Video question script: Teaching sand movement through CASE

Question/Activity	Likely response	Rationale
When teaching about the Earth we often use practical activities to explore Earth processes. This example uses the Earthlearningideas: 'Sand ripple marks in a washbowl' and 'Sand ripple marks in a tank' to develop thinking skills		Preparation for bridging from the model to real Earth processes
What is this? – and this?	A plastic bowl, a plastic beaker, Blu Tac™, water, a spoon – all making a circular channel + some sand	Concrete preparation = asking them to describe the apparatus
Ask: What will happen when I have put a thin layer of sand covering the bottom surface of the bowl and then stir the water very, very slowly, without letting the spoon touch the bottom,? Discuss/ write down your ideas before answering – explain your reasoning	Nothing – there is not enough energy to move the grains	Concrete preparation = explaining what is to be done and miming it Construction = suggesting different ideas Metacognition = people give rationale for their answers
Do the activity	See that there is not enough power to move the grains	
Ask: What will happen if I stir the bowl as fast as I can without the spoon touching bottom and without sploshing the water? Discuss/ write down your ideas before answering – explain your reasoning	The sand will move. Some might say that the sand will be moved to the middle – but probably will be unable to say why	Construction = if low energy won't move the sand, high energy will Metacognition = people give rationale for their answers
Demonstrate why the sand moves to the middle with a bowl containing no sand, and three or four potassium permanganate crystals dropped at the margins, followed by slow stirring	Dye from the crystals spirals towards the centre showing that helical (spiral) flow develops. This shows that the reason why sand was carried to the centre in the previous run, was that it was carried spiralling into the centre but then couldn't be carried up the sides of the central container by the rising current, and so was deposited there. This explains point bar deposition on the inside of a meander bend and erosion of the outside cut bank of the bend by the descending current	Listen to the explanation. Bridging = from the circular plastic channel to a meandering river channel
Return to the sand-filled bowl and spread the sand out over the bottom again. Explain that we have seen what happens to sand at low stirring speeds and at high stirring speeds. Now ask: What will happen at moderate speeds? Discuss/ write down your ideas before answering – explain your reasoning	Most will say that the sand will be moved part way towards the middle by the helical flow	Construction = if low energy does not move the sand and high energy moves it all to the centre, moderate speeds should move it part of the way
Demonstrate the formation of asymmetrical ripples	The helical flow forms a spiral galaxy-like or saw-blade-like pattern, because at moderate speeds, the laminar flow of water breaks down into ripple-	Listen to the explanation. Cognitive conflict = the ripples are the unexpected result –

	forming currents, with water flowing up the shallow upcurrent slopes of ripples and down the steeper downcurrent sides, depositing sand in cross laminations. Erosion of sand from the upcurrent sides and deposition on the downcurrent sides moves the ripples downcurrent.	requiring an explanation of how they develop
Ask: Where would you be likely to find asymmetrical ripples like these forming naturally?	Asymmetrical ripples form anywhere where there is loose sand with moderate speeds of water flowing over the top – in gutters, rivers, in channels on beaches or in tidal channels [also in turbidity current flows and on the slopes of wind-formed sand dunes]	Bridging = applying learning from the activity to the real sand/ water world
You may want to stop the activity here		
Ask: What will happen if the central beaker is removed, the sand is spread over the bottom again and the water is stirred at moderate speeds?	They should be able to apply their knowledge to say that nothing much has changed, so the spiral ripple pattern should develop again	Cognitive conflict = how will the pattern learned previously apply to a new situation?
Demonstrate the formation of asymmetrical ripples again	The central beaker makes little difference – the circular channel is still a circular channel	Listen to the explanation
Ask: What will happen if, instead of stirring with a spoon, the bowl is rocked gently from side to side?	Some may realise that if moderate circular flows move sand to form ripples, then moderate flows from rocking might also form ripples	Cognitive conflict = how will the pattern learned previously apply to a new situation?
Demonstrate the formation of symmetrical ripples	The rocking motion causes currents that flow backwards and forwards, as these are moderate energy flows, ripples form, but this time they are symmetrical ripples (Although the pattern from above is disturbed by the circular shape of the bowl) Each current moves sand up the side of a ripple, depositing it in a cross lamination, so interfingering cross laminations form as part of the symmetrical ripples	Listen to the explanation. Cognitive conflict = the new ripple pattern may be unexpected, prompting an explanation of how they form
Since symmetrical ripples form more evenly in a rectangular tank than a circular bowl, you may wish to demonstrate this too, with views both from the top and the sides	The rocking motion causes the formation of symmetrical ripples in a rectangular tank, as before	
Ask: Where would you be likely to find symmetrical ripples like these forming naturally?	Symmetrical ripples form where there is loose sand with moderate speeds of water flowing backwards and forwards over the top – currents formed by waves. So symmetrical ripples are key indicators of waves on beaches and in shallow seas	Bridging = applying learning from the activity to the real sand/ water beach/ shallow sea world
Ask: What orientation do symmetrical wave ripples have to the waves and so to the beach and the coast?	Symmetrical ripples form parallel to the wave crests (and so at right angles to the wave movement) and so parallel to the beach and to the coastline	Bridging = applying learning from the activity to the real sand/ water beach/ shallow sea world
Ask: For the first photograph and then for the second photograph: Is this ripple mark preserved in sandstone an asymmetrical or a symmetrical ripple ?	First photo: • Asymmetrical ripple mark – current flowing from left to right Second photo: • Symmetrical ripple mark	Bridging = applying learning from the activity to ripple marks preserved in ancient sandstone

If it is asymmetrical: • Which way was the current flowing (e.g. right to left)? If it is symmetrical: • What were the directions of the wave crests (e.g. right to left) • What was the probable direction of the beach? • What was the probable direction of the coastline?	- wave crest direction top to bottom - beach direction (although measurements from many more than one ripple would be needed and their mean direction taken) – top to bottom - coastline direction – also top to bottom, but needing many more measurements	