Environmental Science in the Field

Water quality and flow rates

Narrator
The students are going to be measuring two things. They're going to be measuring the water flow through streams and through the soil and these sorts of measurements enable us to estimate a water budget for a catchment area. The second thing they're going to be doing is looking at water quality, the physico- chemical properties of water.

Man 2 (talking to students)
This is a scene setting, see where we're at, what the place is like, look around. Just to the left of the big cliffs you can see in the valley bottom, just one the other side of the wall, there's a section there where the stream meanders around through a couple of cliffs that it's broken through and that valley goes down to form Gordale Scar, which is a very spectacular water fall feature. When we're down in the valley we'll actually see bedrock outcropping on the valley sides and then the stream bottom with this glacial stuff sitting on the side of it. What's happening down just in front of us? Yeah, it's a bit waterlogged and wet and soggy so if its acid we might find some bits of butterwort but we know it's pretty calcareous because there's lots of these….pansies and we'll start picking up and noticing those birds eye primroses. We'll cut down through here and over this ridge and into the valley of Gordale Beck.

Man 2 (talking to students)
So here we are. This is base camp for our work on Gordale Beck. We've walked up the stream and hopefully you've seen the full range of conditions that the water is flowing in and what we'll try and do we'll try and sample the most so that we've got the most extreme fast flowing and the most extreme slow flowing. We'll try someone in the deepest bit we can get, but if its' deeper than wellies we won't do it because it won't be safe. And we'll have someone just below I think the big waterfall. It's a raging torrent but still safe. We're measuring the width of the water. We've got to split it up into cells. Measure your depth at each bank and at nine points in between. You'll have to decide with the flow meters how many different places in that cell that you think it is appropriate to measure the velocity at. What would you expecting to happen? Where is the water going to be flowing fastest and slowest in a particular cell? ….Slow by the banks…faster in the middle… and what about within the water column? Fast at the top…slower in the middle. What are the reasons behind thinking that?….Friction, okay.

Man 2 (talking to students)
So Andrew if your group could go down the waterfall end, no swimming.

Narrator
We can actually make water flow in three ways.

Student – female
The first experiment we did was measure flow-rate with an orange

Student - female
So we measured out a straight ten metres of stream and dropped the orange into the stream and literally timed with a stop watch and literally timed how long it took for the orange to get to the bottom of the ten meter section and we did that I think in total about six times because the orange got stuck behind some rocks.

Student – female
We also measured the flow using a hydro-prop flow meter, which is basically a brass pole with another one at a ninety degree angle and a little propeller on the end and you pull the propeller out to the end and when you lower it to the water the propeller spins back and you just time the amount of time it takes at different depths so you an assess where the flow is fastest within the river.

Narrator
And the third method is an indirect method using the Manning equation in which you need to know the cross-sectional area of the stream. You can do this using a chain laid across the bottom to estimate the wetted perimeter.

Student – female
You lay it from one bank to another going in and out of all the crevices and all the rocks on the actual bed of the stream, so you can get an accurate measurement of the perimeter of the stream rather than just the width across the stream.

Student
Three centimetres

Student
Three centimetres

Student – male
Then we measured across the width of the stream and measured down at various points across that, for example, ten, twenty, thirty centimetres across the width of our section.

Narrator
The surveying equipment enables them to estimate the slope of the channel, so obviously the slope of the channel affects how quickly the water passes down it.

Student – male
We set up the dumpy level and took a reading from the height at the low point and one at the upper point.

Student – female
You need to collect pretty good date and you need to take amount of sample of data and not just take one or two.

Narrator
In the stream they took measurements of Ph, dissolved oxygen and conductivity, which gives you a measure of the overall concentration of irons, dissolved irons in the water.
We also carried out an infiltration exercise to look at the density of the soil and how quickly the water could be taken in by the soil, in which you insert pipes into the soil, add a certain volume of water and you can time how long it takes to drain away.

Man 2
So what we're doing here on this site is we're going to try and assess, how, look at the hydraulic conductivity, of the water, of the soil underneath the ground and we're also looking at the gradient of the water, hydraulic gradient.

Narrator
What the students have been doing here on the heath this afternoon is estimating the flow of water to below the surface, the hydraulic conductance of the soil, the peat that we have here, so that we can have some idea of how much water is getting into the tarn through the soil.

Man 2
So this is the upper dip-well.

Student – male
We measured the water table depth by use of a probe.

Student – female
Seventy-seven point five

Man 2
Seventy-seven point five. Right, are you okay?

Student – male
Yes

Student – male
A simple piece of kit that tells you when you're at the water table from both sump locations.

Male 2
So we've got 37 centimetres of pipe above the ground so you'd have to take that 37 centimetres off the, whatever it was down to the water depth.

Student – female
We then used the surveying equipment to find the distance from that to the first dipping well and that to the second dipping well, which gives us the distance between the two, and from that we can work out the gradient to the water table.

Man 2
This is the auto-level and its basically a fancy telescope with incredible optics which is quite fun to play with.

Narrator
On the first day the students measure the height of the water which gives us a measure of where the water table has come to. They can bale out some of the water and measure the height again to give us a difference and then the following day, the second group of students come back and can see where the water has got to in the period that's elapsed. Using Darcy's Law we can work out the rate of water movement through the soil.

Student
Nought point four nine metres

Narrator
In this sort of peaty soil you find that the water table isn't horizontal but actually domes up within the peat soil to have a gradient

Student
When you put all that information together it enables all sorts of predictions to be made. River flow rates enable people to say when a certain amount of rain falls in a certain area. What happen with the rivers? It enables us to predict floods and water supply. Some of the chemical analysis we do inform us where the water has come from. Again some of the chemical analysis will inform us what's, not just what's in the water, but what we might have to change. Is the water safe to drink? What could we possibly do with that water? So all sorts of information can be gleaned from the data that we've gathered this morning.