

#STEPSYOUNGENGINEERSAWARD  
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STEPS  
Young Engineers  
Award

ENGINEERS  
IRELAND  
STEPS

# YOUNG ENGINEERS AWARD LESSON PLANS



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# STEP 1: HOW WILL YOU CHANGE YOUR WORLD WITH ENGINEERING

TIME  
90 MINS

## Objective

Fill out STEP 1 in the STEPS Project Book – Brainstorming ideas and picking your project!

## Strand

Environmental Awareness and Care

## Strand Unit

Environmental awareness, science and the environment

## Skills Required

Working scientifically: questioning, observing.  
Designing and making: exploring, planning

## Learning Objectives

### Students will:

- Learn about engineering – they will be introduced to engineering
- Learn that engineering is everywhere – they will be able to identify examples of engineering in their everyday life
- Learn to think outside the box – they will be encouraged to be imaginative and explore ideas
- Learn how to critically analyse their ideas – by considering the positives and negatives
- Learn listening skills – they will learn to listen to others ideas and respond like an engineer

## Learning Activities

Students use the STEPS Project Book to help them think of ideas for the project. They then choose the engineering project they will do for the STEPS Young Engineers Award and think about their design.

### Instructions

**A:** Divide the class into engineering teams of up to 6. Hand out a Project Book to each team. Ask them to come up with a Team Name. Fill in section A.

**B:** This question is to get them thinking outside the box to come up with ideas of how they would like to improve their community (or the life of someone in their community like a friend, neighbour, family member etc.). This might be a good time to do some research or lessons on social, geographical or environmental problems in your locality, or to discuss diversity and inclusion and how they could use engineering to improve this in your school, at home or in the community.

**C:** From the three ideas and solutions explored in the first table, they choose the one they will work on as their STEPS YEA Project. Give the project a title and write a brief description of the plan. Write about the possible benefits.

Teams think about how they will build their design, as a prototype. You might ask them to write a procedure to work out the steps they will need to take to build their design prototype and pick out what will be the most difficult part. Discuss this.

### STEP 1: HOW WILL YOU CHANGE YOUR WORLD WITH ENGINEERING (CONTINUED)

| Learning Objectives                                                                                                                                                                                                          | Learning Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
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| Some simple ideas to begin your engineering journey                                                                                                                                                                          | <p>This is a list of some suggestions for introducing engineering and the STEPS Young Engineers Award to your students. They are completely optional.</p> <p><b>Isometric drawing practice</b><br/>Why not try the optional isometric drawing activity in the STEPS Project Book with your class to prepare them for the next step: Draw. Engineers use isometric drawings to visualise their design from every angle. This was especially useful in the days before 3D software was available! It's fun too!</p> <p><b>Engineering Vocabulary</b><br/>Use some engineering vocabulary to introduce student to engineering. Perhaps do some dictionary work. .</p> <p><b>Engineering is Everywhere</b><br/>Pick a photo or even look around your class to see if your students can spot all the things that have been engineered. This is a question with no wrong answers really (other than natural items such as leaves or feathers etc) as most manufactured items have been engineered to some degree. It is an exercise to point out that engineering is all around them and they interact with it everyday – often without realizing it!</p> <p><b>Observation Walk</b><br/>Discuss the examples of engineering they spot with the questions below. There are no right and wrong answers. It is an exercise to get them thinking about engineering, and how engineering is a method of applying science to our world, to benefit and improve our lives.</p> <ul style="list-style-type: none"> <li>- Who benefits from this example of engineering?</li> <li>- What type of engineer might have designed it?</li> <li>- What would life be like without it?</li> <li>- Why does it look like that? (e.g.electricity cables are high and covered in thick material to protect us from dangerous voltage).</li> </ul> <p><b>Research</b><br/>You may wish to give your students a related research project – perhaps on the locality before you start to highlight engineering in the area or to find issues that an engineer could help with.</p> <p><b>STEPS Webinar 1</b><br/>You may like to watch Webinar 1 with your class. This is a 30minute video on the importance of ideas and creativity in engineering and helps students to think like an engineer.<br/><b>Let them do the work – not you!</b></p> <p><b>Preparatory work on Listening like an Engineer:</b><br/>This is a great opportunity for students to experience work in teams and to learn to listen to each other. They should not be allowed to say “no” or “I don’t like that” instead they should ask questions (and look for justification with reasons). “Have you thought about...?”; “How would you build/achieve that?” “Why do you think that is a good idea?” They must then decide as a team the best idea or solution, based on exploring positives and negatives. Part of being an engineer is learning to make thought-through decisions as a team, to balance risks with benefits.</p> |
| Resources                                                                                                                                                                                                                    | <p>Pens &amp; paper<br/>STEPS Project Book per team</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| <p><b>Integration</b><br/>English – procedural writing for how they plan to design and build their idea<br/>English oral language – verbalising ideas, solutions and methods as a team<br/>SPHE – Myself and wider world</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |

# STEP 2: DRAW YOUR DESIGN

TIME  
90 MINS

### Objective

Fill out STEP 2 in the STEPS Project Book – Draw your design!

### Strand

Materials

### Strand Unit

Properties and characteristics of materials.

### Skills Required

Working scientifically: questioning, predicting,  
Designing and making: planning, evaluating

### Learning Objectives

Students will:

- Develop planning skills
- Learn about materials and identify characteristics
- Learn to think logically and practically – think and predict the steps involved in producing a prototype before attempting to construct it physically
- Make informed thought-through decisions as a team
- Learn to consider the wider picture: materials, safety, environment
- Develop written communication skills – designs drawings must be clear and informative for all project members
- Practice teamwork – teams must work together on the solution

### Learning Activities

The design drawing is the most important step in the project.

It is surprisingly difficult to design on paper – it is easier to just give out materials and to let them off! But the discipline of discussing design options and then using a drawing to express their design decisions on paper is a fantastic skill not just for an engineer, but for life as communication is a very important skill that needs to be learned and developed.

#### Before you fill in the STEPS Project Book

Hand out rough paper. Allow the teams lots of time to discuss their ideas on the design. Let them do lots of rough drawings. Engineers do many drawings before they reach the final design. It is a great way for them to represent their concepts visually using images rather than words.

#### Discussion in class

#### Materials

This is a great opportunity to discuss the properties of materials – the design should consider what materials they will use to build their prototype (or alternatively what materials would be used if it were to be built in real life).

#### Maths and Science

Designing is a time when engineers will use maths and science. Can you students think of ways to bring some of their knowledge to the project? Think of shapes (2D and 3D, circle for wheel, triangle for roof, cube for block etc.), forces, size, dimensions etc. There will be bonus points for this!

### STEP 2: DRAW YOUR DESIGN (CONTINUED)

| Learning Objectives                                                                                                                                                                        | Learning Activities                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                     |
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|                                                                                                                                                                                            | <p><b>Evaluating</b><br/>Can they think of the advantages and disadvantages of one of their design ideas?</p> <p><b>Here are some prompts to aid design planning:</b></p> <ul style="list-style-type: none"> <li>- What will it look like? (draw)</li> <li>- What will it do?</li> <li>- How will it do it?</li> <li>- How will you build it?</li> <li>- What will it be made from?</li> <li>- Would it be safe for use in the real world?</li> <li>- Will it affect the environment? How?</li> <li>- How will it affect people's lives? Positively? Negatively? Why?</li> </ul>                                                                                                                                                                                                        |
| <p>Fill in your final design in the STEPS Project Book</p>                                                                                                                                 | <p><b>Complete STEP 2 in the STEPS Project Book</b></p> <p><b>Instructions</b><br/>Fill in the 'title block' in the bottom right corner. Draw the final design in the space provided for STEP 2.</p> <p>Annotate the drawing clearly. They can colour it in to make it look nice. Remember the judges will be looking carefully at this drawing!</p> <p>Here are some examples of annotations:</p> <ul style="list-style-type: none"> <li>- Materials (plastic straw, cardboard for the walls, tin foil to cover it etc.)</li> <li>- Instructions (glue the roof to the walls)</li> <li>- Dimensions</li> </ul> <p><b>Remember</b> – once they start building it they will most likely realise that they will need to modify their design – and that's totally normal and expected.</p> |
| <p><b>Resources</b></p>                                                                                                                                                                    | <p>Pencils, colouring-in materials &amp; paper<br/>STEPS Project Book per team</p>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                      |
| <p><b>Integration</b><br/>English – procedural writing for how they plan to design and build their idea<br/>English oral language – verbalising ideas, solutions and methods as a team</p> |                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                         |

# STEP 3: MAKE YOUR PROTOTYPE

TIME  
90 MINS

### Objective

STEPS 3 - Make your prototype!

### Strand

Materials

### Strand Unit

Properties and characteristics of materials.

### Skills Required

Working scientifically: questioning, predicting,  
Designing and making: planning, evaluating

### Learning Objectives

Students will:

- Learn that modifications of the plan may have to be made
- Understand that material choices are important in engineering
- Understand that written instructions (drawings) need to be clear
- Learn how to investigate what went wrong
- Learn how to think of practical solutions quickly
- Learn how to analyse what designs or methods were successful

### Learning Activities

Build the prototype! Start by using the Final Design from STEP 2.

#### Instructions:

##### Make a list and gather materials

Fill out the list of materials needed (based on the design in STEPS 2). These may need to be collected in advance. Also – be prepared to have more materials than required as there may be a few (many!) design changes along the way.

##### Start building!

Let the teams build. Hand out their Project Books, or a copy of their design drawing (if they want to keep the book clean) and let them build. They should start by using the drawing as their instructions. However, they will most likely have to make alterations as they build.

#### Tips for Teachers

Avoid instructing or guiding. The teacher's role is to facilitate and support the students through the experience. Expect the students to feel frustrated if their designs don't work. This is great engineering experience! They now need to learn how to analyse what went wrong and think outside the box about how they will solve the problem. Encourage them to practice the skills they learnt in STEPS 1 and 2: listening (listening to ideas, thinking, then asking questions) and evaluating (evaluating the positives and negatives of the solutions). There's also a bit of trial and error. They will think of ways to improve their design as they go. And that's great! There will be space on the next worksheet to tell the judges about their experience.

### STEP 3: MAKE YOUR PROTOTYPE (CONTINUED)

| Learning Objectives                                                                                                                                                               | Learning Activities                                                                                                                                                                                            |
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| Want more fun engineering?                                                                                                                                                        | <b>Swap Drawings!</b><br>Can another team build your design? An engineers drawing should be clear enough that every engineer or skilled worker can read it, understand it and produce the work.                |
| Resources                                                                                                                                                                         | <b>'Junk Art' materials.</b><br>Collect material from home or from nature for the prototype. Have a table of spare materials in the class for teams that need to redesign. They may need a different material. |
| <b>Integration</b><br>English – procedural writing for how they plan to design and build their idea<br>English oral language – verbalising ideas, solutions and methods as a team |                                                                                                                                                                                                                |

# STEP 4 – TEST AND EVALUATE THE PROJECT

TIME  
90 MINS

## Objective

STEPS 4 – Fill in STEP 4 in the Project Book - tell us about your experience as an engineer

## Strand

Environmental awareness and care, Materials

## Strand Unit

Science and the environment, Properties and characteristics of materials

## Skills Required

Working scientifically: questioning, predicting,  
Designing and making: planning, evaluating

## Learning Objectives

### Students will:

- Learn to reflect and evaluate as a team
- Learn to apply their classroom engineering experience to better understand a real-life engineering project
- Learn about material choices and to evaluate why properties of materials are important to know and understand
- Learn to communicate effectively in writing
- Practice report writing skills
- Reflect on what they have learnt while completing their project.

## Learning Activities

In this step the students will record their experience on the engineering project.

### Instructions

Hand out the STEPS Project Books.

There are five questions to fill in that the judges will be interested in reading.

There is also an (optional) section to draw the final prototype or to stick in some photos.

**A** Tell us about your prototype (three questions)

**B** Reflection (two questions)

**The judges will be particularly interested in what went wrong, how they analysed it and then the solutions they came up with.**

**Recommended** – look at the marking scheme in the back of the STEPS Project Book. The (more detailed) judges Marking Scheme is available to view on the website.

After the teams have completed the evaluation – you may want to prepare a presentation for a STEPS Volunteer Engineer, a Guest Engineer or for their parents or peers in school. There is guidance in the STEPS Project Book on this.

## Resources

STEPS Project Book, pens, pencils, colouring materials.  
Optional: photos and glue

## Integration

English – procedural writing for how they plan to design and build their idea  
English oral language – verbalising ideas, solutions and methods as a team