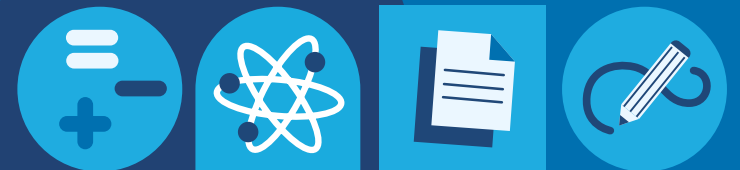


Teaching Engineering

Engineering Habits of Mind



Ways of teaching Engineering

Engineering is a broad subject, with many different definitions. The Royal Academy of Engineering have suggested that education should focus on developing “**Engineering Habits of Mind**” as the desired outcomes of engineering education.

For younger learners, some researchers have presented a wider range of behaviours, described as “**pre-engineering thinking**”. This document describes how the Let’s Do Engineering resources and activities map onto the concepts of engineering habits of mind and pre-engineering thinking.

Engineering Habits of Mind

What are the Engineering Habits of Mind?



Creative problem-solving



Generating ideas and solutions by applying techniques from different traditions, critiquing, giving and receiving feedback, seeing engineering as a 'team sport'.

SUB HABIT 01

Generating ideas

Comes up with suggestions in a range of situations.

SUB HABIT 02

Working in team

Has good people skills to enable idea and activity sharing; good at giving and receiving critique/feedback.

Systems-thinking



Seeing connections between things, seeking out patterns, seeing whole systems and their parts and how they connect, recognising interdependencies, synthesising.

SUB HABIT 01

Connecting

Looks for links, connections, relationships; working across boundaries.

SUB HABIT 02

Pattern-making

Uses metaphors, formulae, images etc. To find pattern.

Visualising



Seeing the end product, being able to move from abstract ideas to concrete, manipulating materials, mentally rehearsing practical design solutions.

SUB HABIT 01

Thinking out loud

Puts 3d ideas into words as they become pictures or rehearses possible lines of thought or action.

SUB HABIT 02

Model-making

Moves between abstract and concrete, making models to capture ideas.

Problem-finding



Deciding what the actual question is, finding out if solutions already exist by clarifying needs, checking existing solutions, investigating contexts, verifying, thinking strategically.

SUB HABIT 01

Checking and clarifying

Questions apparent solutions methodically and reflectively.

SUB HABIT 02

Investigating

Has a questioning, curious and, where appropriate, sceptical attitude.

Adapting



Making something designed for one purpose suitable for another purpose, by converting, modifying, transforming, adjusting, changing, reshaping, re-designing, testing, analysing, reflecting, rethinking.

SUB HABIT 01

Critical thinking

Analyses ideas, activities and products; able to defend their own thoughts and ideas in discussion and also to change their mind in light of evidence.

SUB HABIT 02

Deliberate practising

Disciplined; able to work at the hard parts.

Improving



Making things better by experimenting, designing, sketching, guessing, conjecturing, thought-experimenting, prototyping.

SUB HABIT 01

Experimenting

Makes small tests or changes; sketching, drafting, guessing, prototyping.

SUB HABIT 02

Evaluating

Making honest and accurate judgments about 'how it's going'; comfortable with words and numbers as descriptors of progress.

Content: Royal Academy of Engineering: 'Learning to be an Engineer. Implications for the education system'

Developing Engineering Habits of Mind through activities

The table below shows how the Let's do Engineering activities fit within the Engineering Habits of Mind.

Our activities introducing all engineers, e.g. films, Trumps game, activity book, posters and the Engineer Song, are all excellent ways to explore the EHoM of problem finding - what are the different problems these engineers are working on?

Other activities and resources can be grouped into themes or topics; by covering all activities within a theme all EHoM can be experienced. Themes include Space, Climate Change, Health, Robots and Drones, Materials and Flight.



Activity	Theme	Engineering Habits of Mind					
		Systems thinking	Adapting	Problem finding	Creative problem solving	Visualising	Improving
The Engineer Song	Covers all engineers and all themes	-	-	✓	-	-	-
Top Trumps	Covers all engineers and all themes	-	-	✓	-	-	-
Activity book	Covers all engineers and all themes	-	-	✓	✓	✓	-
Films - engineer interviews	Covers all engineers and all themes	-	-	✓	-	-	-
Engineer posters	Covers all engineers and all themes	-	-	✓	-	-	-
Engineering design cycle posters	Covers all engineers and all themes	✓	-	✓	✓	✓	✓
Build a rocket	Space Flight	✓	✓	-	✓	✓	✓

Activity	Theme	Engineering Habits of Mind					
		Systems thinking	Adapting	Problem finding	Creative problem solving	Visualising	Improving
Hula hooping and orbits	Space Flight	-	✓	-	-	-	✓
Build a wind turbine	Climate change	✓	✓	-	✓	✓	✓
Scarf throwing and plate spinning	Climate change	-	✓	-	-	-	✓
Make a blood model	Health	-	-	✓	-	✓	-
Build a noisemaker	Health Robots and drones Flight	✓	✓	✓	✓	✓	✓
Acoustic engineering songs	Health Robots and drones Flight	-	✓	-	✓	-	-
Stencilling microchips	Materials	-	✓	-	✓	✓	✓
Build your own water filter	Health	✓	✓	-	✓	✓	✓
Elsie the Engineer	Introducing engineering	✓	-	✓	✓	✓	✓
Introducing engineering (Diane)	Introducing engineering	-	-	-	✓	✓	-
Introducing engineering (Doug)	Introducing engineering	✓	-	-	-	✓	-
Simon Says and do coding	Robots and drones Health	✓	✓	✓	✓	✓	✓
Exploring materials	Materials	✓	-	-	-	✓	-
Painting with natural dyes	Climate change Health	-	✓	✓	✓	-	✓
Famous structures around the world	Climate change	✓	-	-	-	-	-
Structures and balancing	Climate change	✓	✓	-	✓	-	-
Water clean up game	Health	✓	-	✓	-	-	-
Space junk tidy up	Flight Space	✓	✓	✓	✓	✓	✓

Activity	Theme	Engineering Habits of Mind					
		Systems thinking	Adapting	Problem finding	Creative problem solving	Visualising	Improving
Hula hooping and orbits	Flight Space	-	✓	-	-	-	✓
Build a tower/exploring foundations	Materials	-	✓	✓	✓	✓	✓
Computer vision game	Robots and drones	✓	-	-	-	✓	-
Juggling	Robots and drones	-	✓	-	-	-	✓
Build a solar oven	Climate change	-	✓	✓	✓	✓	✓
Mission to Mars	Robots and drones Space	-	-	-	-	✓	-
Space rover design - app and craft	Robots and drones Space	✓	✓	✓	✓	✓	✓
Build your own spectroscope	Robots and drones Space	✓	✓	-	-	✓	✓
Aeroplane model making	Flight	✓	✓	✓	✓	✓	✓
Amy Johnson songs	Flight	-	-	-	-	✓	-
Coral Drama	Materials Health	-	-	-	-	✓	-
Coral strength testing	Materials Health	-	-	-	-	✓	-
Comics	All	-	-	✓	-	-	-

To learn more about the EHoM there are two reports by the Royal Academy of Engineering: 'Thinking like an engineer. Implications for the education system' and 'Learning to be an Engineer. Implications for the education system'.

Both can be accessed by the links below.