

Imagine & Plan – Adapting

Showing how something could be
used in a different way



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Progressing to be an Engineer –
The Approach. Royal Academy of
Engineering.

**Informed by work from St Anne's Catholic School
and Kingsmead Primary School**

The Progressing to be an Engineer Cycle



Overview

Imagine & Plan - Adapting is the process of changing an existing product or service so that it is suitable for different customers or uses. This can often be seen as a less risky business option than launching a brand-new product. An example of this would be changing the position of a steering wheel in a car from the right hand side to the left to suit different driving regulations.



ILOs	Key learning	Suggested activities
<p>What do we want pupils to understand about Imagine & Plan – Adapting?</p>	<p>There are several reasons why products might be adapted – to appeal to different markets; to cater for the needs of different users; or to use for a different purpose. Examples of each are as follows:</p> <ol style="list-style-type: none"> 1. A well known bakery chain launched a vegan sausage roll to cater for its vegan consumers. 2. Lego adapted its famous colourful bricks to correspond with Braille letters and numbers to help children who are blind. 3. The mechanism in a ball point pen has been taken and used in a roll-on deodorant. 	<p>Changing purpose:</p> <p>Taking an existing product and using it in a different way.</p> <p>Activities:</p> <ol style="list-style-type: none"> 1. Five different uses
<p>How do we want them to apply their knowledge?</p>	<p>It is important for pupils to examine products closely and gain a clear understanding of how they work, thinking about each individual part and the mechanisms that are being used. They can then investigate the needs of their users and adapt the products accordingly to meet those specific needs.</p> <p>As they are imaging and planning, pupils should be constantly referring to these needs and critically evaluating the changes that they are suggesting against the agreed design criteria.</p>	<p>Learning from nature:</p> <p>Engineers take many of their ideas from observing what happens in the natural world – how plants and animals have adapted over the years to survive in a changing environment.</p> <p>Activities:</p> <ol style="list-style-type: none"> 2. Biomimicry research 3. Product design



	From	To	Towards
	Suggested 5–7 years	Suggested 7–11 years	Suggested 11–14 years
Pupils should be taught to:	Observe a range of mechanisms (how things are made to work), suggesting ideas for how they could be used for a different purpose.	Plan a design that aims to solve a problem or task for a specific user, by transforming an existing mechanism (natural or man-made).	Plan and evaluate designs that aim to solve a problem or tasks by transforming existing mechanisms (natural or man-made), suggesting alternatives and trade-offs with due regard for criteria such as cost and safety.
Success was demonstrated when pupils:	<ul style="list-style-type: none"> could explain what is special/distinctive about a product, identifying key features. 	<ul style="list-style-type: none"> explained how a feature could be used to solve a different problem or to meet the needs of a specific user. 	<ul style="list-style-type: none"> described the pros and cons of the adapted design in terms of its fitness for purpose and feasibility of use and production.

Generic task

Initial learning activity - eliciting and developing understanding

Activity 1: Five different uses

The pupils were given a 2 litre plastic bottle and asked to think of five ways in which the bottle could be adapted for a different purpose. They were then challenged with developing one of their ideas in more detail - explaining in drawings and words how their bottle was now being used.



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

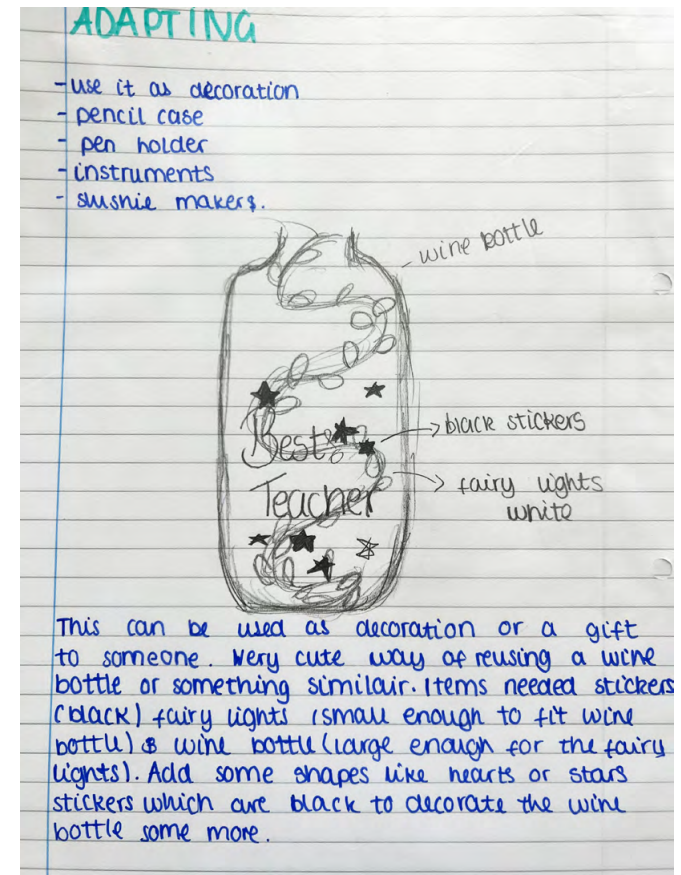
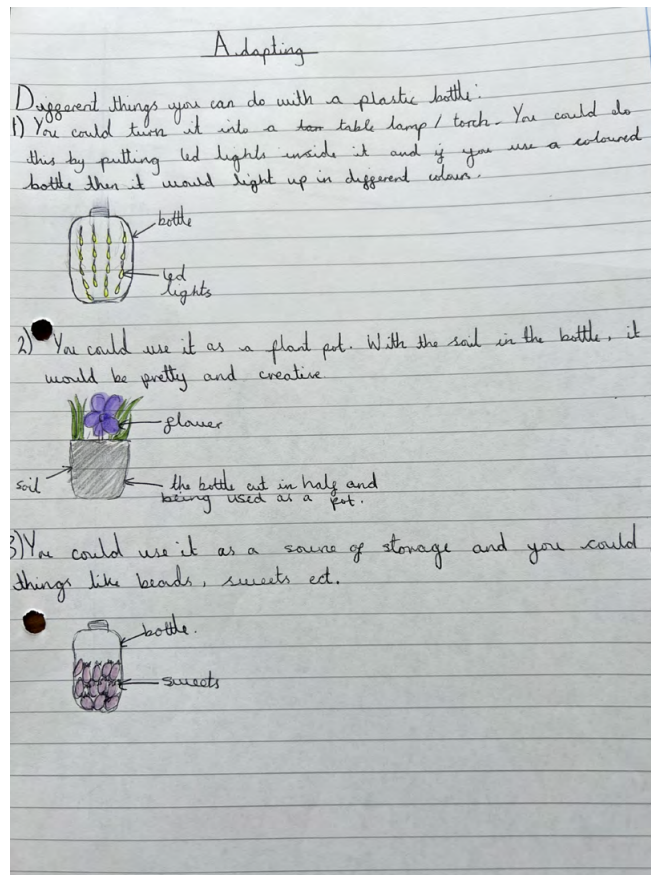
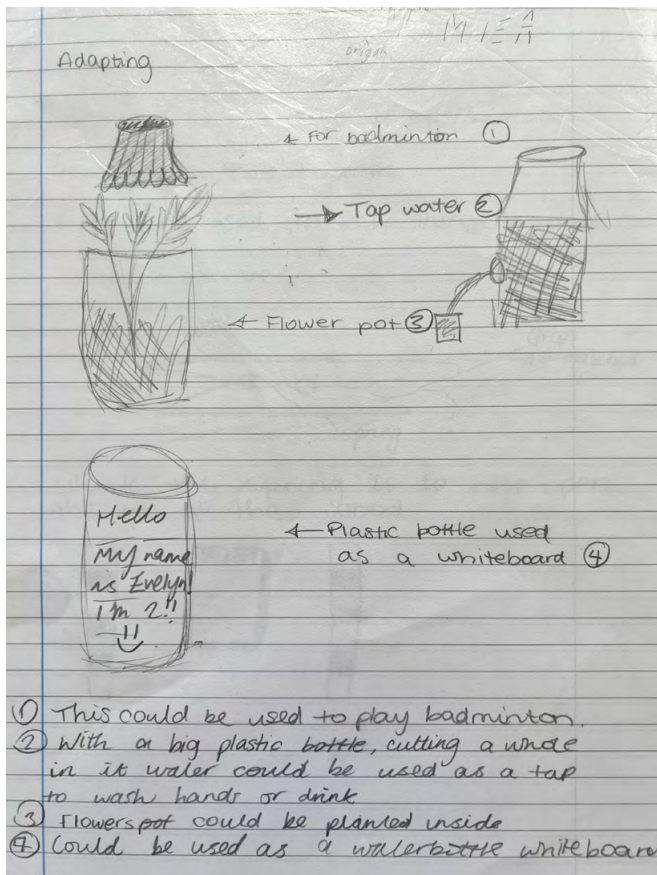


Generic task

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

Activity 1: Five different uses

This led to the following types of ideas.



"Pupils were able to draw on previous knowledge when attempting this task. This may have limited their originality as they had fixed ideas about what a bottle could be used for. They found it much more challenging when asked to respond to other reasons for adapting, such as using existing mechanisms in different ways."

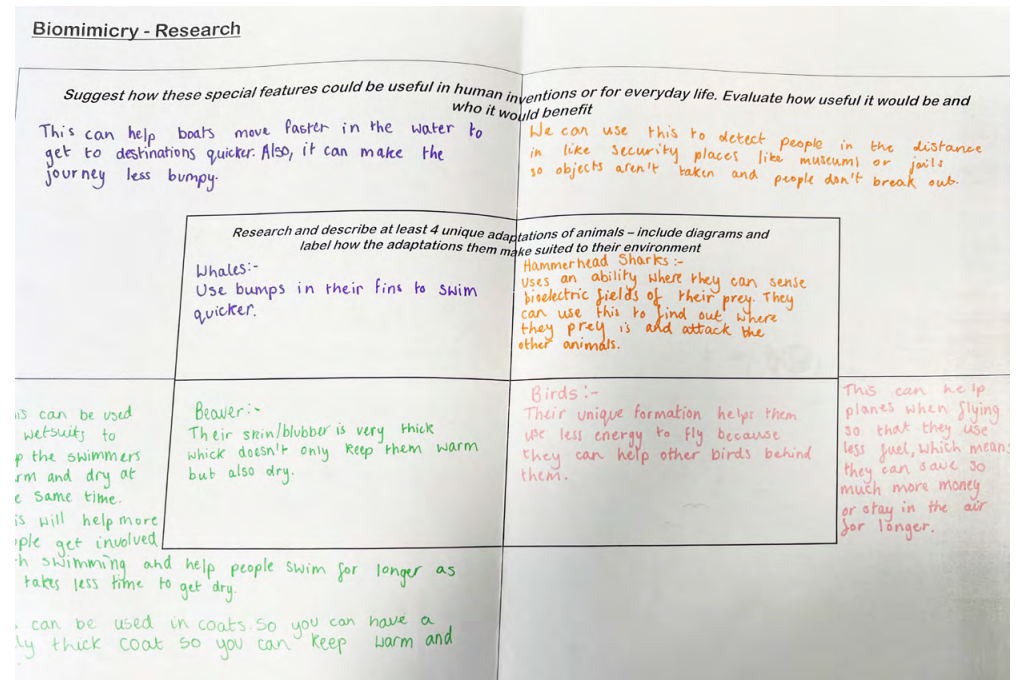
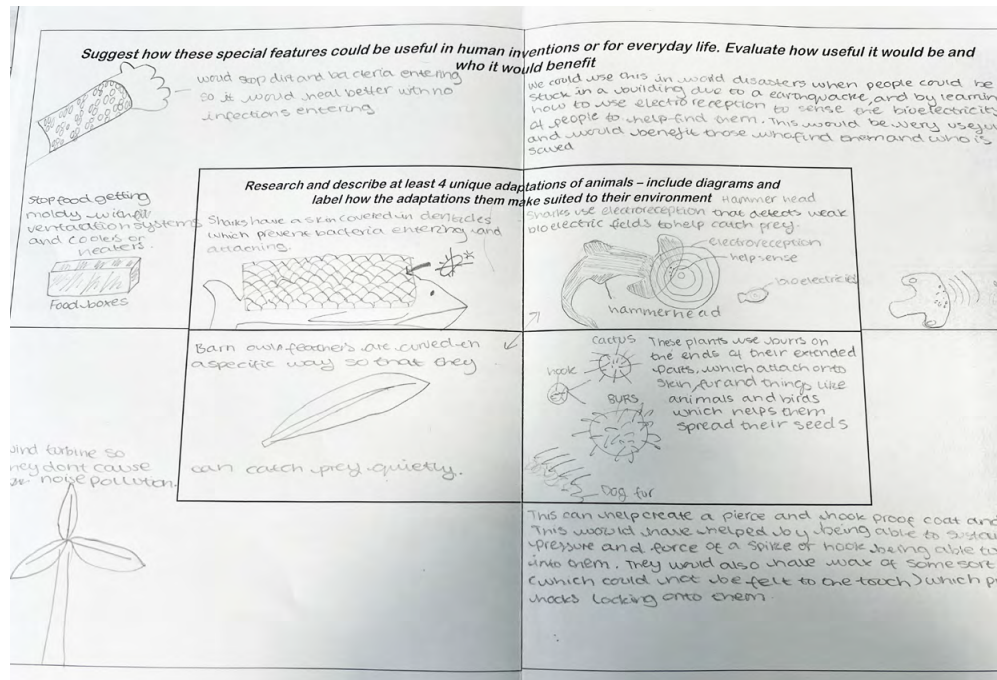


Embedded task

Exploring Imagine & Plan - Adapting in context

Activity 2: Biomimicry research

This activity focused on the third example of adaptation: borrowing from existing systems – this time from nature – and using them to solve human problems. The pupils were introduced to the concept of Biomimicry and shown a number of examples of products that have been inspired by nature. They were then asked to create a list of animals/plants that have adapted well to their environment and identify any special characteristics/features that have enabled this adaptation.



"The topic was engaging and fitted in with previous learning so this made it easy to deliver. Students grasped the concept quickly and so undertook the task with minimal support needed."

Embedded task

Exploring the EHoM in context - the embedded task (continued)

Activity 3: Product design

Pupils were asked to choose one of the special features they had identified from their research and use this to inspire a new product design. The following examples were generated by KS3 pupils.

BIOMIMICRY

Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

After
pergrine falcon wing shape/dive
used when landing/about to land
Front is more narrow to resemble the falcon's beak
compared to a real plane it'd be able to swoop down faster

before:
it'd look like a normal plane, but with different wings so it can swoop down faster

Advantages	disadvantages
<ul style="list-style-type: none"> faster earlier can have a helicopter version for rescues 	<ul style="list-style-type: none"> you could get really, really, really, really plate sick (not really)

Adaptation
How a peregrine falcon dives so suddenly and goes much faster

Draw and label your design, making sure that you identify the original plant or animal, the special feature that has inspired your invention and what job that feature does.

Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

Cyphochilus beetle

the super-whiteness of an Asian Scarab beetle can develop a new material to help improve a range of products.

Original idea
- titanium mining has an environmental cost, and nanoparticles have recently been labeled as suspected carcinogen. In search of an alternative, research study this beetle.

The cyphochilus beetle whitens is a survival mechanism that camouflages it among the white fungi found in its habitat.

The beetle's thin layer of scales on its exoskeleton structure give the beetle its bright white colouration.

we could use the beetle to mimic its white pigment to create environmentally friendly nice dye.

- sunscreen
- toenail polish
- strips painted on roads (zebra crossing etc)

Draw and label your design, making sure that you identify the original plant or animal, the special feature that has inspired your invention and what job that feature does.

BIOMIMICRY

Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

The Floating Island :

This idea was inspired by lotus plant (*Nelumbo nucifera*). We have chosen this plant because it has adapted to let air in the crevices of the of its leaf (to help it float)

greenhouse like roof to help plant growth.

Not to scale

glass dome to stop rain flooding

air hole just in case oxygen runs out

houses + buildings (on)

shape of a lotus plant

at the bottom there are air pockets to help it float

Water

- We believe this could help as a refuge for homeless people by increasing the amount of places to live (with a lower cost)

Draw and label your design, making sure that you identify the original plant or animal, the special feature that has inspired your invention and what job that feature does.

"Students enjoyed designing their own invention and took ownership and pride in their work."

"Some students confused the idea of Biomimicry with actually taking and using things from nature (e.g. using bamboo to make cups)."


Embedded task

Exploring the EHoM in context – the embedded task (continued)

Activity 3: Product design

The following examples were generated by KS2 pupils. It is more difficult to identify which special animal features have been chosen in these examples.

BIOMIMICRY



Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

I could be used for picking fruit from trees easier.


The ladders come off so you can use them like handles to grab onto different branches with.

Sloths have curved claws to make it easier to climb tree. If it was made out of metal it would be really strong.

Ladders on it so you can hook it on to a tree branch so you can climb up it.

Draw and label your design, making sure that you identify the original plant or animal, the special feature that has inspired your invention and what job that feature does.

BIOMIMICRY



Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

These flaps help the fabricator stay and collect the water and make the shape.

Waterproof fabric to direct the water into the pipe.


These help it to balance and not fall off the coat.

Rain goes down the pipe into the bottle when the bottle is full the water will slowly spill out behind the person.

It is made from recycled plastic and fabric so it is very light and does not weigh people down.

Inside the coat there is a layer of insulation from winter coats so you stay warm.

BIOMIMICRY



Many inventions have been inspired by nature. By examining how plants and animals have successfully adapted to their environments over millennia, engineers have been able to imitate the best designs and processes to solve human problems. Can you think of your own nature-inspired solution to a problem – and design a product using your ideas?

Tortoise shell umbrella in case hail or hard rain comes down.

Flaps that protect the human if it is a breeze or wind and rain.

Clippers that increase their size when they don't want the flaps.

extendable pole so it is the perfect size.

easy to handle and super soft.

lock button for when it is the perfect size.

“Adaptation is a challenging concept and some children struggled to understand what it meant. Two children drew nearly identical pictures of a penguin. They had the penguin-shaped item do other tasks (shoot balls, etc) and really struggled to make the link to traits of penguins and how these could be utilised in products.”

Teachers' ideas to extend and support thinking

Extending

Using a bottle as a diffuser of light:

<https://expatorama.com/2015/07/24/litre-of-light/>

Allow pupils to market their ideas in a Dragon's Den scenario.

Further support

Pupils may struggle to understand the concept of Biomimicry and how it relates to engineering products. If this is the case then allow pupils more time to investigate and unpick examples: <https://www.learnbiomimicry.com/blog/top-10-biomimicry-examples-2021>

For lower ability students, scaffold the task by giving them an object/item to start with and then ask them to adapt it in a particular way using inspiration from nature.





Imagine & Plan – Adapting

Showing how something could be used in a different way

FROM – observing a range of mechanisms (how things are made to work), suggesting ideas for how they could be used for a different purpose.

TO – planning a design that aims to solve a problem or task for a specific user, by transforming an existing mechanism (natural or man-made).

TOWARDS – planning and evaluating designs that aim to solve a problem or tasks by transforming existing mechanisms (natural or man-made), suggesting alternatives and trade-offs with due regard for criteria such as cost and safety.