Soil Defenders - Session 2

What problems do farmers face with soil quality?

Context:
Learners build on their learning about the problems that agricultural engineers are finding solutions for on arable farms. They work scientifically to better understand the causes and effects of soil compaction. The link between science and engineering is key in this session as the Learners will use their science skills and understanding to consider engineering solutions to problems related to soil.

Engineering focus:
Learners will be working as an engineer by asking questions to identify problems (Problem finding).

Learning time:
2 hours

Suggested age group:
7-9 years old

Curriculum for Excellence links:

First Level:
I explore and discover engineering disciplines and can create solutions. TCH 1-12a
Inquiry and investigative skills (see Sciences Benchmarks for further details):
Plans and designs scientific investigations and enquiries
Carries out practical activities in a variety of learning environments
Analyses, interprets and evaluates scientific findings
Presents scientific findings

Second Level:
I can extend my knowledge and understanding of engineering disciplines to create solutions. TCH 2-12a
Having explored the substances that make up Earth's surface, I can compare some of their characteristics and uses. SCN 2-17a
Inquiry and investigative skills (see Sciences Benchmarks for further details):
Plans and designs scientific investigations and enquiries
Carries out practical activities in a variety of learning environments
Analyses, interprets and evaluates scientific findings
Presents scientific findings

Keywords
soil
compaction
drainage
tractor
machinery
ploughing
fertilisers
permeability
permeable
impermeable
healthy
greenhouse gases
climate
penetrometer

Resources:

Materials for each group:
- 8 x level tbs of soil (2 x level tbs for each condition)
- 4 x small wads of cotton wool (enough to prevent soil falling through the funnels)
- access to water
- measuring cylinders (x4)
- funnels (x4)
- stop watches (x1)
- a selection of weights to compact soil in the funnel

Optional:
Cameras/ipads
Materials for each group:
- 1 x cotton reel
- 1 x metal knitting needle (or similar) - must fit inside cotton reel
- 1 x permanent marker
- 1 x rubber band
- 1 x 30cm ruler

Step-by-step plan

1

What do you see? Listen & Match

Remind Learners that farmers say that soil is the most valuable resource on earth! Rewatch the **NFU Introduction to arable farming** video, engaging learners in listening and matching to elicit what they think they can see happening in the different photos on Slide 2 and what problems are linked to this activity.

Photo	Description	Problem it relates to
1	Heavy farm vehicles have compacted the soil in the field. Root growth will be restricted and it is difficult for water/nutrient uptake which decreases crop yield.	Soil Compaction
2	Ploughing gets more oxygen in the soil, however different bacteria turn the oxygen into carbon dioxide which contributes to the level of greenhouse gases in the air. We need a good balance of oxygen in the soil for it to be healthy.	Release of Greenhouse gases
3	Natural fertilisers such as liquid manure pollute the air with ammonia. This is harmful to human health and can also pollute waterways.	Soils need regular fertilising to put the nutrients back that the crops/plants remove when growing.
4	Artificial fertilisers are produced by burning fossil fuels which adds greenhouse gases which leads to global warming.	Release of greenhouse gases

2

What's the soil like in our school?

Take a walk around the school grounds to look at where soil is found, e.g. a flower bed which has been recently dug up for gardening, somewhere that is regularly walked on, the middle of a grassy area, where vehicles frequently pass over it etc. Take the opportunity to observe and explain the differences between compacted soil and non-compacted soil.

You could take a camera/ipad and make a montage of soil around the school. Sort and classify into areas that are more or less compacted. This could be developed into an optional science investigation with Learners measuring soil compaction (page 4).

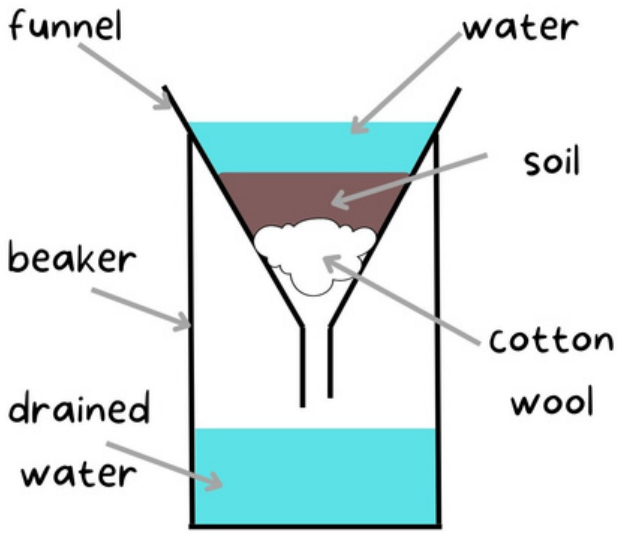
Investigation: How does compaction affect the amount of time taken for water to drain through soil? (comparative test)

Learners compare how quickly water drains through the soil (variable they measure) with different amounts of compaction (variable they change). They change the amount of compaction by squashing the soil down (no compaction, light compaction, moderate compaction and heavy compaction). This could be achieved by using different weights placed on the top of the soil.

3

Learners gather data through simple measurements by recording the time (mins/sec) for a fixed volume of water to drain through the various soil samples with different levels of compaction, recording their results in a table and then analysing by drawing a bar chart on pre-prepared axes.

Encourage Learners to use their bar chart to look for patterns and trends and develop these into conclusions that answer their scientific question. Their results should suggest that soil compaction increases the time it takes for water to permeate through the soil. Often this can result in the water running off the soil surface.



To support your Learners in their science enquiry work you could include some Great Science Skills Starters resources into you lesson, especially the 7-11 Conclusion Creator.

4

Relating their scientific evidence to what happens on a farm?

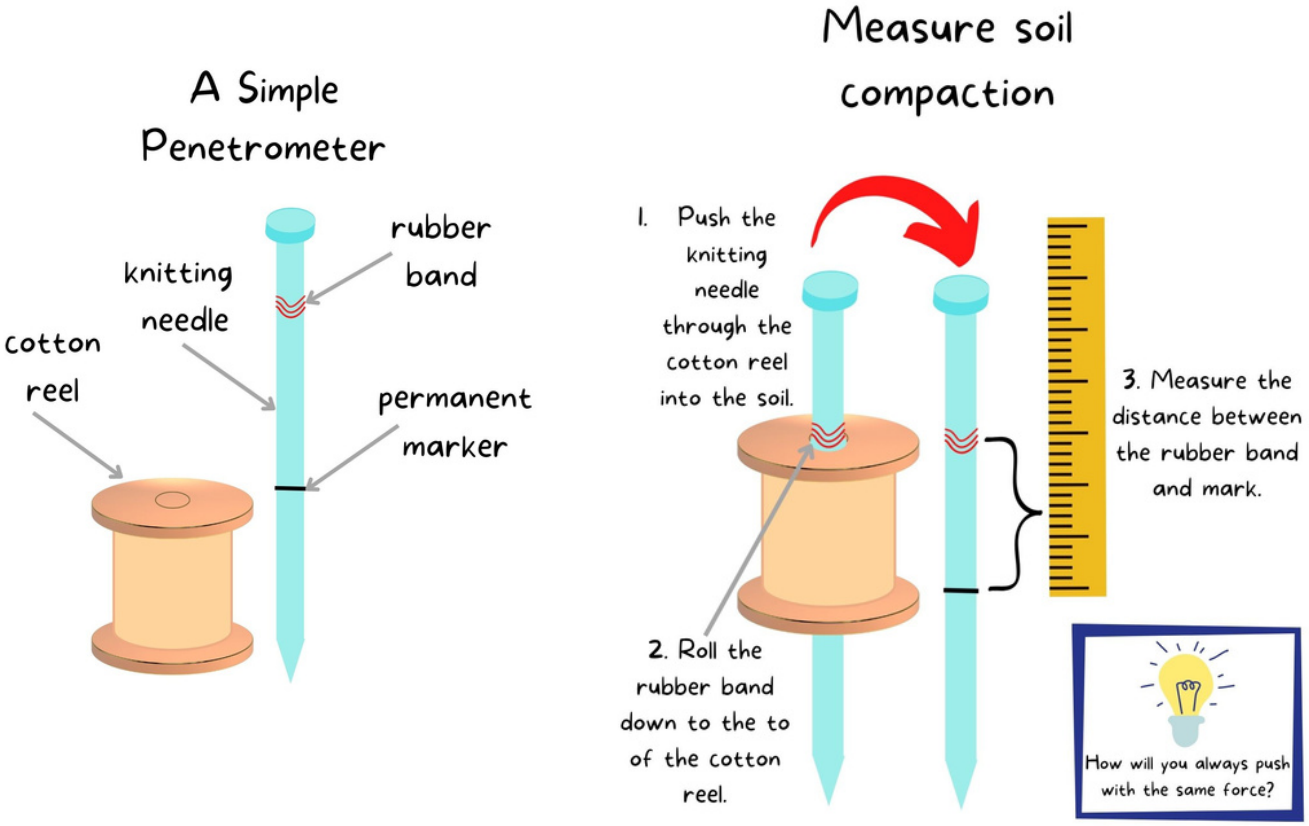
So what does this mean? Why is this a problem? Learners make the link between their enquiry findings and heavy machinery on the farms causing compaction. Ask Learners how they think this will affect seeds growing into healthy crops.

If possible organise the opportunity for your learners to talk to a farmer/engineer about how this problem relates to their work.

Take it further

Optional Investigation: Where is the soil on our school grounds most compact?

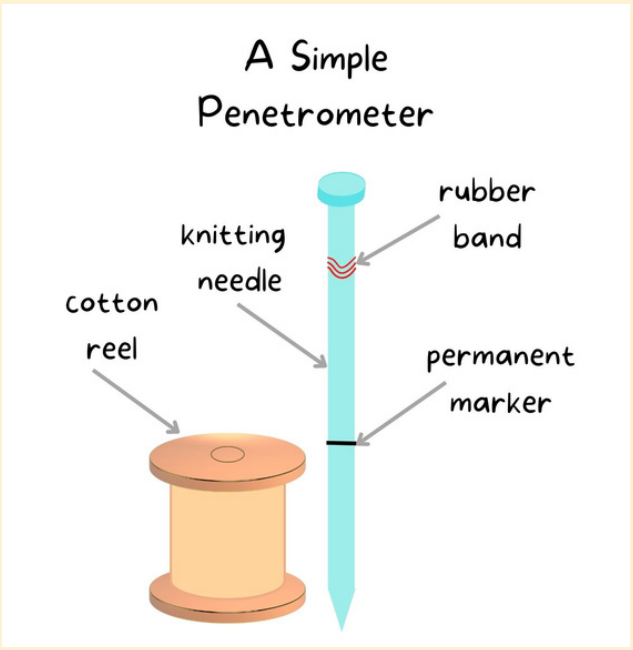
Why not develop step 2 of this session into an additional science enquiry? Using simple, readily available resources your learners could make their own 'penetrometer', a device for measuring the compaction of soil.



As your Learners observe soil samples in different locations around the school grounds they could use this penetrometer and a ruler to take a measure the level of soil compaction.
They push the knitting needle through the cotton reel and into the soil (using the same force in each location they measure soil compaction). They then roll down the rubber band to mark where the top of the cotton reel is, remove their penetrometer and measure the distance between the rubber band and the mark.

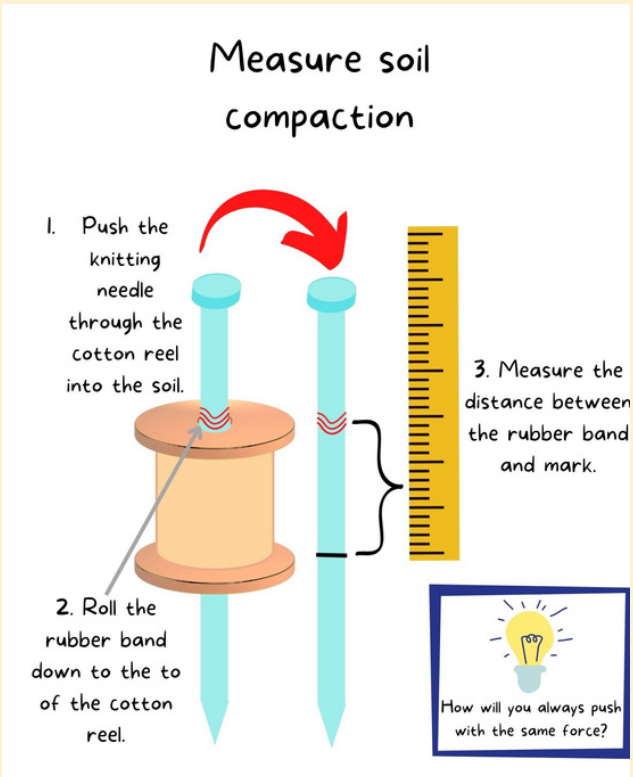
If the soil is more compact the knitting needle will not be easily pushed into the soil and the distance between the mark and the rubber band will be small. If the soil is less compact the knitting needle will easily be pushed into the soil and this distance will be bigger. Learners can record their measurements in a table and then use a bar chart to compare and analyse their findings. Encourage your Learners to draw conclusions that try to explain the differences in soil compaction in different locations.

Where is the soil most compact in our school grounds?

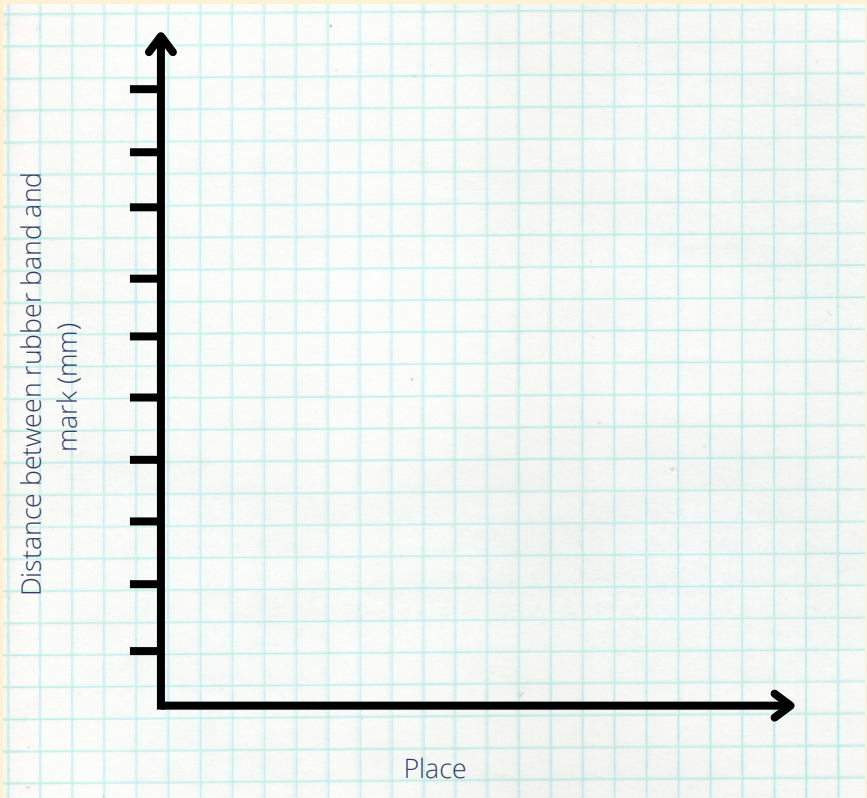


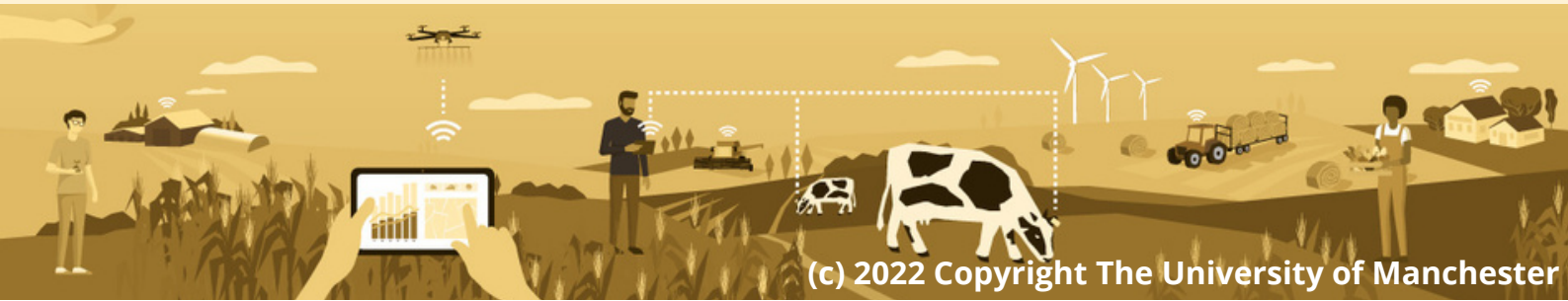
Results

Place	Distance between rubber band and mark (mm)



Analysis - bar chart

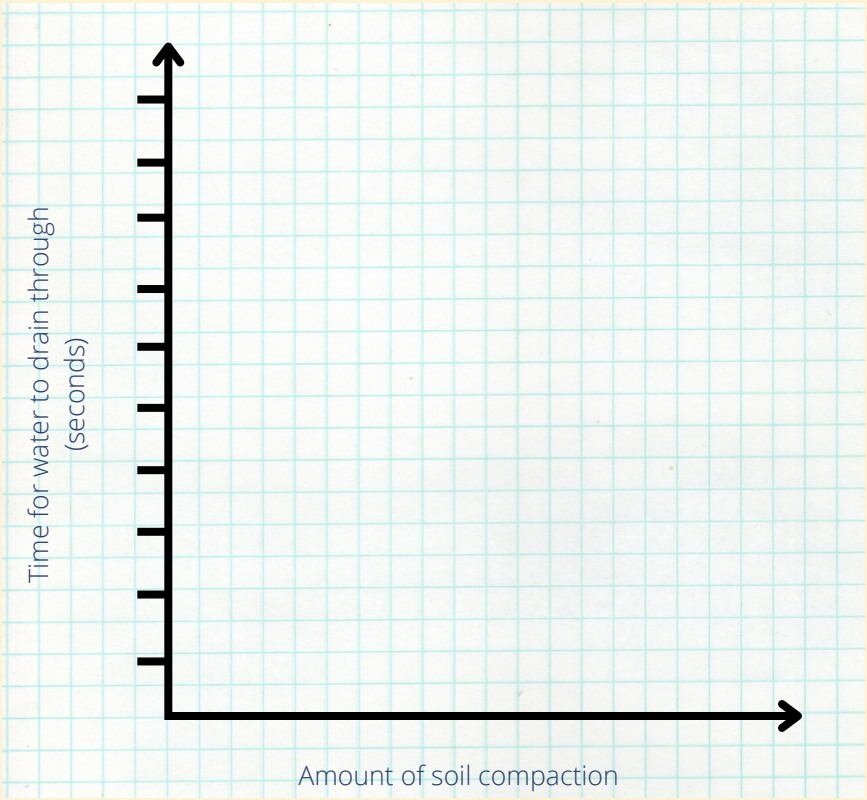




Does soil compaction affect the time it takes for water to drain through it?

Planning

Analysis - bar chart



Results

Amount of soil compaction	Time for water to drain through (seconds)
no compaction	
light compaction	
moderate compaction	
heavy compaction	

Conclusion