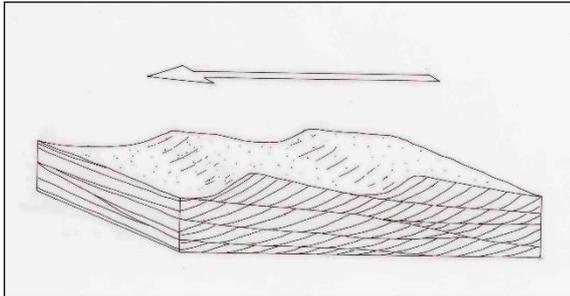


Sedimentary structures – make your own cross-bedding

Classroom activities to make and explain how cross-bedding forms

Cross-bedded sands can be laid down by flowing water or wind, as this diagram shows:



Cross-bedding formed by flowing water or wind.

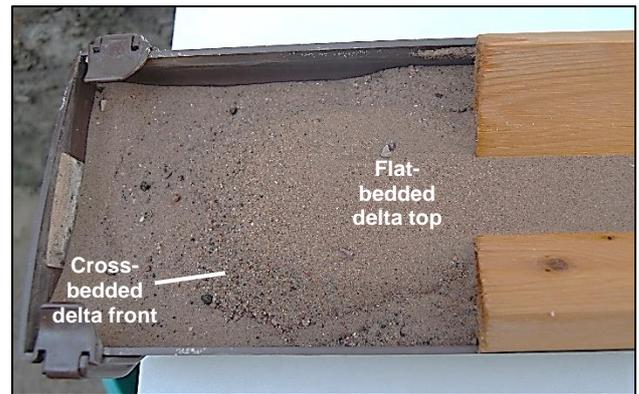
The sedimentary structures formed are called dunes; subaqueous dunes, if formed by water, eolian dunes if formed by wind. They develop in similar ways, the water or wind moves the sand up the shallow slope of the dune and tips it over the top. The sand then flows down the steeper slope, forming sloping beds or cross-beds which slope (dip) down current.

Demonstrating sub-aqueous cross-bedding

You can demonstrate how one type of subaqueous cross-bedding forms in the classroom, using a sloping piece of guttering filled with sand (see the context section for the set up). This photo shows the lower end of a longer piece of guttering with a pool in the lowest part. When water was added to the upper part of the guttering it transported sand along the guttering until it reached the pool, where the current slowed and sand was deposited. The sand deposited in a micro-delta built out into the pool.



The micro-delta is seen more clearly in the following photo. The first photo shows the delta when the pool was full, the second photo, the same delta after the water had dried out.



(Gutter photos, Chris King).

Both photos show the gently sloping top of the delta with its flat bedding, and the steeper-sloping front of the delta, where sand has been deposited as cross-bedding. As more and more sand deposited, the delta built out into the pool, each layer of sand being laid down at an angle, as a layer of cross-bedding. Because the sand is deposited on a flat surface, this is called planar cross bedding. [Another form of sub-aqueous cross-bedding, called trough cross bedding, cannot be formed in a gutter of this type.]

Note: The two pieces of wood in this photo were used to keep the flow in the centre of the gutter to build out a clear delta shape. Without the wooden blocks, deltas still build out into the pool, but usually on either side of the pool and not in the centre.

Demonstrating eolian cross-bedding

Wind blowing over sand dunes moves the sand up the sloping back of the dune and deposits it just over the top of the dune on the steeper downwind slope. This slope becomes steeper and steeper until it collapses, forming a layer of sand down the front of the dune as a cross-bed. You can demonstrate how this eolian cross-bedding forms using a glass jar partly filled by loose dry sand. Put the bottle on its side on a table and roll it gently to the side. Eventually the sand slope will become so steep that it collapses in a layer of cross-bedding.



(Sand jar photos, Peter Kennett).

You can measure the steepest angle that cross-bedding can form in loose sand in air by measuring the angle with a protractor, as in the following photo. You can experiment with this process using the guidance in the *Sandstones and slopes* Earthlearningidea at: https://www.earthlearningidea.com/PDF/66_Sandcastles.pdf



Using cross-bedding to work out water or air current directions (palaeocurrent directions) in ancient sandstones is described in the *Sedimentary structures – cross bedding and ancient currents* Earthlearningidea at: https://www.earthlearningidea.com/PDF/195_Cross_bedding_2.pdf. Meanwhile the use of cross-bedding as a way up structure is described in the *Sedimentary structures – cross bedding and 'way up'* Earthlearningidea at: https://www.earthlearningidea.com/PDF/194_Cross_bedding_1.pdf

The back up

Title: Sedimentary structures – make your own cross-bedding

Subtitle: Classroom activities to make and explain how cross-bedding forms

Topic: Classroom demonstrations of how subaqueous and eolian cross-bedding form.

Age range of pupils: 10 years upwards

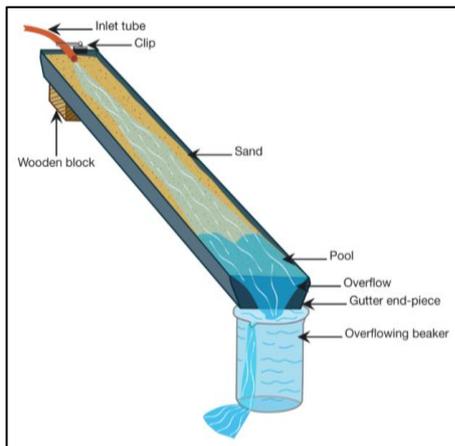
Time needed to complete activities: 20 minutes

Pupil learning outcomes: Pupils can:

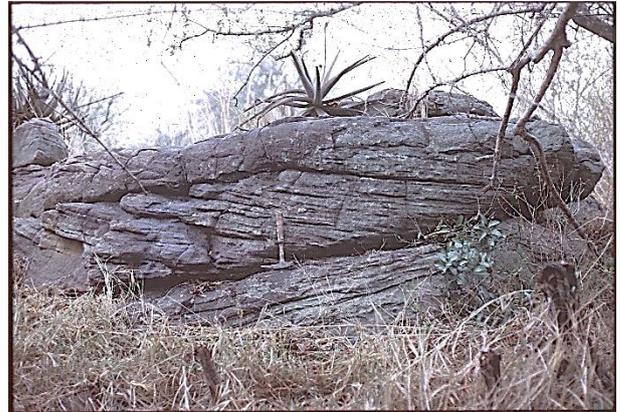
- demonstrate how cross-bedding is formed by water and air currents;
- explain the depositional processes involved.

Context:

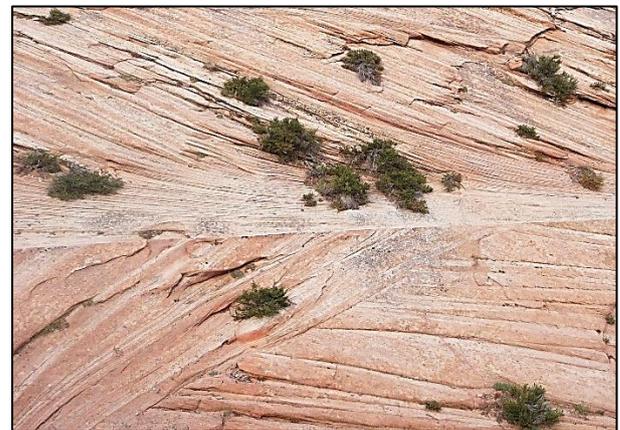
The subaqueous cross-bedding demonstration uses a piece of gutter as shown here, but the demonstration also works well in a much shorter gutter or similar-shaped container. Water can be added either by a pipe connected to a tap, as shown here, or by pouring from a jug. The overflow can be caught either in a beaker in a sink or a bucket below the table.



Planar subaqueous cross-bedding in ancient sandstones often forms sets of up to around a metre in thickness (Jurassic sandstone photo). However, eolian cross-bedding sets are usually more than a metre in thickness and can be much thicker (Navajo sandstone photo).



Planar cross-bedded Jurassic sandstones, Swaziland.
(Chris King).



Eolian dune sand cross-bedding in the Navajo sandstone,
Zion National Park, Utah, USA.

Image licensed by Zion National Park under the Creative Commons Attribution 2.0 Generic license.

Following up the activity:

You can make a range of other sedimentary structures in the classroom using the Earthlearningideas described in the 'Rock cycle', 'Sedimentary structures' section of the 'Teaching strategies' part of the Earthlearningidea website at: https://www.earthlearningidea.com/home/Teaching_strategies.html#rockcycle.

Underlying principles:

- Flowing water and blowing wind can form loose sands into dunes, called sub-aqueous dunes in water and eolian dunes in wind.
- Sands are laid down in dunes as cross-bedding, with the downward slope in the direction of flow of the water or wind.
- Demonstrating how these different types of cross-bedding form in the classroom can show how they form naturally, underwater in rivers and the sea, and by wind where there is enough loose sand (e.g. deserts, coastal areas).
- Cross-bedding formed in these ways is fairly common in ancient sandstones.

Thinking skill development:

Understanding how fluids deposit cross-bedding is a construction activity. Applying the ideas to ancient rocks involves bridging skills.

Resource list:

To demonstrate sub-aqueous cross-bedding:

- length of guttering (square section guttering is preferred) with two end pieces, or similar
- wooden block to raise up one end
- washed sand to fill the gutter to within 2cm of the top
- a cloth (to wipe up spillages)

EITHER

- a watering can or jug to pour water
- a bucket or washbowl to catch the overflow

OR

- rubber tubing to connect to a lab tap
- clip (to fix the tubing to the gutter)
- container such as a large beaker to put in the sink to catch any sediment washed over the end of the gutter – to prevent it from blocking the sink

To demonstrate eolian cross bedding:

- an empty glass or plastic jar with a screw top lid
- dry sand
- (optional) protractor

Useful links:

A blackboard explanation of how trough cross-bedding forms can be seen at:

<https://www.youtube.com/watch?v=ogM-UqcYIfU> with an animation at:

<https://cmgds.marine.usgs.gov/data/seds/bedforms/animation.html>. A video of the Navajo sandstone cross-bedding can be seen at:

<https://www.youtube.com/watch?v=LD2Lj0IsrXU>.

Source: Chris King of the Earthlearningidea Team.

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