Royal Academy of Engineering

Employer Engagement Challenge

Assembly line manufacture

Can you work as a team to create the perfect gift box?

Ariennir gan Lywodraeth Cymru
Funded by Welsh Government

THIS IS ENGINEERING

Acknowledgements

The Royal Academy of Engineering thank Blessed Carlo Acutis Catholic School (St Mary's campus) and Vishay for developing this challenge resource.

They have helped to raise awareness of engineering among young people, improve STEM teaching in schools and created new career opportunities for STEM learners.

Pupil comments

"This challenge has given me ideas about the types of job opportunities available to me and that there are so many different types of engineering."

Teacher comments

"Producing an experiential curriculum has been a key part of our new curriculum and this challenge really meets that requirement as it is so interactive and hands-on."

"Key curriculum skills were achieved through this challenge. It linked with IT, DT and Maths, building pupils understanding of industry."

Employer comment

"We get to see the talent out there and see what the pupils are interested in."

"There is a skills shortage in engineering and in the Welsh Valleys. We'd like to recruit from within Wales more than we currently do."

Vishay

Have you ever wondered how your computer or phone works, or how a bulb lights up? The answer is semiconductors.

Vishay is a company that specialises in manufacturing semiconductors. Semiconductors are materials that can conduct electricity, but not as well as metals such as copper. This makes them perfect for use in electronic devices because they can be used to control the flow of electricity.

Mass automated production of semiconductors at Vishay is a large-scale manufacturing process in which a significant quantity are produced using identical procedures, often on an assembly line. It is important that products are right 100% of the time – there is no room for error.

However, mass production can have a negative environmental impact because it requires the use of large volumes of natural resources and energy, contributing to climate change and pollution. In this challenge, pupils work as a team to create large-scale production of a single identical item.

In the first part, pupils will learn about the different stages of large-scale production, the equipment and technology used. They will also explore quality control procedures and the impact this has on the environment.

In the second part of the challenge, pupils build their knowledge and skills to design and manufacture a gift box for a selected group in their community. This could include centres that provide social support, such as care homes, or volunteering organisations like the Cubs, Brownies and Scouts.

This challenge is designed to support practitioners to follow Curriculum for Wales' careers and work-related experience guidance. It is supported by a set of videos that give an inside look at how engineers at Vishay work, and introduces first-hand how the challenge is delivered in school.

The challenge is recommended for primary school pupils and can be adjusted to match different age groups and abilities.

Here are some of the learning opportunities that the challenge provides:

- **Teamwork and collaboration**
- **Creativity and design**
- **Community engagement and empathy**
- **Project management**
- **Environmental awareness**

Challenge overview

Setting the class challenge

Become a super-efficient gift box designer and manufacturer, just like the engineers at the Vishay semiconductor factory.

The aim of this challenge is to design and create multiple identical gift boxes to distribute to your local community, such as residents in care homes or other social support groups. Each gift box will contain a surprise treat.

You will be working in teams of gift box makers, setting up your own assembly line to speed up the manufacturing process. Each team member will have a specific task to focus on. Remember to check the quality of each gift box you make to ensure they are all identical.

Once assembled, it's time to visit the local care home or social support group and hand out your gift boxes, making a difference in someone's life and brightening up their day.

By participating in this challenge, young learners will develop the skills and practices that engineers use every day in their professional lives.

Asking questions, imagining and planning ideas, creating and refining outcomes, while continuously reflecting on how things could be improved, are all 'Engineering Habits of Mind' as demonstrated in 'the Progressing to be an Engineer' cycle.

The Progressing to be an Engineer cycle

Learning opportunities	Core skills
■ Teamwork and collaboration ■ Creativity and design ■ Community engagement and empathy ■ Project management ■ Environmental awareness	**Literacy:** Reading and technical vocabulary. Selective research. Writing and reporting. Presenting and communication. **Numeracy:** Data collection and analysis. Pattern spotting. Measurements and calculation. **Scientific:** Problem-solving and experimenting. Visual and special awareness. **Technical:** Systems thinking and problem-solving. Communication and teamwork.

Engineering design process		Activity	Success will look like
0–1 hour	Research the challenge	**Watch the challenge videos** – engineers films **Time to play** – marble drop **Interactive quiz** – based on challenge topics	Understand the aims and requirements of the challenge, as well as how engineering concepts relate to it. Gather relevant information and have a clear and comprehensive understanding of the topics.
1–2 hours	Ask	**Time to problem solve** – plasticine cubes **Time to question** – systems thinking	Identify problems and ask questions to understand how to resolve them. Explain how systems work while identifying ways they can be improved.
2–4 hours	Imagine Plan	**Time to imagine** – design and visualise gift box ideas **Time to present** – showcase design ideas to the class **Time to plan** – manufacturing stages of the assembly line	Draw and label multiple design ideas, effectively communicating fitness for purpose and why certain ideas are better than others. Use simple annotated sketches to turn ideas into words and drawings. Plan a design that aims to solve a problem or task for a specific user, by transforming one idea in a better one.
4–6 hours	Create	**Time to create** – build identical gift boxes as a team	Use knowledge of how systems and components work and interact to create a product that achieves a specific purpose. Evaluate the product's fitness for purpose and look to find ways to improve this based on observation and improvement.
6–7 hours	Improve	**Time to reflect** – on experiences in relation to each stage of the challenge	Test for quality control using a logical approach gathering evidence to make an informed decision. Evaluate how the product is working, identifying areas for improvement and describe possible changes that can enhance the design.
7–8 hours	Present the challenge	**Time to deliver** – visit to deliver the gift boxes	Communicate ideas effectively and with confidence, making complex concepts understandable to the audience. Engaging interactions and making a lasting impression.

Research the challenge

Ask

Imagine

Plan

Create

Improve

Present the challenge

Time to start

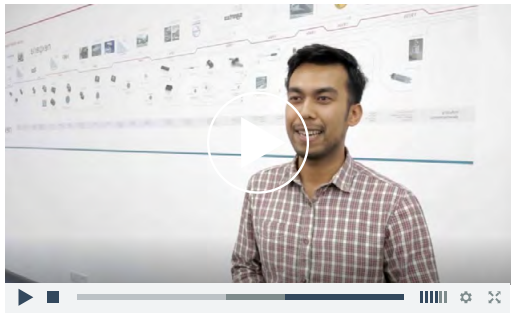
Begin by showing the class the set of three engineer videos that showcase the diverse range of engineering roles within the company. Each video is approximately three minutes long.

Go to **raeng.org.uk/wvep** or scan the QR code to watch the videos.

Max: Apprentice technician

Jana: Failure analysis technician

Pranjal: engineer



Time to play

The aim of the first activity is to work in teams and design a contraption that ensures a marble consistently lands in the yellow or red inner sections of the target board.

Divide the class into small groups of three to four pupils.

Drop a marble from the same height every time. The goal is to drop the marble and hit the inner yellow target. Use a green marker to mark where the marble lands every time.

Repeat this 20 times.

The marble will often land in the outer area of the target board or even off the chart. Count the landings and use a table to show the results.

Work as a team to problem solve and create something that controls the landing to ensure the marble lands in the inner sections each time.

Drop the marble again 20 times.

This time, use a red marker to show where the marble lands and add results to the table. What do you observe?

Materials

- Paper, marbles, sellotape and target sheet

Research the challenge

Ask

Imagine

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Create

Improve

Present the challenge

Time to play – *continued*

Find or create your own interactive, game-based quizzes with multiple choice questions using the topic titles below.

Put your class knowledge to the test in a fun and engaging way!

Topic titles	
1	Semiconductors
2	Scales of production
3	Robotics
4	Assembly line manufacture
5	Automation verses human manufacture

Kahoot is a free online learning platform that promotes active participation and encourages teamwork.

Young engineers in the laboratory

Research the challenge

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Time to problem solve

The aim of this activity is to engage in a hands-on learning experience to create identical cubes using plasticine.

Divide the class into small groups of three or four pupils.

Work collaboratively as a team to build as many plasticine cubes as possible in a set period of time and to a specific size.

This will require precision, teamwork, communication and creativity in achieving identical results.

Use a ruler to check the dimensions of each side, making adjustments if necessary.

Materials

- Plasticine
- Rulers
- Cutting tools (plastic knives, safety scissors)

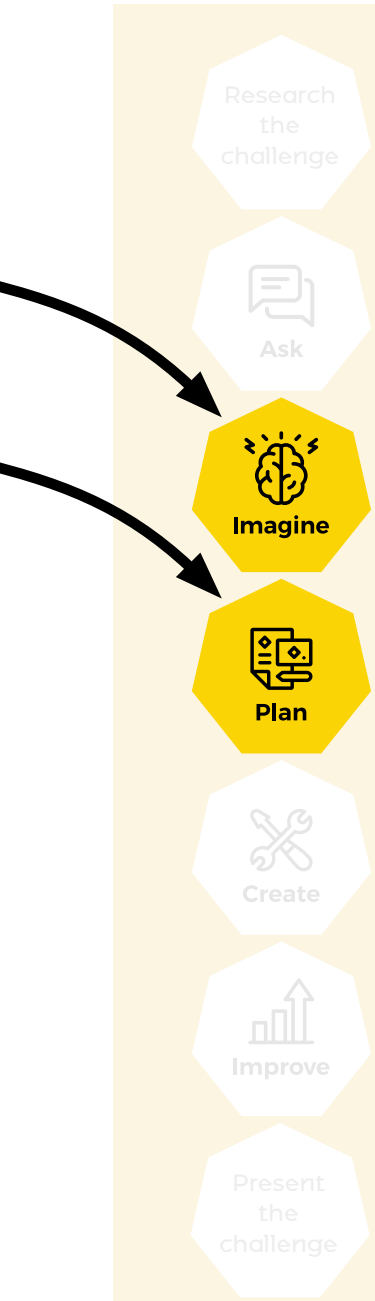
Time to question

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

Discuss the following questions as a group and facilitate the conversations in class.

Systems thinking questions	
1	Are each team member's cubes identical?
2	What approach did your team take to complete the activity?
3	Why do you think your team constructed more or fewer identical cubes than the other teams?
4	What challenges did you face during the activity, and how did your team overcome them?
5	How could you adapt your system to achieve better results if you were to do it again?

Teacher: reinforce that the task is not only about constructing the most identical cubes in the shortest time. It is about learning how to collaboratively work as a team to improve outcomes and learn from each other's mistakes.



Time to imagine

The aim of this activity is to work together as a team to plan, visualise and present your ideas for gift boxes.

Divide the class into small groups of three or four pupils.

Explain that the gift box design is not just about the physical appearance but should also consider the needs of the users, materials, manufacturing processes, and sustainability.

Write a list of the users' needs, such as ensuring easy opening and creating a visual appeal.

As a team, ask pupils to draw and label several ideas of what the gift box will look like. Be as creative as possible and use colour to present the decorative aspect of each design.

Encourage them to show and explain how the gift box will be constructed and what its physical structure will look like. Discuss the materials that will be used and the reasons for selecting them.

Ask teams to think about about ways to make the gift boxes more user friendly, sustainable and visually appealing.

Time to present

Allow each group to present their gift box designs and manufacturing plans to the class.

This should be a group task where every member of the team contributes to the presentation in some way.

Time to plan

The aim of this activity is to plan each manufacturing stage of the assembly line where each team member has a specific goal they are working towards, while also being part of a broader team.

An assembly line is a manufacturing system where each person has a specific task, leading to increased efficiency.

Assign roles to each group member that can be interchanged and 'doubled up' if necessary.

- **Designer:** responsible for creating the gift box design and choosing decorations
- **Material coordinator:** in charge of gathering materials and ensuring they are cut to the correct size
- **Assembler:** responsible for assembling the gift box and adding decorations according to the design
- **Quality controller:** inspects the completed gift box and ensures it meets quality standards

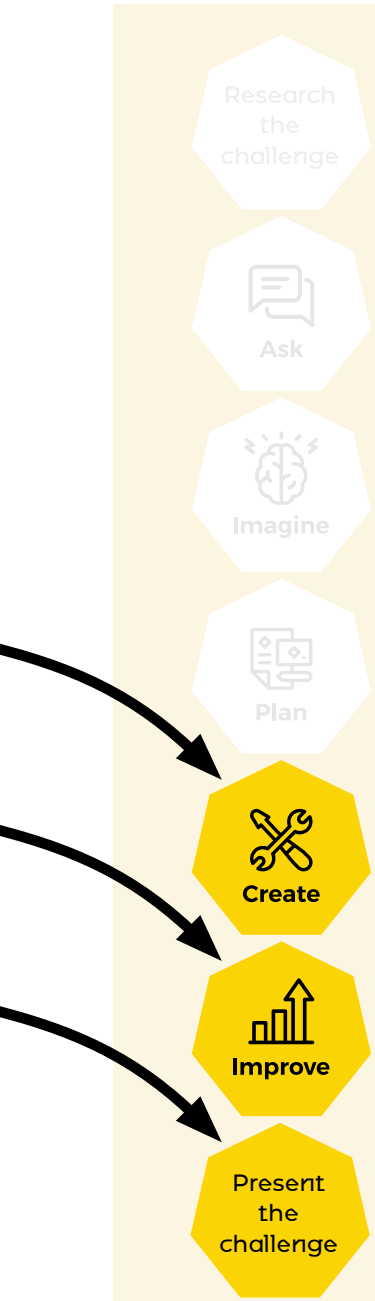
Teacher: allow time to discuss individual roles and how they can work together efficiently.

Provide each group with a sample gift box and materials for prototyping. Ask the groups to create a prototype gift box following the assembly line process. Emphasise the importance of effective communication and collaboration.

After prototyping, ask each group to present their process and any challenges they encountered. Encourage peer feedback and suggestions for improvement.

Materials

- Paper, pencils, and colouring materials
- Scissors, glue, and other craft supplies
- Sample gift boxes and materials for prototyping



Time to create

The aim of this activity is to work together and build as many identical gift boxes as possible within a set period of time using an assembly line.

Teacher setup

Prepare the materials and workspace: arrange the workstations in a way that promotes assembly line processes.

Each team member should have specific tasks in the gift box creation process. For example: cutting cardboard, wrapping, folding, taping/gluing plus adding decorations.

Standardise the gift box design: ensure that all teams are provided with the same gift box template and materials to ensure identical gift boxes.

Materials

- Cardboard or pre-cut gift box templates
- Wrapping paper or decorative materials
- Scissors
- Tape or glue
- Ribbons and bows (optional)

Pay attention to...

1. The timing of the activity: how long each stage takes and how to make adjustments to improve the efficiency of the production line.
2. The materials for the gift boxes: the size, cost and environmental issues connected to using these materials.
3. Think about the gift: toffee or chocolate containing nuts might not be suitable to give someone in a care home.

Time to reflect

Success can be based on the skills pupils develop and the practices they acquire throughout each stage of the 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
- Teamwork and collaboration
- Project and time management

At the end of the challenge, gather teams for a post-challenge debrief. Encourage them to reflect on their experiences and assess their personal growth in relation to the skills they have developed and practised throughout the challenge.

Time to deliver

The aim of this final activity is to coordinate with a local care home or other service, and schedule a visit to deliver the gift boxes.

During the visit, arrange for the class to deliver the gift boxes to individual residents or distribute them during a communal gathering.

Encourage pupils to interact with the residents, engage in conversations and share a few moments of companionship.

After the visit, ask pupils to share their thoughts on how the activity impacted them and what they learnt.

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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