



Royal Academy of Engineering

Employer Engagement Challenge

Upcycled structures

What can you create from unwanted items?



 Ariennir gan Lywodraeth Cymru
Funded by Welsh Government

THIS IS ENGINEERING



Pupil comments

"It changed the way I think about it because I learnt that science and also designing are part of engineering."

"I learnt how much you can make out of some stuff that you would usually put in the bin."



Teacher comments

"This project has extended the children's understanding of engineering and helped to develop their thinking and planning skills across different year groups."

"The children were all really engaged with this challenge as the final product was something relevant to our school."

Employer comment

"The teachers can add to the challenge themselves and extend the curriculum. Graphs, categorisation, testing materials, design, building and thinking about recycling or the environment."



Acknowledgements

The Royal Academy of Engineering thank Pantysgallog Primary School and Tata Steel 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.

Tata Steel

Tata is a large global company that manufactures steel for various industries, including construction, automotive and household products.

It mass produces steel on an industrial scale before shaping it into different forms to be used in cars, buildings, wind turbines, baked bean cans and much more. In Wales, Tata Steel operates in Port Talbot, the largest steelworks in the UK, producing approximately five million tonnes of steel each year.

Tata Steel is inviting teams of environmentally conscious engineers in the making to take part in the eco-sculpture challenge. The aim is to create a 3D sculpture themed around steel production.

Steel is an essential material in our daily lives, present in objects we interact with regularly. However, its production can have significant environmental impacts. Tata Steel want schools to help promote sustainability and environmental responsibility in steel production. As future leaders, your pupils will be challenged is to find innovative ways to upcycle discarded goods into a 3D sculpture that represents eco-friendly steel production.

The challenge is to design and construct a sculpture that showcases the journey of steel production while highlighting the importance of recycling, recyclable materials and environmental responsibility. Activities include learning about recycling techniques, sustainable materials, construction principles, and the impact discarded waste has on the environment and climate change. Throughout the challenge, pupils will build their knowledge of mathematics and science to sort, test and select materials wisely.

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 Tata Steel 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 societal responsibility**
- **Project management**
- **Environmental awareness**

Challenge overview

Setting the class challenge

Get ready for a 3D experience of art, engineering and environmental responsibility.

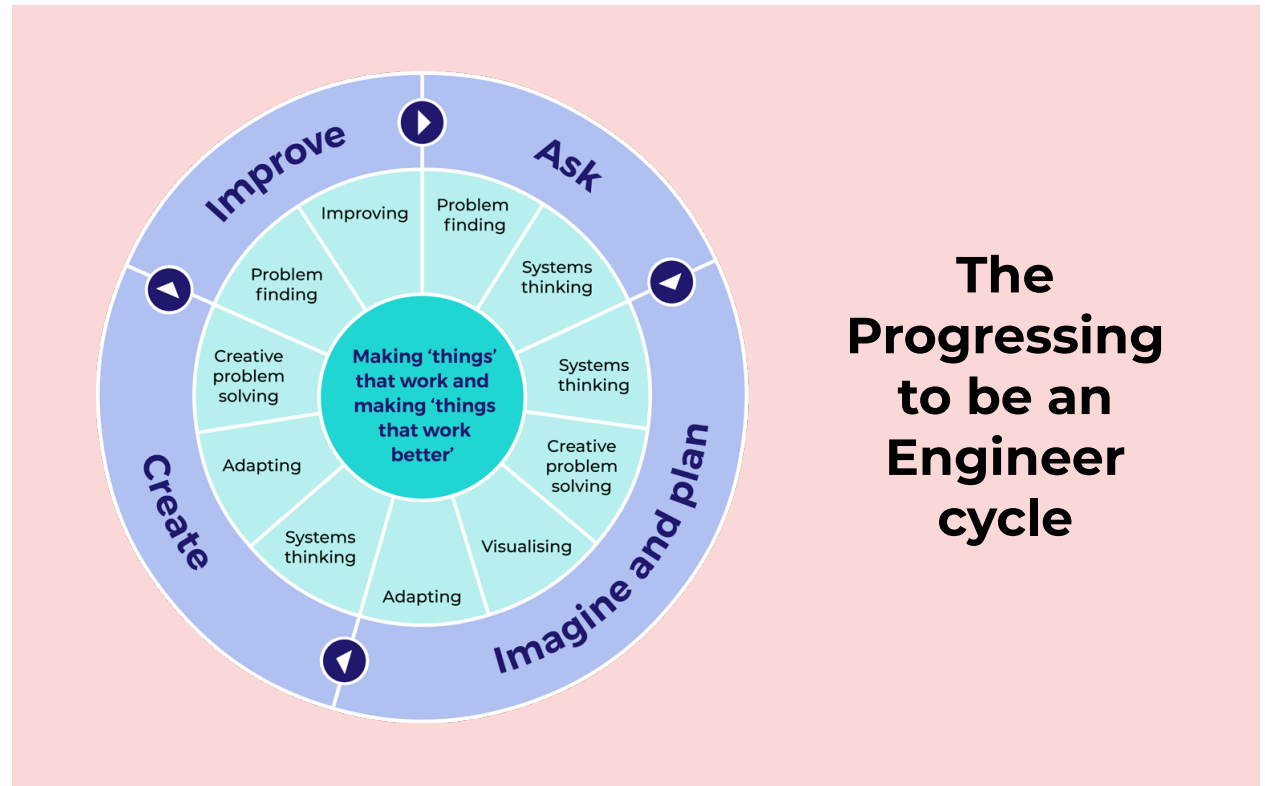
Tata Steel invites you to take part in the eco-sculpture challenge! Let loose your creativity and build a 3D sculpture that showcases the story of steel production while emphasising the importance of recycling and environmental responsibility.

Steel is an important material that surrounds us in our daily lives. From the knives and forks we use in the kitchen, to the vehicles that transport us, steel is everywhere! But did you know that steel production can impact our environment? That's why we need young eco-engineers like you to find innovative solutions.

Your challenge is to design and construct a 3D sculpture that tells the story of eco-friendly steel production. Imagine creating a mini-world where steel is made responsibly, using recycled materials and sustainable practices. Show us how you can make a difference by reducing waste and protecting our planet.

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
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- Teamwork and collaboration
- Creativity and design
- Community engagement and societal responsibility
- 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 	Watch the challenge videos – engineers films Time to play – <i>National Geographic</i> kids recycle roundup Time to research – sculptures made from recycled materials	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 challenge.
1–2 hours 	Time to problem solve – surveys, campaign and collection 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  	Time to imagine – design and visualise sculpture ideas Time to present – showcase design ideas to the class Time to plan – plan the steps to construction	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 into a better one.
4–6 hours 	Time to create – build the eco-sculpture	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 	Time to reflect – on experiences in relation to each stage of the challenge	Test the outcome for quality 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 	Time to raise awareness – select the location and organise an environmental awareness fair	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.



Leigh:
Development engineer



Jess:
Regulatory affairs specialist



Leah:
Senior development engineer



Time to play

National Geographic kids recycle roundup: the aim of the first activity is to help clean up the park in an online interactive action adventure.

Help Gus clean up the park by sorting all the waste material. Your job is to sort the stuff people throw away and put it in the proper bin. Is it recycling, compost, or rubbish?

Learn facts about climate change and tips on how you can help save the planet.



<https://kids.nationalgeographic.com/games/action-adventure/article/recycle-roundup-new>

Time to research

Start by grouping pupils in teams of two and three and ask them to gather ideas for a recycled sculpture project by looking online. They can use some of their favourite books and films for inspiration.

Encourage them to think about how recycled items can be used to build your sculpture.

Research the challenge



Ask



Imagine



Plan



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

Topic titles

- 1 Sculptures made from recycled items
- 2 Where does metal come from?
- 3 Why is recycling important for the planet?
- 4 Metal recycling processes
- 5 Reuse verses recycling and upcycling



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





Time to problem solve

The aim of this activity is to determine how and where to safely collect a large amount of unwanted items people have thrown away.

Start by asking pupils to brainstorm various methods on how to collect large volumes of recyclable rubbish. Here are some suggestions on how to do this.

Surveys

- Create a survey and interview teachers and family members to understand their motivations and methods for recycling items in and around the school community.
- Record the responses and compile the data. Create graphs and charts to show the results.
- Analyse the data and present the findings to the class.

Campaign

- Create a recycling awareness campaign to promote responsible practices and habits within the school and local community.
- Prepare a whole school assembly to raise awareness of recycling, supporting the challenge by donating unwanted items.
- Write a persuasive letter to friends and family asking them to donate their household recycling to the school.

Recycling collection

- Organise a class litter pick to learn about the environmental and wildlife impacts of not properly disposing of recyclable items. Remember to wear protective clothing and use litter pickers during the activity.
- After the litter pick, return to the classroom to discuss the findings.
- Set up recycling units or multi-bin drop-off points around the school where people can bring their recyclable waste to a central collection point.

Time to question

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

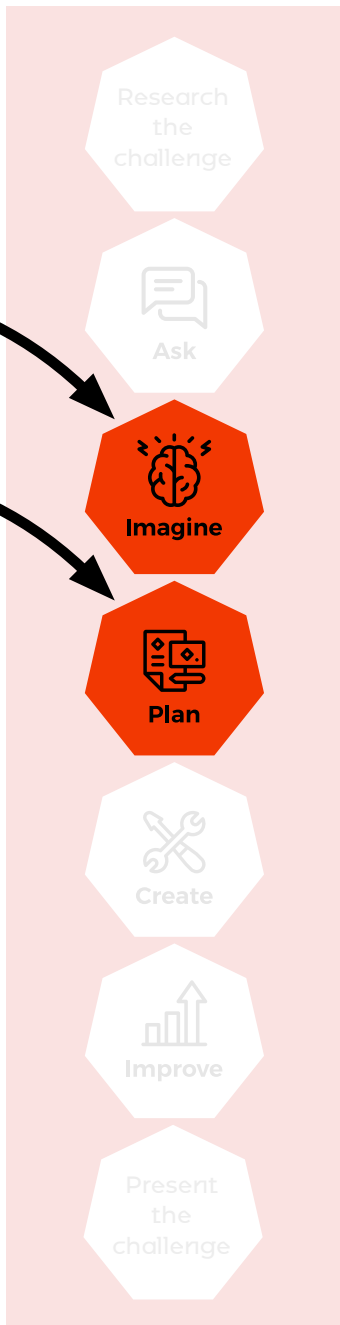
Now the materials to build the sculpture have been collected, what questions should pupils be thinking about before they start constructing?

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

Systems thinking questions

- 1 Will the choice of recycled materials influence the design and aesthetics?
- 2 What are the potential challenges or limitations of working with recycled materials?
- 3 What material properties are best suited for the construction of the sculpture?
- 4 How might the sculpture inspire others to consider recycling and sustainability?
- 5 How can the sculpture's lifecycle be considered to ensure its eventual disposal or recycling?





Time to imagine

The aim of this activity is to work together as a team to plan, visualise and present ideas for the eco-sculpture challenge.

Divide the class into small groups.

Explain that the design process for the sculpture goes beyond just its physical appearance; it also involves considering the views of those surveyed, the available materials, and sustainability, which should be an important factor when generating ideas.

As a team, ask pupils to sketch and label several designs depicting what the sculpture could look like, and then share ideas with each other. Encourage them to be creative and use colour to illustrate each design. They can take inspiration from their favourite books and films that were researched.

Ask them to present how the sculpture will be constructed and explain its physical structure. Discuss the reasons for selecting the materials that were collected.

Throughout the design process, teams should demonstrate how they used their imagination to create a memorable and lasting impression regarding the issues of waste materials.

Time to present

Allow each group to present to the class their sculpture design journey and assembly plans for the chosen idea.

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 the construction of the selected sculpture idea using a variety of recycled materials.

Start with each team reviewing and sorting the collected materials that align with their sculpture ideas. Put these materials into appropriate categories for use in different parts of the sculpture.

Ask them to make a note of any missing or unwanted items. They can share these with other groups and source the missing materials required.

Also, guide them to source any equipment needed to construct or attach materials together. Then, teams are ready to start building their sculpture. Remind teams to be creative and experiment with different shapes and textures.

Teacher: demonstrate how to prepare the materials by cutting, bending or arranging them to suit their design concepts.

Remind teams about the safe use of tools and equipment and stress the importance of working in a clean and organised manner.





Time to create

The aim of this activity is to work together to construct a 3D sculpture that emphasises the importance of recycling and environmental responsibility.

Teams start constructing their sculptures using the materials and designs they planned for. Provide guidance and support as needed, encouraging experimentation and creativity.

At various points, ask teams to share their progress and any difficulties they faced during the construction process. Discuss potential solutions and collaborative ideas for overcoming these problems.

Materials

- Assorted recycled materials (cardboard, plastic bottles, newspapers, egg cartons, aluminium cans, etc.)
- Scissors
- Craft glue or glue gun (with adult supervision)
- Markers or paints (optional)
- Protective Collectively (e.g., gloves and aprons)

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 raise awareness

The aim of this final activity is to maximise the impact of creating environmental awareness and promoting the importance of recycling.

Collectively decide on the final locations for each sculpture based on the research. With permission from the school or relevant stakeholders, set up the sculptures in the chosen locations.

Organise an environmental awareness fair at the school or community venue where the sculptures are displayed. Set up booths with information brochures, posters, and interactive activities related to recycling and environmental awareness.

Invite parents, pupils and members of the community to the fair. Allow each group to present their sculptures and the messages behind them to visitors.





Royal Academy of Engineering

The Royal Academy of Engineering is harnessing the power of engineering to build a sustainable society and an inclusive economy that works for everyone.

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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Talent & diversity

We're growing talent by training, supporting, mentoring and funding the most talented and creative researchers, innovators and leaders from across the engineering profession.

We're developing skills for the future by identifying the challenges of an ever-changing world and developing the skills and approaches we need to build a resilient and diverse engineering profession.

Innovation

We're driving innovation by investing in some of the country's most creative and exciting engineering ideas and businesses.

We're building global partnerships that bring the world's best engineers from industry, entrepreneurship and academia together to collaborate on creative innovations that address the greatest global challenges of our age.

Policy & engagement

We're influencing policy through the National Engineering Policy Centre – providing independent expert support to policymakers on issues of importance.

We're engaging the public by opening their eyes to the wonders of engineering and inspiring young people to become the next generation of engineers.



Royal Academy of Engineering
Prince Philip House
3 Carlton House Terrace
London SW1Y 5DG

Tel: +44 (0)20 7766 0600
www.raeng.org.uk
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