



Imagine & Plan – Systems Thinking

Explaining how things work together and why each part is there





Download the full report:

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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



Overview

Imagine & Plan - Systems Thinking is the process of explaining how things work and how each is part plays a role. When imagining and planning, pupils get the opportunity to design considering the system and the subsystems - moving beyond a 'black box' approach to design.

ILOs	Key learning	Possible activities
What do we want pupils to understand about Imagine & Plan – Systems Thinking	Pupils benefit from appreciating the way things work - and the multiple components and mechanisms that come together. It often isn't evident how many of the products we use include components and mechanisms that work together as a system, and indeed the number of subsystems that come together to make something work. E.g. Pouring a simple glass of cordial drink involves multiple systems related to how we source the fruit, water, packaging and the glass in our hands. Being aware of the many systems and subsystems that make up a problem / situation / product enables us to understand the interplay between these and encourages more effective problem finding, leading to better solutions.	 Thinking inside the box: Identifying the way things work together and why they are needed. Activities: 1. <u>Have you ever seen?</u> 2. Systems within systems
How do we want them to apply their knowledge?	It is important that pupils have opportunity to freely explore their imaginative ideas in response to a brief. This is a key part of Design & Technology and allows for creativity, innovation and flare. To 'systems think' inspires the more detailed thinking about 'how' a product could work, and encourages pupils to respond to how the product will meet these specific needs. As they are 'imaging and planning' pupils should review and refer to design requirements/specifications using critical evaluation to refine and add detailed annotations to their design ideas.	 Designing to meet user needs: Engineers review the needs of the people they are designing for. They consider subsystems and how they work together to achieve a solution. Activity: 3. Harry's Heart



	From	То	Towards
	Suggested 5–7 years	Suggested 7–11 years	Suggested 11-14 years
Pupils should be taught to:	Draw and label a design with different parts, showing how they connect together.	Draw and label a design that uses a system, explaining the role of each part.	Draw and label a design that uses a system, justifying why each part is there and how it best suits a user.
Success was demonstrated when pupils:	 use basic sketches to communicate an idea and use annotations/ simple notes to explain the designs to others describe the systems they notice, for instance what happens first, second and third 	 explain how each part of the system has a role and function describe how the product responds to defined user needs. 	describe how the product responds to defined user needs.

Generic task

Initial learning activity - eliciting and developing understanding

Activity 1: Have you ever seen?

Pupils were asked to draw a diagram explaining to someone who has never seen a scooter how to ride one. This was to encourage close observation of the mechanical parts in something familiar to them, and for them to examine how each part worked together to make a system. Pupils were shown some initial examples to help with the flow of ideas however could then follow with other objects they wished to explore.



Generic task

Initial learning activity - eliciting and developing understanding



'This particular class hadn't previously explored systems thinking so their knowledge of systems thinking and parts was really developed in this lesson. They were fascinated by how many parts made up the scooter. They really began to understand the role of each part and understood that if a part was missing or broken in a mechanical system the whole system would not work'



'The pupils discussed the parts of the system prior to disassembly.'

'What was crucial in this activity was that real physical objects as opposed to images were used to encourage hands-on investigation and testing of the different parts and how they work together.'







Infant pupils found that:

"All parts are connected so they can work together. You need a strong material to connect them.

You can use metal. Metal is strong.

The handles are metal so they are strong and you can turn them this way and that. But you need the rubber covers so your hands are comfy.

The pedals are plastic and they spin all the time. You need to push them to give the bike power because it has no electricity."

	er. . think it looks like inside. and label them – what does each part do? have been used?
Visualise: Draw the whole system	Visualise: Draw what you "think" the different parts of the system look like.
T	Handles 2 wheels Brakes Wire Handle bar Handle bar Platform Handle bar clip
Look closely together, teacher pointing out the different parts. Draw each	part. Label each part, what is its job? What materials have been used and why?
Wheel rear work? Wheel rear work? Wheel rear work? brake WHHH Screws	- handle wire - handle

Clearly showing component drawings from lower junior pupils.

Generic task

Initial learning activity - eliciting and developing understanding using a generic task (continued)

Activity 2: Systems within Systems

Pupils were asked to use sticky-notes to draw out all the different steps needed to make a cup of squash drink. For every step, they were asked to try to ask a question: Where did it come from? How is it made? What is it made from? Where do the ingredients come from... Pupils were encouraged to continue to reverse engineer the system, and to identify the sub-systems within it.



Initial learning activity eliciting and developing understanding using a generic task (continued)

Activity 2: Systems within Systems

This led to the following types of ideas.

'Some pupils showed an emerging understanding of how the parts fitted together in the apple juice system, either by grouping parts or by using arrows.'





'Sticky notes were an ideal way to support pupils to show sub systems.'

Initial learning activity eliciting and developing understanding using a generic task (continued)

Within this task, pupils developed the knowledge that there are many parts to a product. They recognised how multiple systems needed to achieve one product. They learned where familiar things came from, e.g. where does paint come from?, and used peer learning to find out if they didn't readily know.

Others were able to show this as a process. Most pupils could think beyond the immediate system to wider systems, although they weren't always able to show how these wider systems fitted together."



'Within this task, pupils developed the knowledge that there are many parts to a product.'



Embedded task

Exploring Imagine & Plan -Adapting in context

Activity 3: Harry's Heart

Pupils were asked to design a system that will help someone take the right amount of medicine at the right time every day (two tablets when they wakes up in the morning, and two tablets with their afternoon cup of tea.)

The scenario included various 'user needs' - that the person is a little forgetful and needs some help remembering when to take his medicine, and how many tablets he should take each time.

This provided the remit for the task in more specific detail.

Systems Thinking: Imagine and Plan – Harry's Heart



Name_Duis	SU-Mai Year Broup Y6 R
SYSTEMS THINKING	Explain the system you are trying to develop: Lo create it system to help to bail theth tablets thing and Patrillo
Draw and label a diago	pram of your system (explain what each part does and your ideas for how to make your system function)
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Boz	Telolet despusar
	The Third Hun set

'This pupil considered the sensory issues Harry may face and wanted her device to be worn.'



Embedded task



In this design the pupil included an alarm and screen with a small compartment for the tablets. The device was designed to fit inside Harry's pocket and to go off when he needs to take a tablet. The alarm doesn't stop until Harry turns the alarm off directly. If he doesn't take the tablets the screen turns off so he can't use it for other purposes and also encourages healthy screen time too. (9–10 year old)



Here the pupil considered how the robot was going to be powered in case Harry wasn't at home and the device's battery failed. She decided it could be solar powered therefore also helping the environment too. (10–11 years)



'They developed a deeper understanding of how to communicate ideas for Harry but also as a group working together to find a solution. The pupils developed further understanding of how parts need to be designed to work together. They understood the need to ask questions of their design.'

Teachers' ideas to extend and support thinking

Extending

The more abstract the design challenge the harder the task will become. Where you can link with experiences the pupils already have in their lives, their likelihood of them responding well to the task is higher.

Further challenge pupils to explore ways in which they look at systems that more unfamiliar, e.g. the systems in a car; dishwasher; washing machine etc. This will require research by secondary sources. There are some 'look inside' books published that also support this type of observation.

Further support

Pupils may struggle to understand the difference between adapting and improving. This is something that often can become confused. Seek to emphasise that using an existing idea or mechanism again in a different way is 'adapting' – changing it in any way is 'improving it'.

For lower ability students, scaffold the task by giving them the mechanism and asking them what else they could do with it without changing it. They will then develop to be being able to identify the mechanisms themselves in later work.





Imagine & Plan – Systems Thinking

Explaining how things work together and why each part is there

FROM – drawing and labeling a design with different parts, showing how they connect together.

TO – drawing and labeling a design that uses a system, explaining the role of each part.

TOWARDS – drawing and labelling a design that includes a system, justifying why each part is there, and how it best suits a user.