How much carbon is locked in that tree?

Worksheet 1 – How to measure a tree

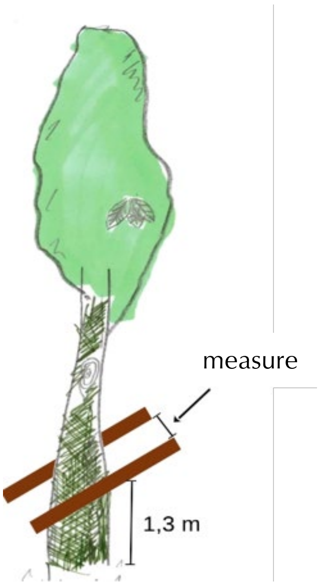
Main question:

One person causes 680 kg of CO_2 during a return flight of 2 × 1343 km (2686 km in total), which is equivalent to a return flight from Düsseldorf (Germany) to Mallorca or from ________________________ to ____________________________.

How many trees are needed to remove 680 kg of CO_2 from the air?

This will be based on the volume of the tree, so, to find out, you need to determine the diameter (thickness) and height of a tree.

But how can the height of a tree be determined, without climbing up?



1. Measure the diameter of the tree

For consistency, the diameter (*D*) of tree trunks is always measured at 'breast height', which is defined as 1.30 m.

You can estimate the diameter by having one group member hold two sticks at a height of 1.30 m in front of and behind the tree trunk and measure the distance between the sticks.

Diameter (*D*) result: ________________ cm

A more accurate way is to measure the circumference (c) of the tree trunk at a height of 1.30 m using a tape measure or piece of string and folding ruler.

Circumference (c): _______________ cm

You can then use the formula $c = \pi \times D$

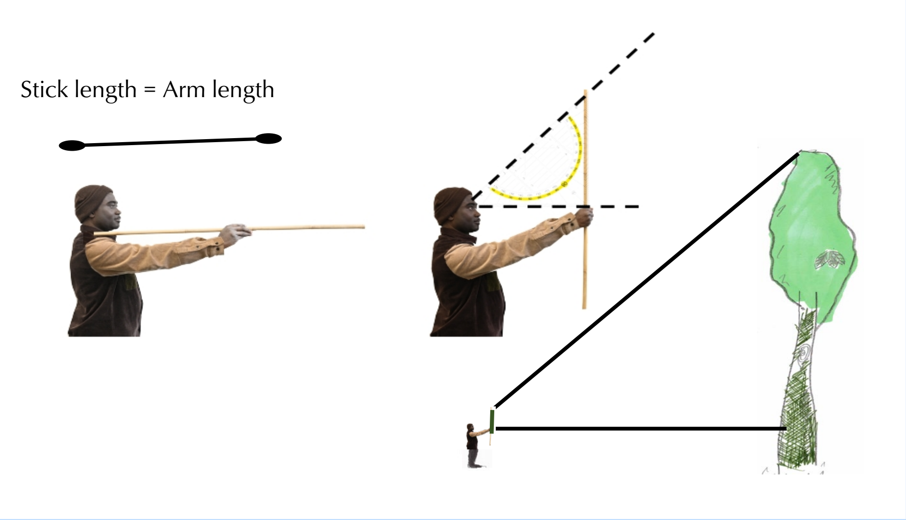
Diameter (D) = c/π = _______________ / π = _______________ cm

2. Measure the height of the tree

For generations, foresters have measured the height of trees by employing the so-called forester's triangle.

The forester's triangle

- The forester takes a stick and places one end of the stick on their shoulder with their arm outstretched. The stick is then exactly as long as their arm (hand-to-shoulder distance = hand-to-eye distance when using the triangle).
- Subsequently, they align the stick vertically so that an imaginary line between their eye and hand forms a right angle with the stick – just like the set square in the figure below.
- IMPORTANT: the forester holds their hand at eye level!
- The forester moves away from the tree until they can see the top of the tree above the tip of the stick.
- The height of the tree corresponds approximately to the distance between the forester and the tree



Application of the forester's triangle method

Here you work in groups (3 students).

Each of you should carry out the next task steps once by yourself. The other two will assist you in measuring and documenting. Each of you determines the height of a tree in the schoolyard or neighbourhood with the forester's triangle:

1. Take a stick that is as long as your outstretched arm.
2. Hold the stick at the level of your eyes on your outstretched arm so that it points upward. Another student can check you are holding it at eye level.
3. Now move away from the tree until you can see the top of the tree above the tip of the stick. One of the other students can help make sure you don't walk into anything. At this point, you are now as far away from the tree as the tree is tall. Mark the spot on the ground.
4. Now measure the distance to the tree. You can do this with a tape measure or meter rule. You can also practice taking steps of 1 m like a referee and then estimate the distance this way and see how it compares to the measured distance.

Distance to the tree: ___________________ m

This gives an approximate tree height.

Optional question: for more accuracy, another distance should be added. Looking at figure 1, can you see what that is?

More accurate tree height: ___________________ m