Cross-curricular approaches in science: what really works?

Grace Marson

SEERIH (Science & Engineering Education Research and Innovation Hub)
The University of Manchester

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TELL US WHAT YOU THINK!

Cross-curricular in practice:

***P**ositive*

The benefits, what works well

***M**inus*

Any barriers or negatives

***I**nteresting*

Any other thoughts or reflections - could be examples

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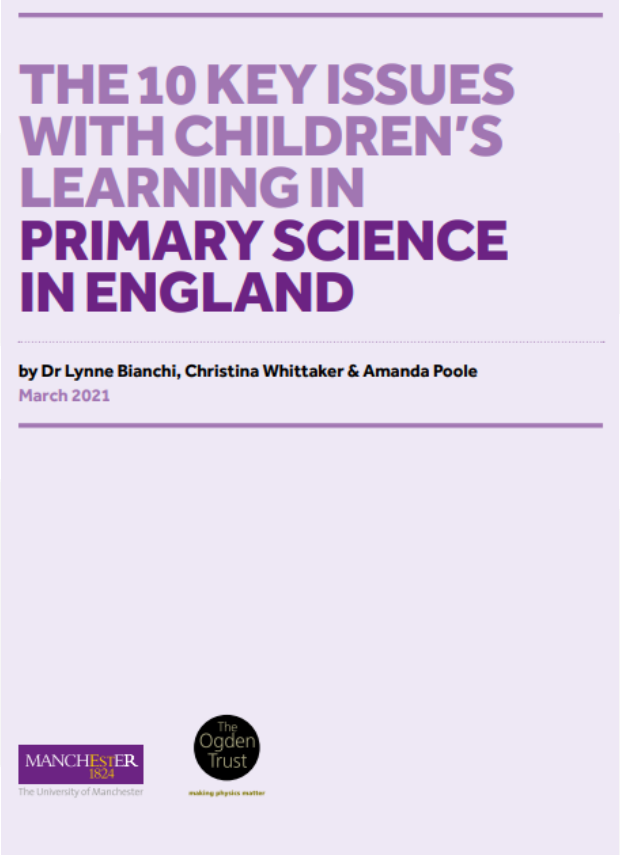

THE 10 KEY ISSUES WITH CHILDREN’S LEARNING IN PRIMARY SCIENCE IN ENGLAND

by Dr Lynne Bianchi, Christina Whittaker & Amanda Poole
March 2021

Introducing…

Engineering Educates Farmvention Challenge

What is engineering Educates?

- A **NEW** national campaign to inspire 7-14 year olds to think as engineers, finding solutions to real world problems.
- Builds on the success of **Great Science Share for Schools**
- **CPD opportunities and resources** to support the development of engineering education

1

LEARNER FOCUSED

2

INCLUSIVE & NON-COMPETITIVE

3

COLLABORATIVE

Flexible delivery

Within Curriculum
Half-day session weekly, 5 weeks

STEM Week
A full week of Engineering Educates Challenges

Enrichment
Delivered through extra-curricular STEM club

ENGINEERING DESIGN PROCESS

Introducing the Farmvention Challenge

- Learners work through the **Engineering Design Process** developing engineering skills working like an agri engineer.
- Learners complete a series of challenges where they work to **find solutions** to real-world problems in farming.
- The challenges link to the Science, Mathematics, Design & Technology and Computing curriculum through **three pathways**.

Soil Defenders

for 7-9 year olds

Engineering Design Process	Ask	Ask	Imagine & Plan	Create	Improve
Soil Defenders	Introduction to British Farming	Problems with soil	Animal Deterrent	Seed Machine	Spray -Stop- Spray
STEM Curriculum	Mathematics	Science	Design Technology Technologies		Computing Technologies

7-9 years

KEY CURRICULUM LINKS

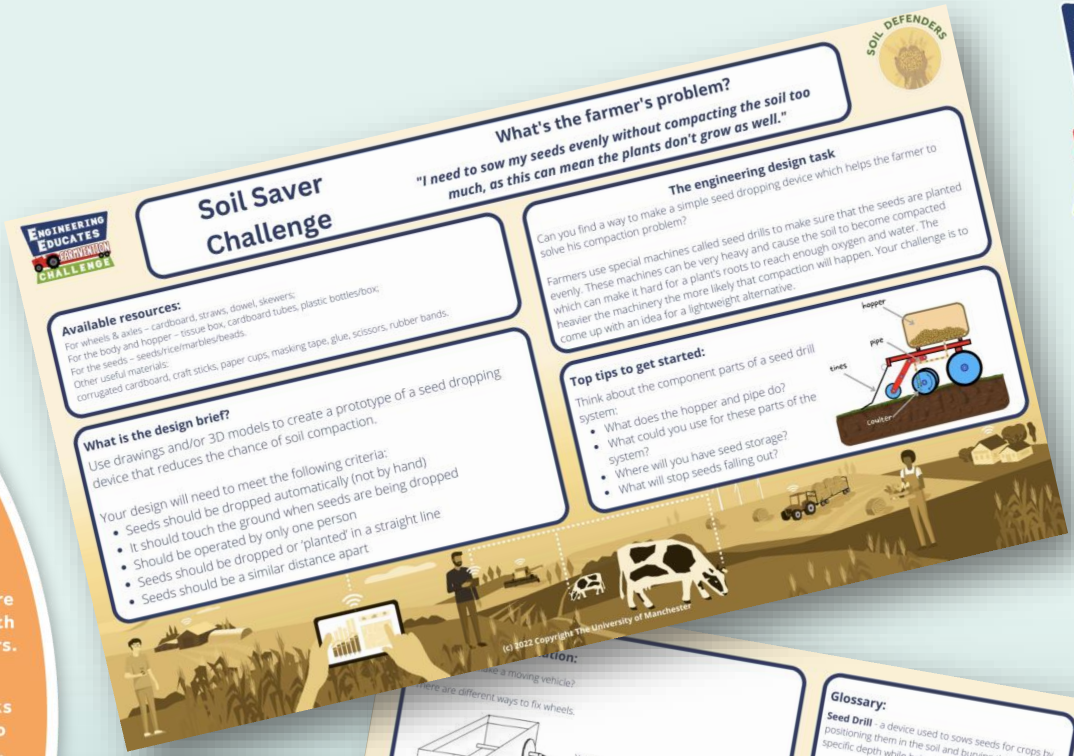
- Science
- Maths
- Design Technology
- Computing

https://www.engineeringeducates.org/engineering-educates-curriculum

What's the farmer's problem?

"I need to sow my seeds evenly without compacting the soil too much, as this can mean the plants don't grow as well."

Soil Saver Challenge


Soil Saver Challenge

What's the farmer's problem?

"I need to sow my seeds evenly without compacting the soil too much, as this can mean the plants don't grow as well."

Available resources:
For wheels & axles – cardboard, straws, dowel, skewers;
For the body and hopper – tissue box, cardboard tubes, plastic bottles/box;
For the seeds – seeds/rice/marbles/beads.
Other useful materials:
corrugated cardboard, craft sticks, paper cups, masking tape, glue, scissors, rubber bands.

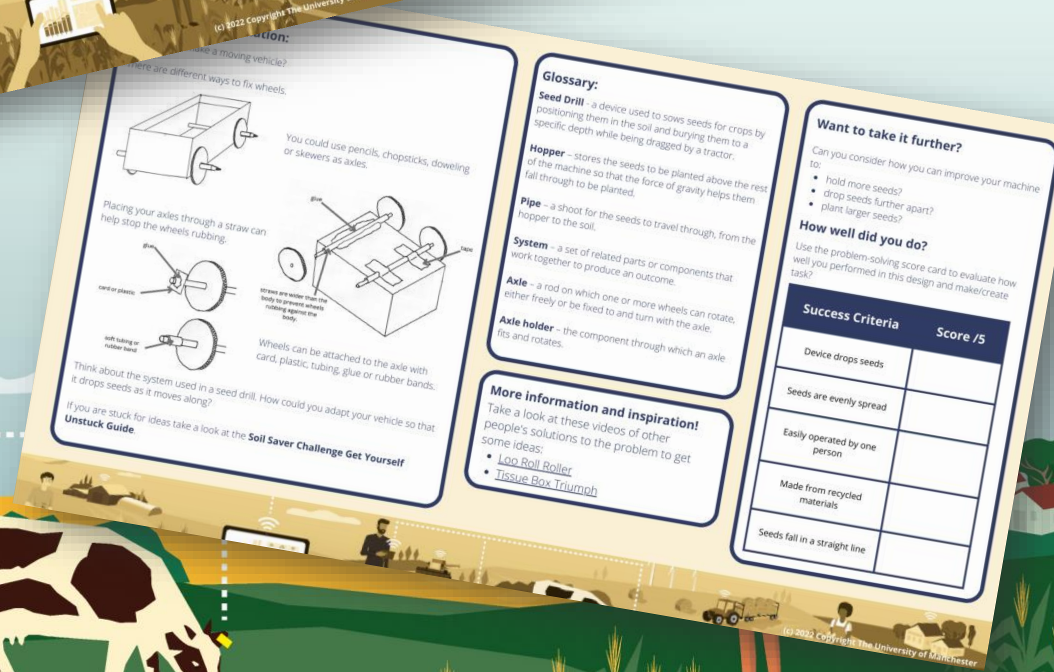
What is the design brief?
Use drawings and/or 3D models to create a prototype of a seed dropping device that reduces the chance of soil compaction.

Your design will need to meet the following criteria:
- Seeds should be dropped automatically (not by hand)
- It should touch the ground when seeds are being dropped
- Should be operated by only one person
- Seeds should be dropped or 'planted' in a straight line
- Seeds should be a similar distance apart

The engineering design task
Can you find a way to make a simple seed dropping device which helps the farmer to solve his compaction problem?

Farmers use special machines called seed drills to make sure that the seeds are planted evenly. These machines can be very heavy and cause the soil to become compacted which can make it hard for a plant's roots to reach enough oxygen and water. The heavier the machinery the more likely that compaction will happen. Your challenge is to come up with an idea for a lightweight alternative.

Top tips to get started:
Think about the component parts of a seed drill system:
- What does the hopper and pipe do?
- What could you use for these parts of the system?
- Where will you have seed storage?
- What will stop seeds falling out?


...ation:
...ake a moving vehicle?
...here are different ways to fix wheels.

You could use pencils, chopsticks, doweling or skewers as axles.

Placing your axles through a straw can help stop the wheels rubbing.

Wheels can be attached to the axle with card, plastic, tubing, glue or rubber bands.

Think about the system used in a seed drill. How could you adapt your vehicle so that it drops seeds as it moves along?

If you are stuck for ideas take a look at the **Soil Saver Challenge Get Yourself Unstuck Guide**.

Glossary:
Seed Drill - a device used to sows seeds for crops by positioning them in the soil and burying them to a specific depth while being dragged by a tractor.
Hopper – stores the seeds to be planted above the rest of the machine so that the force of gravity helps them fall through to be planted.
Pipe – a shoot for the seeds to travel through, from the hopper to the soil.
System – a set of related parts or components that work together to produce an outcome.
Axle – a rod on which one or more wheels can rotate, either freely or be fixed to and turn with the axle.
Axle holder – the component through which an axle fits and rotates.

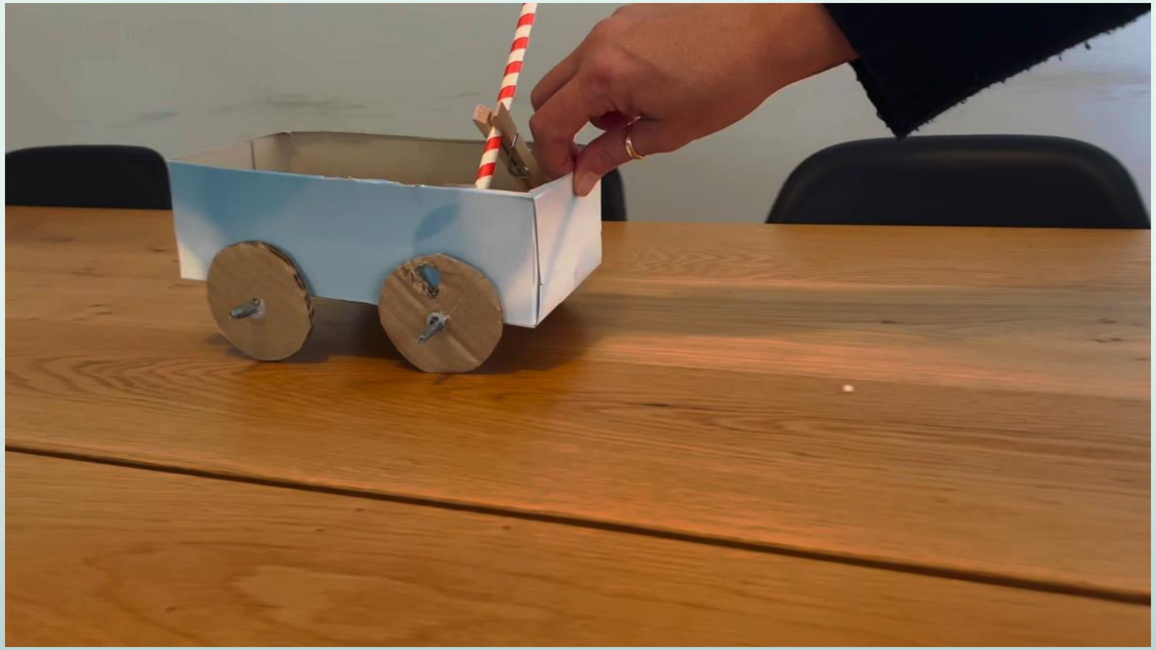
More information and inspiration!
Take a look at these videos of other people's solutions to the problem to get some ideas:
- Loo Roll Roller
- Tissue Box Triumph

Want to take it further?
Can you consider how you can improve your machine to:
- hold more seeds?
- drop seeds further apart?
- plant larger seeds?

How well did you do?
Use the problem-solving score card to evaluate how well you performed in this design and make/create task?

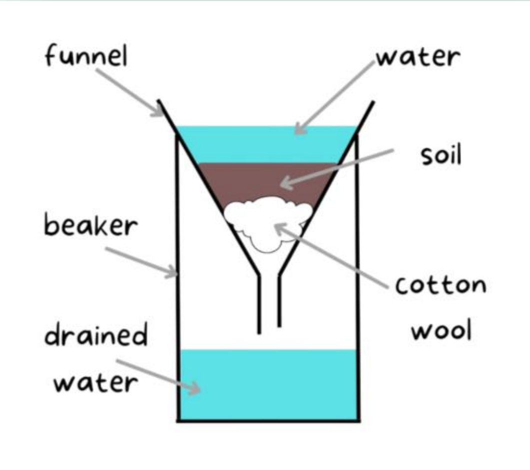
Success Criteria	Score /5
Device drops seeds	
Seeds are evenly spread	
Easily operated by one person	
Made from recycled materials	
Seeds fall in a straight line	

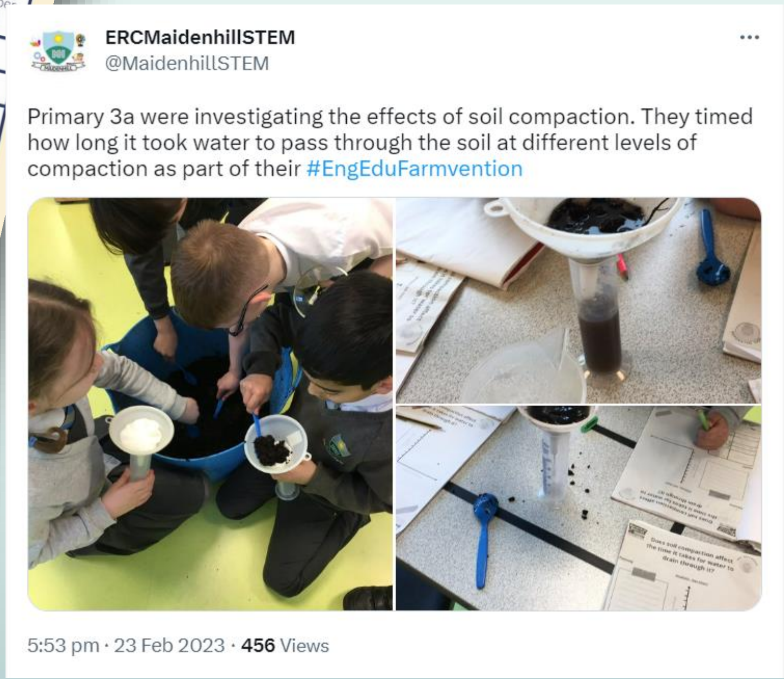
So many possible solutions….



Can adapt your prototype to meet these farmers' needs?

Science of Soil





Session 5 - Computing

Soil Defenders - Session 5

How can automation make fertilising fields more efficient?

Context:
Learners think about how technology can improve new innovations in arable farming. After harvesting, the soil is depleted of nutrients, and farmers use slurry to add nutrients back into the soil, ready for new crops. Learners create a program on the micro:bit which simulates turning the slurry spray on and off so that waterways or neighbouring properties are protected from excess slurry going over the field boundaries.

Engineering focus:
Learners will be working as an engineer by improving 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 it.

Learning time:
2 hours

Suggested age group:
7-9 years old

Keywords
automation
efficiency
fertiliser
nutrients
slurry
Microbit
program
algorithms
debug
sequence
input
output

Curriculum links: *Computing*
Learners will be:
- designing, writing and debugging programs that accomplish specific goals, including controlling or simulating physical systems
- using sequences in programs
- working with various forms of input and output device.

Resources:
- Challenge Instruction Video
- computer with access to the internet for MakeCode
- micro:bits (or micro:bit simulator at MakeCode)
- servos (optional)

If you don't have micro:bits in your school, you can still complete this lesson using the online micro:bit simulator at https://makecode.microbit.org/

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1

Step-by-step plan

1

Understanding the problem
Ask learners to talk about and share what might have happened in the photo on slide 2. Explain that the first picture is of a car which was parked too close to a field when a farmer was spraying the field with slurry to fertilise the soil.

Explain that farmers spray their fields with fertiliser and their challenge will be to create a technological solution to prevent the spray going beyond their field (slide 3). The task is to engineer a solution to turn off the spray as the tractor turns at the boundary of the field, and then automatically turn it on again. Explain that the micro:bit is a small computer that will simulate whether the tractor is spraying or not (slide 4 & 5).

2

Code Exploration
Explain to learners that we will be using the micro:bit's buttons to explore how these work with some simple code. Display the code on slide 6 and ask the learners what they think the commands might do when the program is run. Why do they think this?

MakeCode commands are quite easy to read as they use clear language terms. When run, this code will display a smiling face on the LEDs when button A is pressed and a sad face when button B is pressed. Both faces will disappear after 100ms and the screen will be clear again. Give learners time to add the above code to their micro:bits. Ask learners to run the code to see if their predictions were correct.

Challenge the learners to:
- change what is displayed by clicking on the individual LEDs
- add another 'on button pressed' command and get the micro:bit to display something different when buttons A+B are pressed together
- change the time the LEDs display for before the screen is cleared.

Then lead a class discussion to consolidate key learning about the code, namely:
- When a button is pressed this triggers the LEDs to display the pattern chosen.
- The 'pause' command can be used to change the duration the LEDs display for before the screen is cleared.
- The 'clear screen' command sets all the LEDs to off.

Image Credit: Andy Harris/Graham Horn

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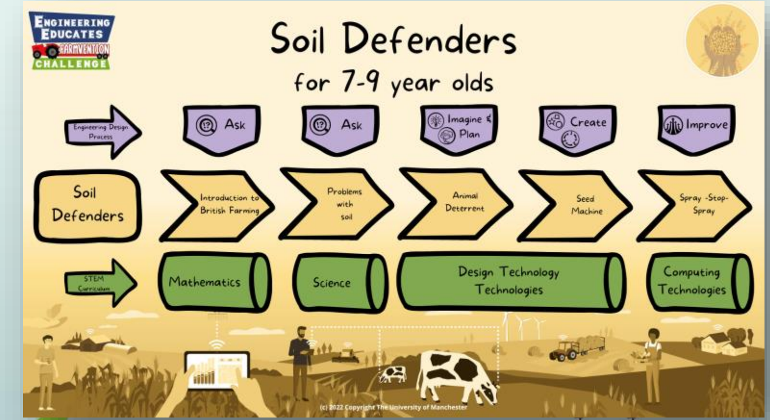
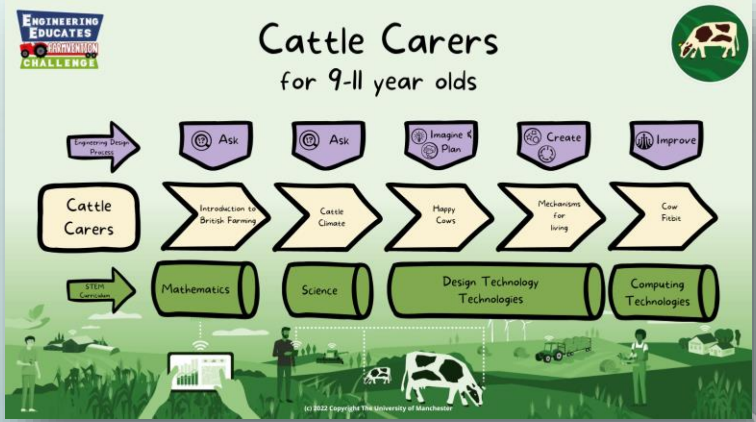
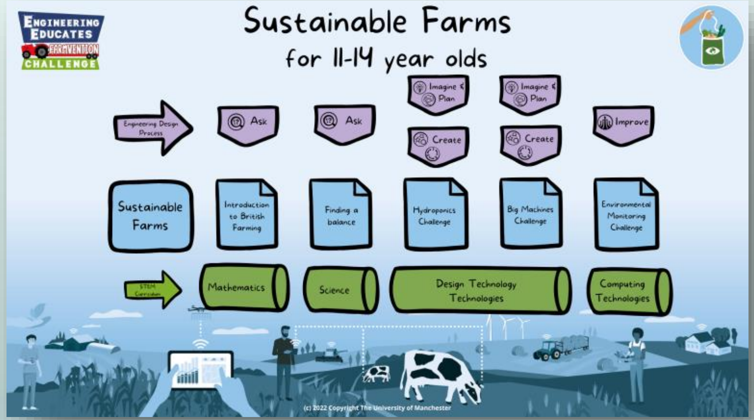
2

Register for a free class set of micro:bits supplied by BBC

Which pathway will suit your learners?








NFU Education
Engineering Educates
Farmvention Challenge
Becca & Lizzie meet...
Erin
A Champion Shepherdess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Engineering Educates
Farmvention Challenge
Becca & Lizzie meet...
Poppy
A Tractor expert


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Farmvention Challenge
Becca & Lizzie meet...
Small Robot Co.
The Roboteers
Small Robot Co


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Engineering Educates
Farmvention Challenge
Becca & Lizzie meet...
Amy
A dairy farmer


NFU Education
Engineering Educates
Farmvention Challenge
Becca & Lizzie meet...
Flavian
A pig Farmer

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Next steps

www.engineeringeducates.org

- Download the resources
- Collaborate with other subject leads in school and incorporate into your curriculum
- Register for the newsletter
- Follow **@EngEduChallenge** on Twitter

Questions?