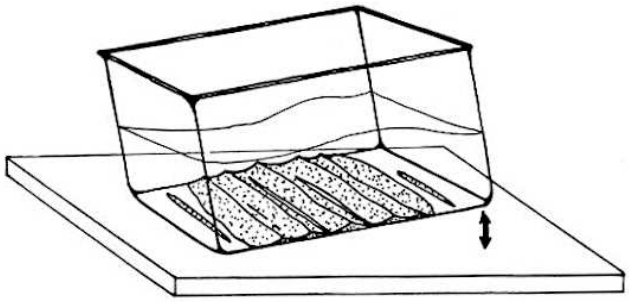
Sand ripple marks in a tank
How symmetrical ripple marks form in sand

Put some water into a tank or similar, preferably transparent, container, e.g. a cut-off, large drinks bottle, as in the diagram opposite. Add a few table-spoonfuls of washed sand as evenly as possible. Use only half a table-spoonful of washed sand in a drinks bottle. It is essential to use washed sand as otherwise the water becomes cloudy and it will be difficult to see what is happening. Wash the sand by rinsing it several times and pouring off the cloudy water.



Gently lift one side of the container up and down, as illustrated in the diagram opposite, until the sand has formed a pattern on the base of the container.

Ask the pupils:
- Why do you think the sand forms these symmetrical shapes?
- How are the shapes linked to the direction and speed of the water flow?
- How could we use ''fossilised' symmetrical ripple marks, like those in an ancient sandstone, to work out the speed and direction of the water when the sand was laid down?
- What can 'fossilised' symmetrical ripple marks tell us about the ancient coastline?
- What was it like to be there - when the ripple marks were forming?

Symmetrical ripple marks
Drawing: Chris King Photograph: Peter Kennett

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The back up:

Title: Sand ripple marks in a tank.

Subtitle: How symmetrical ripple marks form in sand.

Topic: Ripple marks can indicate flow conditions produced by waves. This can then be used to give clues about the environment in which 'fossil' symmetrical ripple marks formed.

Age range of pupils: 10 - 18 years.

Time needed to complete activity: 20 minutes.

Pupil learning outcomes: Pupils can:-
- explain why a two-way (oscillating) current of water creates symmetrical ripple 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' symmetrical ripple marks, often seen in sandstones, as being formed by a two-way oscillating current of water e.g. on a beach;
- relate the trend of the 'fossilised' symmetrical ripple marks to wave trend and coast alignment;
- describe a beach/shallow sea environment in which ripples like these probably formed.

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 symmetrical shapes? *The water is moving fast enough to form undulations. As the water moves in one direction, sand grains are moved up the ripple marks and deposited on the other side. The same process occurs when the water moves in the opposite direction. Symmetrical ripple marks result. These are common on sandy beaches and in shallow seas where waves are active.*
- How are the shapes linked to the direction and speed of the water flow ? *Because a two-way oscillating current is created, the ripple marks are symmetrical in shape.*
  They only form at certain wave 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.

Note: *It is difficult to destroy the ripple marks in the tank without spilling the water!*

- How could we use ‘‘fossilised’ symmetrical 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 two-way oscillating flow of water of similar speed to that produced in the tank.*
- What can ‘fossilised’ symmetrical ripple marks tell us about the ancient coastline? *The trend (particular direction) of the ‘fossilised’ symmetrical ripple marks indicates wave trend and therefore coast alignment. For example, if the majority of ‘fossilised’ symmetrical ripple marks were east - west, you would know that they were made by waves that were either coming from the north or from the south and that the coastline was also east - west. You would need further evidence to say definitely whether the sea or lake was to the north or to the south.*
- What was it like to be there - when the ripple marks were forming? *The pupils should describe a sandy beach or shallow sea area. The beach could be yellow (if the sand came from eroded rocks), white (if of tropical coral sand), black (if of volcanic sand) or a mixture.*

Following up the activity: Try the ‘What was it like to be there - rock?’ activity with symmetrical ripple marks or other structures.

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.
- Other sedimentary rocks that form in tropical areas are made of calcium carbonate (lime) sediments.
- These sedimentary rocks contain clues, such as sedimentary structures like symmetrical ripple marks, about how they were formed.
- The sand grains are carried up one slope of the ripple mark, carried over the top and deposited. Almost immediately, they are picked up by the flow of water from the other direction, carried up the slope and deposited on the other side. As this process continues, a symmetrically shaped ripple mark is created.
- If the velocity of two-way flow is increased by faster movement of the tank, 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 and/or carbonate sediments from one place to another.

Thinking skill development:

- Ripple mark shape indicates flow character, (pattern, construction).
- Ripple mark trend indicates wave trend and coast alignment, (cognitive conflict)
- Explanation of how the symmetrical ripple marks form i.e. the reasoning behind the answers, (metacognition).
- 'Fossil' symmetric ripple marks give clues about the environment in which they formed, (bridging).

Resource list:

- tank or container e.g. large cut-off drinks bottle
- washed sand
- water.

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.

Symmetrical ripple marks in a drinks container
Photograph: Elizabeth Devon