

Video question script: From rain to spring – groundwater

Question/Activity	Likely response	Rationale
What is this? – and this?	A fairly transparent plastic box, sand, plastic cups with the bases removed, plastic partitions, on a slope	Concrete preparation = asking them to describe the apparatus
We will add water to the cups in this model to show groundwater flow. What do the different parts of the model represent?	The upper area with the cups is a hilly or upland area where rain falls. The rest of the model represents the soil and rock under the ground surface	Concrete preparation = asking them to think about the apparatus Bridging = linking the model to larger reality
What will happen if water is poured into the two cups? Why will this happen?	The water will sink into the sand – because the sand is not only porous (has spaces between the grains) but is permeable too (the spaces are interconnected enough to allow the water to flow through)	Construction = suggesting what will happen, based on previous experience Metacognition = a rationale for the answers is given
Add the water	The water sinks in	
If we continue to top up the cups with water, what might you eventually see from the side?	You might see a darker area of damp sand begin to appear	Construction = picturing how the water might flow through the sand
Continue to add water	A darker area of sand appears	
If we continue to top up the cups with water, what will happen to the dark area of saturated sand? Why will this happen?	It is likely to grow and then to begin to move downslope. More water will make it grow, then it will flow downslope through gravity.	Construction = picturing how the water might flow through the sand Metacognition = a rationale for the answers is given
Continue to add water	The dark area does grow and flows downslope	
If we continue to top up the cups with water, what will happen to the dark area of saturated sand? Why will this happen?	The saturated area will reach the bottom and a ‘front’ of darker sand will move downslope	Construction = picturing how the water might flow through the sand
Continue to add water	The dark area does grow and flows downslope	
What should we call the boundary between the dark saturated sand below and the paler unsaturated sand above? If a hole was dug from the surface down to the water table, what should this hole be called?	<ul style="list-style-type: none"> • The water table is the boundary between the saturated area beneath and the unsaturated zone above • A hole to the water table is called a well or borehole 	Bridging = from the model to reality in the ground
What will happen when the front of water reaches the end of the box and rises to the surface?	The surface of the sand will become saturated and visible water will appear	Construction = picturing how the water might flow through the sand
Continue to add water	The dark area does grow and flows downslope	

<p>Explain that toxic chemicals (soluble purple potassium permanganate crystals) have been buried at different depths near the cups in the partitioned areas. Dye from which of these will appear at the surface first: the deepest one, the intermediate depth one or the shallowest one?</p>	<p>Likely responses:</p> <ul style="list-style-type: none"> • Purple dye from the shallowest will appear first, it is nearest to the surface • Dye from the deepest will be seen first, you can see how the water is flowing to carry it to the surface • Dye from intermediate depth will appear first because we expect the unexpected from this 'tricky' teacher 	<p>Cognitive conflict = with little idea of what might actually happen , different ideas can be discussed and explained Metacognition = the explanations</p>
<p>Continue to add water</p>	<p>Visible water appears at the surface at the lower end of the model</p>	
<p>What should we call the pool of water at the bottom? When the water in the pool overflows, what should we call that?</p>	<ul style="list-style-type: none"> • A pond or lake (could be a marsh or bog if plants were there) • The water overflow represents a spring 	<p>Bridging = from the model to reality</p>
<p>Continue to add water</p>	<p>The pool overflows in a 'spring'. No purple dye appears</p>	
<p>Explain that no purple dye has been seen because none has actually been buried (so this was actually a thought experiment) No permanganate crystals were buried because it is very difficult to wash the dye out of the sand afterwards to reset the model</p>	<p>When the model has been run on previous occasions, the shallowest dye has sometimes appeared first; the deepest dye has sometimes appeared first; the intermediate-level dye has sometimes appeared first. It just depends on how the water flows through the model on that day</p>	
<p>How deep does soluble toxic material have to be buried to ensure it doesn't flow back to the surface</p>	<p>It doesn't matter how deep toxic material is buried, if there is groundwater flow through it, it will always be brought to the surface</p>	<p>Bridging = from the model to the burial of toxic waste</p>
<p>What would you have to do to ensure that buried soluble toxic waste does not return to the surface?</p>	<p>Either the waste should not be buried at all, or it must be buried in some impermeable material, so that water cannot flow through</p>	<p>Bridging = from the model to the burial of toxic waste</p>