Soil Compaction - Teacher's Notes

These activities compare air spaces in soil before and after compaction.
The average composition of dry soil is:
About 40% broken bits of rock (weathered fragments)
About 10% humus (decaying living things)
About 50% water and air, which fills in the spaces between the humus and rock fragments.
Airways are necessary because this is how plants in the soil can access carbon dioxide for energy for growth and maintenance and release oxygen.
Water is necessary because plants use dissolved nutrients to grow.

Activity 1: Air in Soil

You can estimate how much air is in a particular soil by finding out what volume of water will displace air held in the soil. The water should be seen to soak all the soil and form a thin layer above it.

Materials

- 2 or more dry soil specimens (1 garden & 1 roadside)
- 2 test tubes
- 1 teaspoon (most teaspoons hold 5ml)
- Pasteur pipette or transfer pipette
- Water
- A clock or watch
- A pen or pencil

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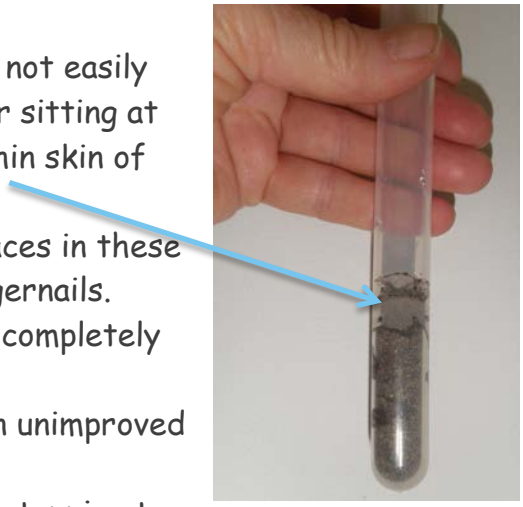
Method

1. Place 10ml (2 teaspoons) of dry soil into a test tube
2. Fill the pipette with exactly 3ml of water
3. Drop by drop add the water to the soil in the test tube until it is soaked and can accept no more water.
4. Refill the pipette as required
5. Using the measuring gradations on the side of the pipette estimate the volume of water that was used to displace air

NOTE



Some WA coastal soils are hydrophobic (do not easily accept water). This photograph shows water sitting at the top of the soil and not penetrating. A thin skin of water-repelling soil can trap air bubbles.
To help the water to penetrate into the spaces in these soils gently tap the test tube with your fingernails.
Students can also time how long it takes to completely soak their soil.
Garden soil should accept water faster than unimproved soil.
It has taken me almost 10 minutes of gentle tapping to ensure some coastal soils become completely soaked. Some dry patches need persistent tapping.

Observations

Original volume of soil + air 10ml

Volume of water that replaced the air Likely about 4ml

Percentage of air in soil = Volume of air X100

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Volume of soil

= 40%

Students who are still at "fraction level" should estimate the fraction of air in tenths.

4/10ths

Activity 2: Air in Compacted Soil

Repeat activity 1 after first "tamping down" or compacting the dry soils with the blunt end of a pencil or pen.
Students should note the initial height of the loose soil.
After tamping down they should keep adding more soil and tamping it until it regains the initial height of the loose soil.

Predict

What do you predict will happen because you have now compacted the soil?

Observations

Original volume of soil + air	10ml
Volume of water that replaced the air	Xml

Percentage of air in soil = $\frac{\text{Volume of air X100}}{\text{Volume of soil}}$

= X%

Students who are still at "fraction level" should estimate the fraction of air in tenths.

X/10ths

Has compaction had a measurable affect on the amount of air and water in the soil? YES