Sand ripple marks in a washbowl

How asymmetrical ripple marks form in sand

Put a mug of water, or large glass of water, into the middle of a washbowl, as shown in the diagram opposite.

Fill the bowl about half full with water. Add a few table-spoonfuls of washed sand as evenly as possible around the washbowl. It is best to use washed sand as otherwise the water will be cloudy and it will be difficult to see what is happening. Wash the sand by rinsing it in water several times and pouring off the cloudy water.

Stir the water around and around the mug, or glass, fairly fast with a tablespoon until the sand grains move into a pattern on the floor of the washbowl. Remember to stir in one direction only and don't let the spoon touch the bottom.

Ask the pupils:

- Why do you think the sand forms these shapes?
- How are the shapes linked to the speed of the water flow and its direction?
- How could we use 'fossilised' ripple marks like these in an ancient sandstone to work out the speed and direction of the water when the sand was laid down?

Creating asymmetrical ripple marks in a circular bowl

Asymmetrical ripple marks in Devonian Old Red Sandstone

Photographs: Peter Kennett

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The back up:

Title: Sand ripple marks in a washbowl.

Subtitle: How asymmetrical ripple marks form in sand.

Topic: Ripple marks can indicate the direction of flow of the water. Direction of flow can then be worked out when 'fossil' ripple marks are studied.

Age range of pupils: 10 - 18 years.

Time needed to complete activity: 30 minutes.

Pupil learning outcomes: Pupils can:-

- explain why water flowing in one direction creates asymmetrical ripples marks in sand;
- describe how, when the flow of the water reaches a certain velocity, sand grains are picked up by the water and start to move;
- interpret 'fossil' ripple marks often seen in sandstones as being formed by a uni-directional flow of water, e.g. in a river or the sea;
- explain the direction of flow, which created asymmetrical 'fossil' ripple marks.

Context: The activity could form part of a lesson about looking at sedimentary rocks and their structures to find evidence for how the rocks formed.

- Why do you think the sand forms these shapes? *The water is fast enough to form undulations, then to move sand grains up the shallow backs of ripple marks and deposit them on the steeper fronts - but not too fast to destroy the ripple marks and move all the sand to the middle.*
- How are the shapes linked to the speed of the water flow and its direction? *They only form at certain speeds - too slow, and the water does not have enough energy to move most of the grains, too fast and the ripple marks are destroyed. They form with the shallow slope up-current and the steeper slope down-current.*
- How could we use ''fossilised' ripple marks like those in an ancient sandstone to work out the speed and direction of the water when the sand

was laid down? *The ancient ripple marks must have been formed by a current flow of similar speed and direction to those in the washbowl.*

Notes:
- Asymmetrical ripple marks form in water in many places - in rivers, on beaches (as water drains off) and in shallow seas (by tidal currents). They even form in deep seas.
- Asymmetrical ripple marks can be formed by winds in sand dunes too – and give clues to the wind direction in ancient wind-deposited sandstones.

Following up the activity:
Try stirring the water even faster - - -
Try the next Earthlearningidea which is about how symmetrical ripple marks are formed.

Underlying principles:
- Many sedimentary rocks are formed of sediments like gravels, sand and mud which have been weathered and eroded from other rocks.
- These sediments were mostly laid down by rivers and the sea in the geological past.
- These sedimentary rocks contain clues, such as sedimentary structures like asymmetrical ripple marks, about how they were formed.
- The sand that is carried up the shallow slope of the ripple mark is then carried over the top and is deposited by eddies travelling up the front (steep slope) of the ripple mark, depositing sand on this steeper slope.
- The ripple marks migrate downstream by sand being eroded from the upstream side and being deposited on the downstream side.
- Asymmetrical ripple marks form in the washbowl and it can be observed that gradually, they move in the direction of the flow of water. If the velocity of flow is increased by faster stirring, the structures are destroyed.
- Medium sized sand grains of about 0·3mm in diameter are picked up by water flowing at about 0·25 ms^{-1}.
- Most sedimentary rocks are formed from loose sediment which in the past was carried by currents of water. These currents transport vast quantities of previously weathered and eroded material from one place to another.

Thinking skill development:
- How does ripple mark shape indicate flow direction (pattern, construction).
- Explanation of how the ripple marks form i.e. the reasoning behind the answers (metacognition).
- If 'fossil' asymmetric ripple marks are preserved in local rocks with the steeper slope dipping north, which way was the water flowing? (bridging).

Resource list:
- circular washing-up bowl
- mug, or large drinking glass
- washed sand
- tablespoon.

Useful Links:
http://www.geology.pitt.edu/GeoSites/sedstructures.htm
http://www3.interscience.wiley.com:8100/legacy/college/levin/0470000201/chap_tutorial/ch03/chapter03-5sedstr.html

Source: Association of Teachers of Geology (1988) Science of the Earth, Unit 4. *Building Sedimentary Structures - in the Lab and Millions of Years Ago.* Sheffield: Geosupplies.

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