What happened when?: sorting out sequences using stratigraphical concepts

Are the age-based stratigraphical concepts principles or laws? – and how do you use them?

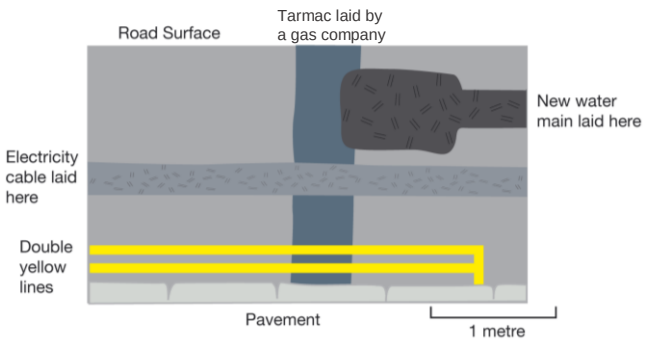
Principle or law?
Ask your pupils to complete the table below by writing if they think each sedimentary sequence statement is a 'Principle' or a 'Law'.

If they think the statement is a 'Principle' they should add any exceptions to the rule. *(Some answers are given in the 'Context' section of this Earthlearningidea).*

Sedimentary sequence	Principle or law?	
	Principle	Law
Superposition of strata – states that: 'the layer on top is the youngest.'		
Cross-cutting relationships – states that: 'anything that cuts across anything else must be younger.'		
Included fragments - states that: 'anything included in anything else must be older.'		

Applying the principles
Now ask your pupils to apply the principles to work out the age relationships in:

- a patched piece of road or pavement;



- outdoor (or indoor) courts (e.g. tennis or badminton courts) with several lines;
- a cracked wall;

- a local rock exposure;
- a geological map.

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The back up

Title: What happened when?: sorting out sequences using stratigraphical concepts

Subtitle: Are the age-based stratigraphical concepts principles or laws? – and how do you use them?

Topic: Understanding and applying stratigraphical concepts, indoors and outdoors.

Age range of pupils: 11 years upwards

Time needed to complete activity: 15 minutes

Pupil learning outcomes: Pupils can:
- determine whether the stratigraphical concepts used for age sequencing are principles (usually apply) or laws (always apply);
- apply the concepts in a range of indoor and outdoor situations, natural and produced by humans.

Context:
The stratigraphical concepts used for age sequencing can be applied through indoor and outdoor exercises in both natural and constructed situations.

- **'Superposition of strata'** is the '**Principle of Superposition of Strata**'; exceptions include:
  - overfolding, when rock sequences are turned upside down (inverted);
  - thrusting, when older rocks are forced up and on top of younger ones by large-scale thrust faults;
  - glaciation, when glaciers and ice sheets can sometimes drop glacial erratics of older rocks on top of younger ones.

  These different possibilities can be modelled using your hands through the *'Modelling by hand 'when the youngest rock is not on top''* Earthlearningidea.

- '**Cross-cutting relationships'** is the '**Law of cross-cutting relationships**' – and always applies.

- '**Included fragments'** is the **'Law of included fragments**' and always applies.

But in both 'Cross-cutting relationships' and 'Included fragments', you must make careful observations to be sure that the relationships are indeed cross-cutting, and the fragments definitely are included.

The concepts are illustrated in these examples.

What is the tarmac sequence in the patched road below?

Patched road outside a farm house – which tarmac was laid first?

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In the cracked wall photo, which came first, the cement blocks (included fragments), the blocks at the bottom or the top (superposition of strata) or the crack (cross-cutting relationships)?

For the indoor court photo, use the law of cross-cutting relationships to work out which tape was laid first, the yellow, the black or the grey?

A wall damaged by monsoon weather in the Gambia.

Dcm250451 has released this image into the public domain.

Indoor courts laid out by tape, Issy les Moulineaux, France.

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Following up the activity:
Try the '*Laying down the principles'* Earthlearningidea to extend the teaching to include more stratigraphical concepts. Then apply them further in the '*Where shall we drill for oil?*' Earthlearningidea.

Underlying principles:
- These concepts are the fundamental methods used by geoscientists to sequence rocks and rock events.

Thinking skill development:
- The concepts are patterns applied to sequences (construction).
- How the concepts should (and should not) be applied causes cognitive conflict.
- Discussion of the application of the concepts involves metacognition.
- The concepts can be applied (bridged) to a range of other contexts including archaeological and forensic ones.

Resource list:
- suitable outdoor and indoor situations

Useful links:
Try: http://www.esta-uk.net/jesei/index2.htm and the quizlet activities at:
https://quizlet.com/194800271/stratigraphic-principles-flash-cards/
Earthlearningideas*: Laying down the principles*
https://www.earthlearningidea.com/PDF/Laying_down_the_principles.pdf
and *What is the geological history?*
https://www.earthlearningidea.com/PDF/40_What_is_the_geological_history.pdf

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