Soil Defenders - Session 3

How can we prevent pests eating the seeds?

Context:
Learners consider how they can help arable farmers protect cereal crops from pests so that more seeds can grow well and be harvested (the yield). Some learners apply their maths skills of fractions and percentages to find out more about the problem. They learn about the types of pests doing harm and the innovative ways that engineers create mechanisms to deter animals. They work in pairs to visualise their design ideas in response to a set design brief.

Engineering focus:
Learners will be working as an engineer by imagining and planning design ideas. They will take the thoughts and ideas in their heads and put it into drawings or words so someone else can respond to them (Visualising).

Learning time:
2 hours

Suggested age group:
7-9 years old

Keywords
seeds
crops
barley
oats
wheat
pest
deter
deterrent
sowing
harvest
yield

Curriculum links:
Design Technology
Learners will be:

- Using research and developing design criteria to inform the design of an innovative, functional and appealing animal deterrent that is fit for purpose and aimed at farmers.
- Visualising design ideas by generating, developing, modelling and communicating their ideas through discussion, annotated sketches, cross-sectional and exploded diagrams.

Resources:

- Soil Defenders Session 4 Presentation
- Samples of oat, wheat and barley seeds
- Sample foods made from oats, wheat & barley
- Hand lens
- NFU Farmer Video - Pest Problem
- Problem on a page - Animal Deterrent
- Laptops/electronic tablets/devices for research
- Paper, pencils, rulers etc

Optional (extension enquiry):

- A small bag of wheat seeds for planting -
- Soil/compost
- 4 x Seed Trays
- Ruler to measure the depth for planting.

Step-by-step plan

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Spot and match it!

Pose a quick-fire challenge to learners to match the seed varieties grown on arable farms to their names and the products they make (Slide 2-6). Where possible, have real seeds and food samples available to handle and develop descriptive language to describe the seeds. Use a hand lens to support. Reveal the match using Slide 3 and continue to Slides 4-6 to identify the differences in the look of the crops when they are growing and ready for harvest. Encourage learners to use descriptive language to explain the differences they notice.

Extend: Have a variety of food stuff available to see and taste, to support pupils in connecting the crops to their everyday lives. This is important to enhance learners' awareness of food moving from farm to plate. Perhaps some learners with gluten allergies will be aware of products made from a variety of grains. Examples could include:

Oat	Wheat	Barley
flapjacks, oat porridge, muesli, oat cakes, oat milk	Weetabix, pasta, noodles, cookies and biscuits, beer, Worcestershire sauce	Barley sugar, barley flour, pearl barley e.g. Scotch Broth,

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Introduce NFU Farmer Video - Pest Problem

In this video, the learners hear from a farmer who explains a regular problem of seed loss from fields. Explain that in this session they will be working like engineers, using their imagination to plan a mechanism that could reduce the problem of seed loss from fields resulting from rodents and birds.

Share an email to your young engineers from farmer Hannah about the problem she faces with seed loss due to pests (slide 7), you could work as a class to engage with this email further applying maths skills to exploring the questions in this optional extension maths challenge:

Extension: Maths Challenge

Posing the problem as a maths challenge will involve learners applying their knowledge of big numbers, fractions and percentages. Adapt this task to suit the ability of your class.

Task 1: What fraction or percentage of the farmers' wheat seeds are not turning into plants?

Answer: 345/460 = ¾ becoming plants ¼ being lost

Task 2: The typical area of a crop field in the UK is 800,000m^2. This farmer's field has 10 fields how many seeds are needed to plant wheat on all these fields?

Answer: The total area = 800,000m^2 x 10 = 80,000,000 m^2
The farmer plants 460 seeds per m^2
Total number of seeds = 80,000,000 m^2 x 460 seeds per m^2 = 36,800,000,000 seeds

Task 3: It takes between ½ m^2 and 1m^2 of wheat crop to make a loaf of bread. Can you estimate how many loaves of bread our farmer can produce from the wheat that is grown on the farm?

Answer: 80,000,000 loaves of bread from the 10 fields, if 1 loaf per 1m^2
40,000,000 loaves of bread from the 10 fields, if 1 loaf per ½ m^2

Understanding the problem we are trying to solve

Share the Problem on a page handout with learners. Provide time to do some initial research into the types of animals that may need to be deterred. The most common are rodents and birds on UK farms, including moles, wood mice, pigeons etc. (See slide 8 &9)

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Stimulate some ideas by providing examples to guide thinking - how do we stop animals or pests in our daily life? E.g. stopping squirrels eating bird food using structural deterrents; bird spikes; security lights to stop intruders; sound deterrents; etc.

Use the design brief to gather learners' ideas about the types of deterrents they think could be used on a farm. Are they aware of anything that farms currently use to deter birds? The most common is of course a scarecrow!

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What could save our seeds?

Launch the design challenge, with learners working into pairs. Remind them that they can adapt ideas from other devices or mechanisms. Access to whiteboards or flipchart paper and pens will allow them to visualise (sketch) ideas and encourage talk to describe how their device will work. The following top tips will help get them started:

- Decide which animal or animals you are going to try to deter.
- Do some research about existing devices that work as deterrents.
- List or sketch ideas that you think could deter the animals you are thinking about. Be open minded and have lots of ideas!
- Collaborate to decide which ideas to take further, and use sketching and annotations to visualise and communicate your ideas.

Discuss the ideas you consider to best meet the design criteria. Encourage peer-review by giving time for learners to go around the classroom looking at everyone else's designs. They could use sticky-notes to leave developmental and supportive comments, or questions for their peers as to how the design could be further improved.

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Evaluate

How well will the engineered designs solve the farmer's problem? Provide some time for learners to reflect on how well their designs have met the design brief using the table on the Problem on a page handout. Learners can score themselves out of 5 on meeting specific success criteria.

Why not share learners designs on Twitter or on social media to raise the profile of their engineering activities? @EngEduChallenge
Of course, learners may wish to create and test prototypes of their designs in your school grounds, although at this stage this is not a requirement of the challenge, if time allows the challenge could be developed further.

Want to take it further?

Consider how could you can further improve your device:

- To operate within certain hours of the day?
- To be programmable by the farmer?
- To move by itself?

How well did you do?

Success Criteria	Score /5
Weatherproof and portable	
Incorporating recycled and sustainable materials	
Incorporate moving parts	
Easy to operate and maintain	
Not harmful to animals or a nuisance to the public	

Take it further

Optional Science Investigation: Does the depth a seed is planted affect its growth?

Challenge learners to design a fair test that will answer the above question – they should work in small groups of 3 or 4 to plan their investigation. Learners should think about what depths they are going to use and how many different depths. They should also consider how they are going to measure the different depths in a precise and accurate manner and what variable they will measure to compare the plants.

Variable that will be changed	Depth of seed (mm)
Variable that will be measured	Height of plant after a fixed time (mm)
Variables that will be controlled	Type of seed, amount of water, soil/nutrients, light, temperature

Learners could sow several rows of seeds on a tray - not only would this better mimic crops growing in a field but would allow learners to gather multiple measurements and calculate the mean average of their data set. Learners will need to decide what their results table will look like in advance so they are clear about the data they are planning to gather.

Once sufficient growth has been achieved (probably after 3 or 4 weeks) learners will gather and record data. To analyse their findings, they can plot a line graph with depth of seed on the x-axis and average height of plant on the y-axis and then use this to identify trends and causal relationships.

Encourage learners to consider how their findings might impact agricultural engineers when they are designing machines to plant the seeds?

Seed Snatchers Challenge

What's the farmer's problem?

"Once I have sown my seeds, they need protecting so that my crop can grow without being damaged by birds or other animals."

Available resources:

- Internet access for research
- Large paper for visualising ideas, pens, rulers and drawing equipment

What is the design brief?

Use drawings and/or 3D models to imagine and design a device that will deter birds and small rodents from eating newly sown seeds or crops on a wheat field.

Your device will need to meet the following criteria:

- Be portable
- Be weatherproof
- Should incorporate recycled and sustainable materials
- Incorporate moving parts
- Easy to operate and maintain
- Autonomous (work by itself)
- Not harmful to the animals it deters or cause a nuisance to the public

The engineering design task

Can you devise a solution to stop crop damage caused by birds and rodents?

Birds are a major problem for farmers. They can quickly decimate an entire crop, leaving the farmer with nothing but empty fields and no income. Some birds, like pigeons and sparrows, will strip seeds from the ground. Other birds eat young plants and buds directly off the plant. The same can be true of rodents such as mice and voles. It is important therefore that farmers protect the crops they have worked so hard to produce whilst still considering the welfare of the animals.

Top tips to get started:

Think about the features and functions of the device:

- What animal(s) are you planning to deter?
- What type of deterrent best suits your purpose?
  - Auditory - what sounds would frighten the animals?
  - Visual – what sights might frighten the animals??
  - Repellents – what smells, feelings and tastes might deter animals?
- Which parts will be the moving parts of your device?
- Could your device incorporate a sensor to detect movement?
- How could the sensor be powered?
- Will your device be stationary or could it move to different parts of a field?

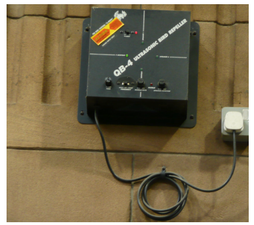
Background Information:

What might deter animals that eat seeds?

A gas gun creates a loud sound when the sensor is triggered.

Human figures can deter some animals.

Some animals don't like particular smells.



Some animals don't like super high pitch sounds (ultrasound).

Animals will keep away from model predators.

Materials that reflect sunlight will startle and deter animals.

Glossary:

Seeds – the grains of plants used for sowing.
Crops – a plant that is grown in a field on a large scale.
Pest – an insect or other small animal that harms or destroys plants.
Deter – to prevent or discourage someone from doing something.
Deterrent – a thing that discourages or is intended to discourage someone from doing something.
Sowing – to plant or scatter seeds for growing.
Harvest – the process or period of gathering in crops.
Yield – the amount produced of an agricultural or industrial product.

More information and inspiration!

You will probably want to research ideas to deter animals from eating seeds and seedlings. Explore some of these websites:

- 5 ways to protect crops from wold animals
- How to protect crops from birds

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