



How can we turn sand into healthy soil?

Lesson overview:

In this lesson, children compare the growth of peas plants from seed in sand mixed with different substances. The challenge for children is to design and carry out a controlled investigation to identify which substance provided the best improvement for growing pea plants. The context for this are the problems for agriculture that sandy soils can cause: fast drainage and poor water retention leading to leaching of nutrients and poor crop yields.

Five different substances are suggested for children to investigate. Three are organic (compost, sawdust and paper pulp) and two are inorganic (clay and vermiculite). Advantages of using organic substances is that they decay in the soil releasing nutrients and often they are waste materials making their use sustainable. The disadvantage is that they need replenishment after they decay. Advantages of inorganic materials is that they do not decay and so last longer. However, some may get washed away or degraded by the action of oxygen and water. Their disadvantages are they are mined or quarried making them less sustainable, and they do not release nutrients into the soil to the degree that organic additives do.

Equipment needed:

- Pea seeds (preferably pre-soaked and starting to germinate)
- Sand (preferably washed to remove traces of salt)
- Fine-grain potting compost
- Pottery clay
- Sawdust
- Vermiculite
- Shredded paper for making paper pulp
- 30 cm rulers
- Balance (to 0.1 g precision)
- Seed trays, plant pots or cream pots
- Measuring cylinders

Safety information:

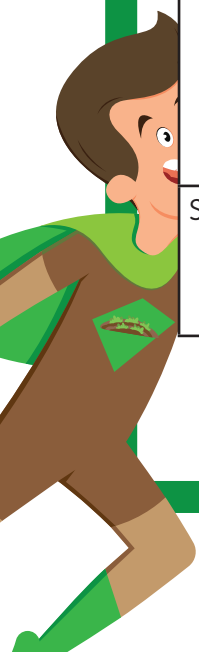
Standard safety procedures should be followed. Spills should be cleared up immediately and children should wash their hands after handling compost, sand etc.





Presentation guidance:

<p>Slide 2:</p>	<p>Explain that sandy soils drain quickly because sand grains are large relative to typical soils. Sandy soils are usually light in colour because they do not contain much humus (decaying organic matter). Ask the children to name nutrients important for plant growth (the main nutrients needed for plants are minerals containing nitrogen, phosphorus, magnesium and potassium?)</p> <p>Explain that sandy soils are improved by adding substances that retain moisture. These substances can be organic (from animals and plants) or inorganic (from non-living sources such as rocks and minerals).</p>
<p>Slide 3:</p>	<p>Explain that the global population is rising quickly and so the need to increase food production is essential.</p> <p>There are many places in the world where land is not currently used for agriculture and this may need to change. For example, in arid or semi-arid areas.</p>
<p>Slide 4:</p>	<p>Explain that food security is becoming more and more important as the world population increases. The UK is a world leader in improving agriculture.</p>
<p>Slide 5:</p>	<p>Explain to children that they will be playing the part of agricultural researchers. Their task is to investigate different ways to improve sand to find the best way for growing pea plants. They will their results and the cost of the different treatment methods to decide which method(s) to recommend to farmers. Their findings will be presented as a research poster.</p>
<p>Slide 6:</p>	<p>Explain that compost typically comes from waste vegetation from farms (straw, waste vegetation after harvesting such as pea and potato plants), garden waste from local authority recycling centres and tree cuttings and bark. Some compost comes from less sustainable sources such as peat bogs.</p> <p>Compost is organic and many sources are sustainable.</p>
<p>Slide 7:</p>	<p>Clay is a fine-grained mineral deposit and is an inorganic material. It is quarried from the ground and so is non-renewable (its use is not sustainable).</p>





Slide 8:	Sawdust is an organic material. It is a sustainable resource provided trees are replanted after felling.
Slide 9:	Vermiculite is a flaky mineral mined from the ground. When heated in a furnace, the mineral flakes expand to form light, porous grains. It is quarried from the ground and so is inorganic and non-renewable (its use is not sustainable).
Slide 10:	<p>Paper pulp is made by mixing shredded paper with water to separate the fibres. For this investigation the paper is best soaked for several hours and mashed to form a 'soup' for mixing with the sand. Mixed paper and card from recycling are difficult to turn into useful paper products and so it could be used as a soil additive.</p> <p>Paper pulp is organic and so most sources are sustainable provided trees are replanted after felling.</p>
Slide 11:	This is a reference slide showing typical costs of the different additives children will test. They will need this information again when they analyse their data.
Slide 12:	<p>Ask children about how they should control the variables in this investigation:</p> <p>For example, will they add the same mass of each additive or add the same volume? How many peas will they grow in each pot? Just one or would they get better results if they use three or five peas? Should they test a pot of sand that has no additive? How will they compare the growth of the pea plants? Will they measure mean plant height or mean plant mass? How can the amount of water in the treated sand at the start of the investigation be controlled? How much water should the plants be given? Should they be watered each day or every two or three days? Where will they place the plants to grow? Should they make and record observations / take photographs every few days?</p>
Slide 13:	After the peas have grown for two to three weeks, children can gather the results. Encourage them to evaluate how healthy the plants look as well as their height / mass.

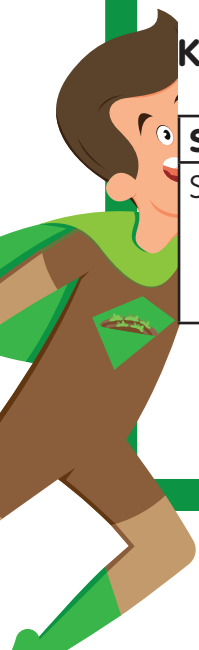




Slide 14:	Children now write a scientific report which, at this level, is essentially an experimental write up. However, an important part of their conclusion will be their recommendation to UK farmers about how they can improve the quality of their sandy soil based on results and cost. As an extension project, children can create a science research poster on A3 or A2 paper. Slide 15 can be used to model the features of science research poster.
Slide 15:	<p>Explain that a science research poster would be used to share a summary of research findings at a science fair or research convention. They usually have lots of diagrams, photos, tables, charts and graphs to break up the text. Draw children's' attention to the following features:</p> <p>Title of research and researchers' names.</p> <p>Introduction: This section gives background information about the area of research and outlines its importance. It may include text, data, diagrams and pictures.</p> <p>Method: This section explains what the research team did to collect their data. It should include some diagrams and / or pictures to show how the investigation was conducted.</p> <p>Findings: This section should include data from the research including tables, charts, graphs and text. It should explain the results including any anomalies and mathematical calculations such as calculating means.</p> <p>Conclusions: This section should highlight the importance of the findings and what show. It should include recommendations for others (such as farmers) as well as ideas for further research. It may contain diagrams, pictures, charts and text.</p> <p>Acknowledgements: People other than those in the research group who have contributed should be included here. For example, the research findings of others that may have contributed ideas for this research, or others who have helped directly.</p>

Key Stage 3 Curriculum Links

Subject	Topic	Objective
Science	Working scientifically	Experimental skills and investigations Analysis and evaluation Measurement





Science	Nutrition and digestion	Plants make carbohydrates in their leaves by photosynthesis and gain mineral nutrients and water from the soil via their roots.
Language and literacy	Reading and writing	<p>Pupils should develop the stamina and skills to write at length, with accurate spelling and punctuation.</p> <p>The writing they do should include narratives, explanations, descriptions, comparisons, summaries and evaluations</p>

