Forty Minute Fieldwork: Interception

Key topic areas	Equipment and resources required
• Water cycle	Rain gauges
• Rivers - Flooding	Mirror
• Ecosystems	Acetate grid sheet
• Biomes - Rainforests	

Context

Students will often hear of interception when they first learn about the water cycle. A plant intercepts precipitation via its canopy - the combination of stems, leaves and branches that expand out from the main trunk. These create a barrier between the falling precipitation and the ground.

In the UK and other temperate climates, this barrier is normally temporary and interception is simply slowing down the movement of water from the atmosphere to the ground. The pointed ends or tapered edges of leaves (known as drip tips) act as funnels of precipitation - channelling the moisture slowly towards the ground, and in doing so, to the roots of the vegetation. Leaves and stems might also funnel water towards the main branches and even the trunk, again, directing the passage of water.

In warmer climates interception acts less as a temporary barrier to the ground surface and more as a permanent one. Here, water that hits leaves and stems may evaporate back into the atmosphere before it has the chance to accumulate and drip towards the ground. For this reason, it is often the case that plants in very hot climates have small, needle like leaves, such as the spines found on a saguaro cactus.

This idea of slowing precipitation down is one reason why afforestation is considered a good soft engineering option in flood management. Large areas of trees can increase the lag time in a rain event (the time between peak rainfall and peak discharge in a river). This gives the river more capacity to drain floodwater away from problem areas and potentially prevent flooding.

Classroom set up

Using an image of the underside of a tree canopy, students can be introduced to the concept of canopy cover - the percentage of a view underneath the tree that is covered by leaves. This is a good opportunity to introduce the concept of crown shyness too. This is a phenomenon in some tree species where, when planted close together, tree canopies grow in such a way that they do not touch each other. Without mentioning the idea of insolation and the disadvantages of leaves shading each other, students can hypothesise why this might be, as they consider the function of a tree.

Crown shyness

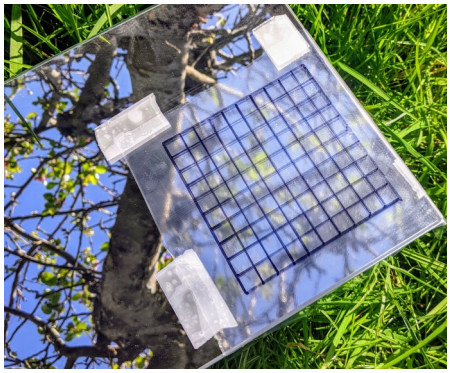
Students should then be reminded of the processes in the water cycle and in particular reminded of the definition of interception. Students may benefit from completing a diagram of the process, either through annotations or by a filling in missing words exercise.

Drawing a blank set of x and y axes on a whiteboard, students can think about the potential relationship between percentage canopy cover and interception rate (the percentage of precipitation that does not immediately reach the ground surface under a tree). Students might like to draw their own set of axes on mini whiteboards and attempt to draw a line of best fit in the direction they believe any relationship to lie.

Finally, students should be introduced to the concept of a control. In this case the control would be a measure of rainfall where

there is no canopy overhead. This would give students a measure of the 0% interception value and allow them to calculate the interception rate underneath a tree.

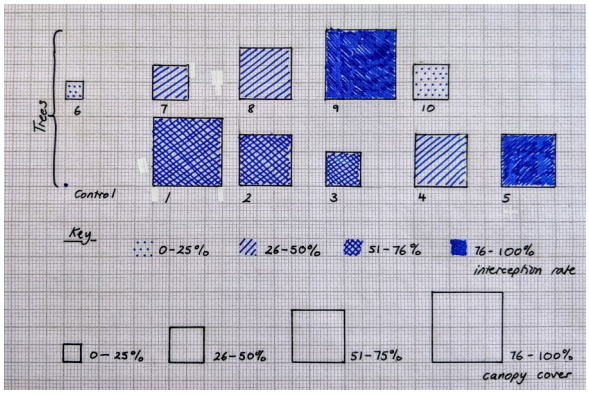
In the field



Using the school grounds students should each (or in pairs) be allocated a tree for which they will measure canopy cover. This is done by placing a mirror underneath the tree canopy as close to the trunk as possible. Students should bear in mind that the position of the mirror will need to also be the position of their rain gauge and this may affect their decision of which spot to choose. On top of the mirror a piece of acetate should be placed. This will have a 10 x 10 grid marked onto it. Viewing this from an angle will allow the student to count how many of the 100 squares have canopy reflected onto them (or sky, whichever is the smaller and easier number to count). This would be the percentage canopy cover value.

Just prior to a forecast rain event, the students should place a rain gauge underneath the canopy of their chosen tree as well as a control rain gauge in a tree-free open space. After 20 minutes, both rain gauges should be collected and the depth of collected rainwater recorded from both. The percentage interception value is the control value minus the tree value, divided by the control value (and then multiplied by 100).

Suggested data presentation



By collating their results together, students can draw a scatter graph with a line of best fit, comparing it to their predicted correlation they made before the data collection. More confident data handlers might like to attempt combining proportional squares (the percentage canopy cover) with choropleth shading (the percentage interception rate). This would require the students to place the interception rate values into categories that covered data ranges, with the high interception values having the darkest colour and the lowest being the lightest colour.

Key questions for reflection and analysis

- Is there a correlation between canopy cover and interception?
- Where there is no correlation, why might that be?
- How would a different season affect the results we recorded?
- How could the method be adjusted to allow us to measure a lag time?
- Which trees should be planted to prevent flooding?
- In what ways might the measuring of the percentage canopy cover be unreliable?
- How could we have improved the accuracy of the overall conclusion?
- Was the control rain gauge reliably comparable with the tree rain gauges?

Taking it further

If there are ten or more trees being measured in the study, it may be possible for students to carry out a Spearman's Rank correlation coefficient test. This will allow them to see statistically if their results give a positive or negative correlation and the strength of that correlation.

Students might also like to hypothesise what the outcomes of this inquiry might be in a world which is further affected by climate change. Ideas around greater intensity rain events and tree species that are more vulnerable to temperature can create some interesting discussions.