Royal Academy of Engineering

THIS IS ENGINEERING

SUSTAINABLE FUTURES INNOVATION CHALLENGE

Hydroponics

SUSTAINABLE FUTURES *INNOVATION CHALLENGE*

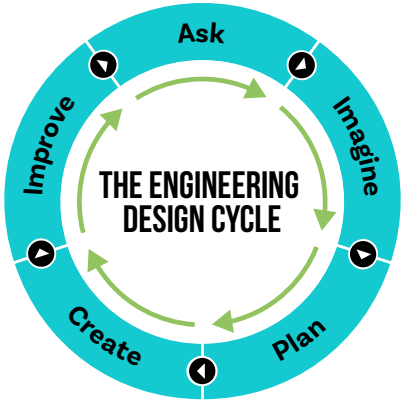
HYDROPONICS

SOME OF THE BIGGEST CHALLENGES WE FACE STEM FROM HOW WE INTERACT WITH OUR ENVIRONMENT, AND ENGINEERING IS AT THE HEART OF FINDING SOLUTIONS.

What can engineers do about an increasing demand for food in a growing population, shrinking resources and the threat of climate change?

Engineering innovative solutions are important to addressing global challenges such as food shortages, protecting biodiversity and improving global health.

Think and learn how to become an engineer by using the **engineering design cycle** in your team.



Learning opportunities	Core skills
■ Teamwork and collaboration ■ Problem finding and solving ■ Creativity and innovation ■ Communication ■ Environmental awareness and responsibility ■ Design thinking and making	■ Research to inform the design and build of an innovative and functional solution ■ Generate, develop, model, and communicate ideas through discussion ■ Write a program to work with various forms of input and output. ■ Use a wide range of tools and equipment to perform practical tasks

SUSTAINABLE FUTURES Innovation Challenge THIS IS ENGINEERING

The box contains the kit required to assemble a fully functional hydroponics system.

Follow the instructions in the booklet provided to set up and operate this equipment.

SETTING THE CHALLENGE

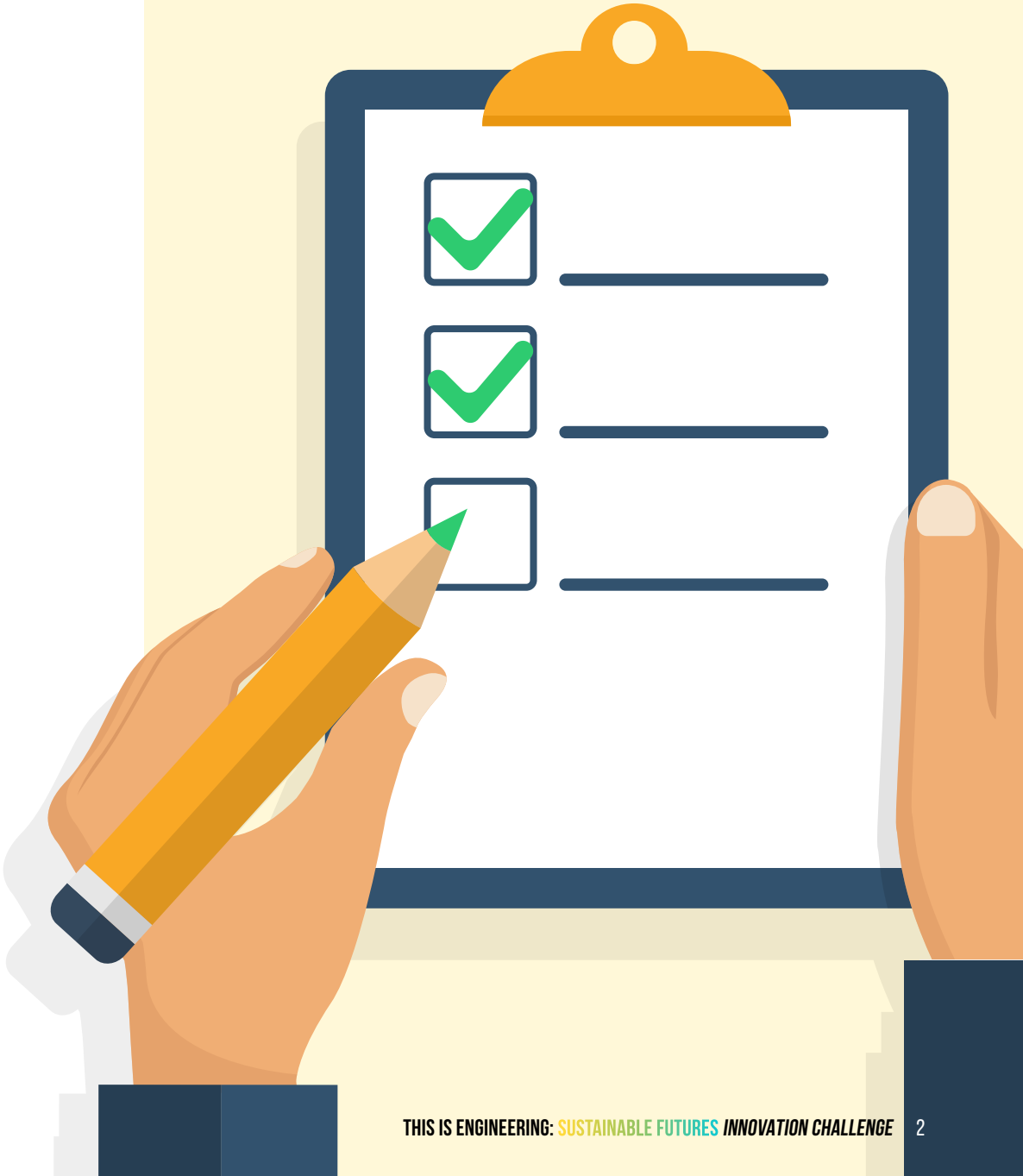
COULD HYDROPONICS BE THE FUTURE OF FOOD PRODUCTION?

Hydroponics uses science and technology to grow plants, feeding them on mineral nutrient salts dissolved in water.

This technique is ideal for living walls, balcony gardens and other spaces where traditional gardening is not practical due to lack of space, weight or accessibility. Hydroponics is significantly faster than traditional growing methods and eliminates the use for pesticides.

As a team of engineers, design and build a functional hydroponic system capable of growing plants such as watercress, lettuce and herbs in a compact environment, using artificial temperature, light, water, and humidity control.

Use the electronics and coding equipment in your resource pack, which includes a pump and sun tracking system, sensors and artificial light source.



RESEARCH THE CHALLENGE

ASK

IMAGINE

PLAN

CREATE

IMPROVE

PRESENT THE CHALLENGE

TIME TO START

Begin by watching the BBC news report – a roundup of the types of radical hydroponic growing ideas currently being tried out, from urban farms to a new way to tackle horticultural crops.

Scan the QR code or view on the BBC website – **Hydroponics on BBC Breakfast**

TIME TO RESEARCH

Working in groups of three or four, search for examples of existing hydroponic and vertical farming systems. Select a specific type of hydroponic system to focus on, based on your interests and research.

Start with LettUs Grow on the **This is Engineering website**.

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TIME TO PLAN

Systems thinking is "explaining how things work together and why each part is there".

Now that your teams have had time to research the type of hydroponic system you'd like to build, what questions should you consider before starting the design process?

Discuss the following questions as a group.

Systems thinking questions	
1	What materials and resources are needed to build the hydroponics system?
2	What challenges or limitations should you consider before building your system?
3	How will the different parts of the hydroponics system (reservoir, pump, artificial grow lights) interact with one another?
4	How can the hydroponics lifecycle be considered to ensure its eventual disposal or recycling?

TIME TO DESIGN

The aim of this stage is to work together to generate a variety of ideas for your hydroponics system.

Each group will design their own system, taking into account factors such as space, plant types, nutrient solutions, and light sources.

As a team, sketch and label several designs that communicate what the system could look like and how it would work. You can use notes to help capture this information.

Draw inspiration from your research and share ideas with each other. Be creative in your approach and use colour to communicate your ideas.

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TIME TO BUILD

This stage involves working together to construct a functional hydroponics system, allowing plants to grow under the conditions your team sets.

Using your preferred design ideas and the following materials, work together to build your system. Discuss any challenges that arise and share ideas for overcoming these problems and finding solutions.

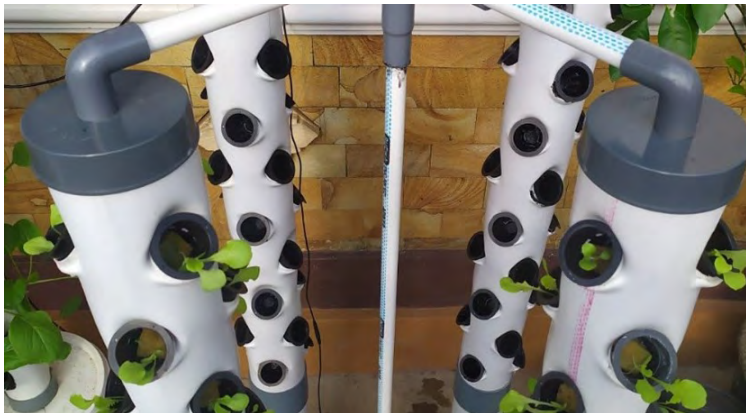
Materials and equipment

- **Containers or trays** – to hold the plants and hydroponic reservoirs
- **Tubing** – for delivering water solution to various parts of the system
- **Seeds/seedlings** – lettuce, herbs, tomatoes, etc

Once constructed, the systems will be set up in a designated area within the school, such as outdoors, in a greenhouse or a specially prepared classroom.

Testing: after construction, begin testing your system with water and plants.

Observation: monitor the system's performance over several days. Take notes on plant growth, water usage and any necessary adjustments.



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TIME TO REFLECT

Success can be assessed based on the skills teams develop and the practices they acquire throughout each stage of the innovation challenge.

These include the ability to ask questions, imagine and plan ideas, create and refine outcomes, while continuously reflecting on how things could be improved.

Engineers also demonstrate the following practices as part of their day-to-day activities.

- Problem finding and creative problem-solving
- Systems thinking and visualising
- Adapting and improving
- Project and time management

At the end of the challenge, gather the teams to evaluate their outcomes and the processes they followed. Encourage them to reflect on their experiences and assess their knowledge in relation to the skills they have developed and practiced throughout the challenge.

TIME TO PRESENT

The final activity is to present outcomes, explain choices throughout the challenge and highlight what went well and what could be improved.

This should be a group task where each team member contributes to the presentation in some way. The presentation can be divided into the following sections:

1. A summary of the final hydroponics system and Its features.
2. What went well during the design and building process.
3. Challenges faced and how they were overcome.
4. How the outcome could be improved or enhanced.

Royal Academy of Engineering

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In collaboration with our Fellows and partners, we're growing talent and developing skills for the future, driving innovation and building global partnerships, and influencing policy and engaging the public.

Together we're working to tackle the greatest challenges of our age.

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