



Coming up with design ideas and evaluating their effectiveness





Download the full report:

Bianchi, L. and Wiskow, J. (2023) Progressing to be an Engineer – The Approach. Royal Academy of Engineering.

Informed by work from project schools: Archway School, All Saints' Primary School, Beech Hill Primary School, Ince Church of England Primary School, Ribblesdale High School, Salusbury Primary School, St Bartholomew's CofE Primary School, St Charles RC Primary, St Edmund's Primary School, St Wulstan's Primary School

The Progressing to be an Engineer Cycle



Progressing to be an Engineer: the Approach | Create – Creative Problem Solving

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Create - Creative Problem Solving is the process of making a product. The physical manipulation of resources to take design ideas from 2D to 3D encourages precision, measurement, joining and forming of materials. The experience leads to iterative problem solving based on observing what works and what could work better.

ILOs	Key learning	Suggested activities
What do we want pupils to understand about Create – Creative Problem Solving?	Creating a product and the resulting problem solving that this entails is a way for pupils to recognise the difference between design engineering and free/playful craft making. The discipline of measurement, accurate cutting and joining, taking a 2D design to a 3D form/object is a tactile and visible process that offers immediate feedback on whether something works or doesn't. How a pupil decides to overcome any challenges will require reflective thinking and resilience, all habits that are inherent in the engineering process.	Making from design: Activity: 1. <u>Satsuma Challenge</u>
How do we want them to apply their knowledge?	Underpinning knowledge of materials, joining, forming and how to construct mechanisms such as levers, pulleys, cams etc. are all areas of learning that are enhanced through a creative making process. Links to the Science and Technology curriculum are evident in this type of activity, drawing on knowledge about the range and properties of materials. Links to sustainability, recycling, repurposing etc. can also be encouraged in this creative process.	Making from design: Activity: 2. <u>Glider Challenge</u>



	From	То	Towards
	Suggested 5–7 years	Suggested 7–11 years	Suggested 11-14 years
Pupils should be taught to:	Create a prototype by taking a 2D design into 3D.	Create and evaluate a series of prototypes taking 2D designs into 3D, making improvements based on observation and feedback.	Create a series of prototypes taking 2D designs into 3D. Use cycles of self and peer- evaluation to identify and make improvements based on testing, observations and feedback.
Success was demonstrated when pupils:	 followed instructions made a 3D product based on a design that was given to them identified and explained what needed changing. 	 made a product in 3D identified and explained any problems that needed solving experimented with materials to find ways to solve the problem. 	 made a product in 3D, identifying and explaining any problems that needed solving Invited and responded to feedback from others before seeking ways to solve the problem.

Generic task

Initial learning activity - eliciting and developing understanding

Activity 1: The Satsuma Challenge

The pupils were tasked to unpeel a satsuma in one continuous piece, aiming for: a symmetrical shape, the longest peel, an animal shape. Pupils were encouraged to discuss their ideas in their group, plan their chosen method then encouraged to use sketching (2D) if needed or even mark the peel (3D). Pupils then peeled their fruit and evaluated whether it went to plan or whether there was anything they could do to improve. Pupils then made a new plan and peeled again, evaluating whether it worked better

They were shown some initial examples to help with the flow of ideas.



Generic task

Initial learning activity - eliciting and developing understanding (continued)

Activity 1: Unpeel a satsuma

This led to the following types of ideas.



'We spent quite a while on the planning and drawing phase of this task.

This gave the children opportunity to think about how and where they would peel the satsuma.

This enabled them to then peel it in the way they wanted and see the result they wanted.

I think if they hadn't planned it well enough, we'd have lots of satsumas with tiny bits of peel and no actual shapes.'





Generic task

Initial learning activity - eliciting and developing understanding (continued)

Activity 1: Unpeel a satsuma

This led to the following types of ideas.



"Some of the children thought about their idea and marked it out on the satsuma before they began to peel."

This shows a methodical approach to the task.



Embedded task

Exploring Create - Creative Problem Solving

Activity 2: Gliders

In this activity pupils were read the story 'Gary Vity' by Jules Pottle, about a young engineer named Rosa. Rosa is curious and explores the effects of gravity on objects around her.

Following the story, pupils make gliders by translating 2D design to 3D models. They investigate a range of variables and how they affect performance.

"Within this session, children developed their understanding of adaptability and how children can constantly evaluate their work following an iterative process.

They added weight to the front of their glider.

This helped the glider to travel further as the weight helped their throw follow through."



'Pupils added extra rubber bands to the end to the end of the wing made it stronger which helped the glider to fly straighter.'

> The sticky-note demonstrates a trial & error process & the model clearly shows the modifications the pupil made.





"When testing their gliders, children wanted to find the best way to launch their glider.

They tested out different ways and then found that the best launch came from higher ground so children climbed different apparatus to gain height.

They developed their understanding of solving problems and how they needed to constantly evaluate their work following an iterative process."

Teachers' ideas to extend and support thinking

Extending

The embedded task was prescriptive in terms of the link to the book and glider challenge, using a given template.

To extend, the 2D-3D make could be something the pupils have designed themselves as opposed to template-inspired.

Further support

Scaffold the task by giving the pupils pre-prepared glider templates which they then can test and problem solve and develop from.

Some may find the precision cutting out difficult in the first instance.





Create – Creative Problem Solving

Coming up with design ideas and evaluating their effectiveness

FROM – creating a prototype by taking a 2D design into 3D.

TO – creating and evaluating a series of prototypes taking 2D designs into 3D, making improvements based on observation and feedback.

TOWARDS – creating a series of prototypes taking 2D designs into 3D. Using cycles of self and peerevaluation to identify and make improvements based on testing, observations and feedback.