks in dried mud	Mud cracks preserved (inferred)	Mud cracks preserved (inferred)
Humidity is changing	No direct evidence	Not preserved	Not preserved
It has been raining	Path is wet; soil is damp (inferred)	Not preserved	Not preserved
Atmospheric pressure is changing	No direct evidence	Not preserved	Not preserved
Things are growing	Shorter and higher things of the same species (inferred); the grass needs mowing regularly	Different sizes of the same species are preserved (inferred)	Different sizes of the same fossil species are preserved (inferred)
Photosynthesis	Vegetation is green (inferred)	Not preserved	Not preserved
Transpiration	No direct evidence	Not preserved	Not preserved
Pollination	Bees are flying (inferred)	Not preserved	Not preserved
Nitrogen Is being fixed	No direct evidence	Not preserved	Not preserved
Decay	Leaves are rotting	Rotted leaves preserved	Leaves in different decay stages fossilised
People are walking Animals are moving	We can see them; footprints	Bodies and footprints preserved	Body and footprint fossils preserved (soft or hard part fossilisation, moulds or casts)
Digestion	Stomach is gurgling	Not preserved	Not preserved
Breathing	We can feel/ see their breath; their chest is rising and falling (inferred)	Not preserved	Not preserved
Circulation	We are pink (not white)	Not preserved	Not preserved
Excretion from lungs and skin	No direct evidence	Not preserved	Not preserved
Excretion	Dog or bird poo	Poo preserved	Fossil poo preserved as coprolites
Burrowing	Worm borrow casts	Casts and burrows preserved	Fossil casts and burrows preserved
Birds are flying	We see flying birds	Not preserved	Not preserved
Birds are singing	We can hear bird song	Not preserved	Not preserved
Insects are crawling/ flying	We can see them	Crawling insects preserved	Fossil insects
Cars are driving by	We can see/ hear them	Cars could be preserved	No ancient cars
Noise pollution	We can hear unpleasant noise	Not preserved	Not preserved
Chemical pollution	No direct evidence	Not preserved	Not preserved
Litter	We can see litter	Litter preserved	No ancient litter
Rusting	Steel objects are rust-colour	Rust-coloured steel objects preserved	Would not survive for Ma
Chemical weathering	Exposed things are discoloured	Discoloured things preserved	Discolouration would not survive for Ma
Biological weathering	Tree roots pushing up stones; soil formation (inferred)	Tree roots and soil preserved	Fossil tree roots and paleosol preserved
Soil is forming	Soil-forming processes are active	Soil preserved	Paleosol preserved
Erosion	Footprints have removed mud; small gullies	Footprints and gullies preserved (inferred)	Fossil footprints and gullies preserved
Transportation	Sand is found in gutters (inferred)	Sediment in gutters, gullies and rivers (inferred)	Sediment in gutters, gullies and rivers
Deposition	Sand in gutters and gullies	Sand deposits	Sandstone deposits
Compaction	Footprints (inferred)	Footprints preserved	Sandstone deposits (inferred)
Earth's magnetism	A compass and/or dip needle on your phone	Not preserved	Not preserved
Radio waves	No direct evidence	Not preserved	Not preserved
Microwaves	Mobile/cell phone in pocket	Not preserved	Not preserved
Infrared radiation	We feel warmth from Sun	Not preserved	Not preserved

Visible light waves	We can see	Animals could see (inferred)	Not preserved
Ultraviolet radiation	Our skin becomes red/brown if exposed	Not preserved	Not preserved
X-rays	No direct evidence	Not preserved	Not preserved
Ionising radiation (a, b, c)	No direct evidence	Not preserved	Not preserved
Cosmic dust falling	No direct evidence	Not preserved	Not preserved
Neutrinos passing through us	No direct evidence	Not preserved	Not preserved
46 things	**30 (+4 inferred only)**	**18**	**13**

Table 2. Phase 5: A dinosaur footprint example.

Environmental reconstruction	**Discussion of the evidence**
• On land	The dinosaur was walking
• Muddy	The footprint was preserved
• Some water	To make mud and for dinosaurs to drink
• There were clouds	To give rain
• Plants were photosynthesising	Dinosaurs ate plants, or ate animals that ate plants; plants photosynthesised
• Plants were green	Photosynthesis is possible due to green chlorophyll
• Sky was blue	Sun's rays and scattering
• Chemical pollution	Dinosaur digestion produced methane
• Etc.	Many more processes from Table 1

Table 3. Phase 5: A shelly limestone example.

Environmental reconstruction	**Discussion of the evidence**
Where the lime and fossil sediment built up:	
• Under water	Most limestone forms under water; sea shells form under water
• Shallow water	Most limestones form in shallow seas; sea shells live in shallow seas
• Warm water	Most limestones form in tropical and sub-tropical seas
• Clear water	Most shells cannot live in very muddy water; the limestone contains little mud
• Moving water	Living seashells need oxygen and food to be brought to them and excrement to be carried away
At the surface of the water:	
• Sky was blue	Sun's rays and scattering
• There were clouds	To give rain
If you could see land (a tropical/subtropical coastline):	
• Plants were green	Photosynthesis is possible due to green chlorophyll
• Etc.	Many more processes from Table 1