Royal Academy of Engineering

MANCHESTER 1824
The University of Manchester

# Improve – Improving

## Making changes to make things work better


**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 Burnside College, Rode Heath Primary, Beech Hill Community Primary and Burlington Junior School**

# The Progressing to be an Engineer Cycle

# Overview


**Improve – Improving** – Products never stand still, they are continually evolving to meet the growing needs of consumers. Product improvement is the process of making meaningful product changes that result in obtaining new customers, retaining existing users or recapturing lost customers. The two most popular ways to make product improvements are to add new product features or improve existing ones.

| ILOs | Key learning | Suggested activities |
|---|---|---|
| **What do we want pupils to understand about Improve – Improving?** | Product development is not always about coming up with a completely new idea. Nowadays there are very few products that are absolutely original and innovation tends to focus on looking for new ways to improve existing designs so that, for example, they perform their purpose more effectively or are easier to use.<br><br>The EHOM Improving has strong links with that of Problem Finding as it is important to be observant and look carefully at how products are being used, so that you can discover and improve their limitations. | **Identifying changes:**<br><br>Recognising improvements and associating them with the problems they have solved.<br><br>**Activities:**<br><br>**1.** **What's the improvement?**<br>**2.** **Making things work better** |
| **How do we want them to apply their knowledge?** | Encouraging pupils to think critically about the everyday products around them can help when they are imagining and planning their own designs. It should promote the generation of questions such as:<br><br>■ Who is this product for?<br>■ How well does it meet the needs of the user?<br>■ How does it work?<br>■ Which parts could work more effectively?<br><br>Using a technique such as SCAMPER is then a great starting point for pupils to think about ways of improving the product they have chosen. | **Engineers make things work better:**<br><br>Investigating the evolution of the bicycle and identifying the changes over time.<br><br>**Activities:**<br><br>**3.** **The evolution of the bicycle**<br>**4.** **Improving the design** |

| | From | To | Towards |
|---|---|---|---|
| | **Suggested 5–7 years** | **Suggested 7–11 years** | **Suggested 11–14 years** |
| **Pupils should be taught to:** | Identify areas for improvement in a product and suggest changes to make it work better. | Evaluate how the product is working, identifying areas for improvement in a product and describing possible changes that can enhance the design. | Identify areas for improvement in a product and describe changes to enhance the design, evaluating the ideas that are most feasible and desirable. |
| **Success was demonstrated when pupils:** | ■ described how products were being used and could give ideas for how they could work better. | ■ used their own or others' experiences to identify problems, making simple changes and considering their individual impact. | ■ were able to match their improvements to specified success criteria. |

# Generic task

## Initial learning activity – eliciting and developing understanding

### Activity 1: What's the improvement?

The pupils were shown a series of photos of products which had been enhanced in some way in response to the perceived needs of the user. They were asked to identify, explain and evaluate the changes and then suggest any further ideas they might have.

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"The pupils enjoyed discussing the images and the improvements that had been made. Before, they thought an engineer was someone who built things; now, they think/know that an engineer improves objects.

They also have an understanding of why an object may need improving and what an engineer might do in that process."

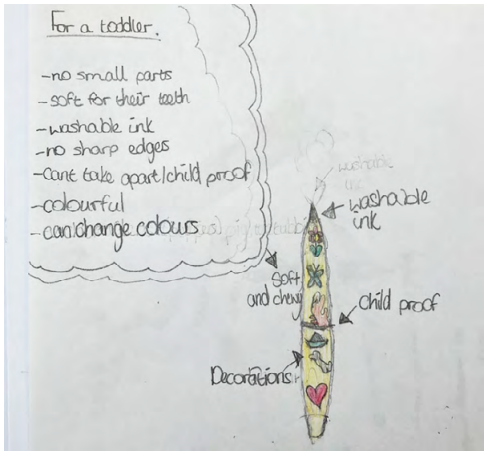
**"The pupils enjoyed discussing the images** and the improvements that had been made."

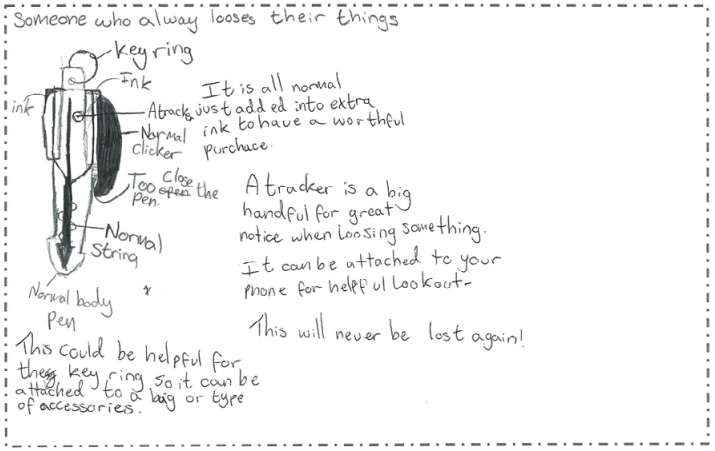
# Generic task

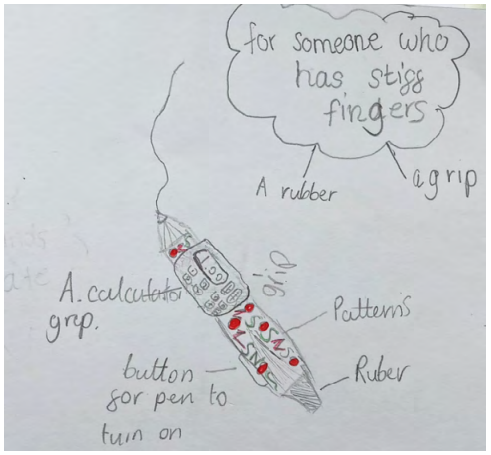
## Initial learning activity – eliciting and developing understanding using a generic task (continued)

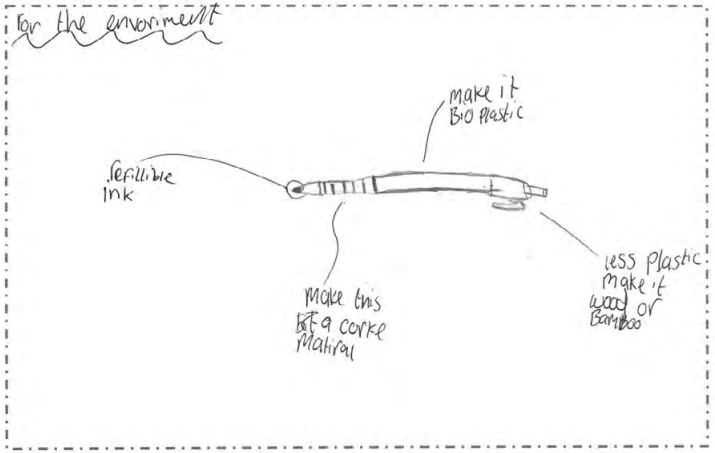
### Activity 2: Making things work better

Pupils were asked to find ways to improve a pen for different users and environments. They were introduced to the SCAMPER technique to help them generate ideas.



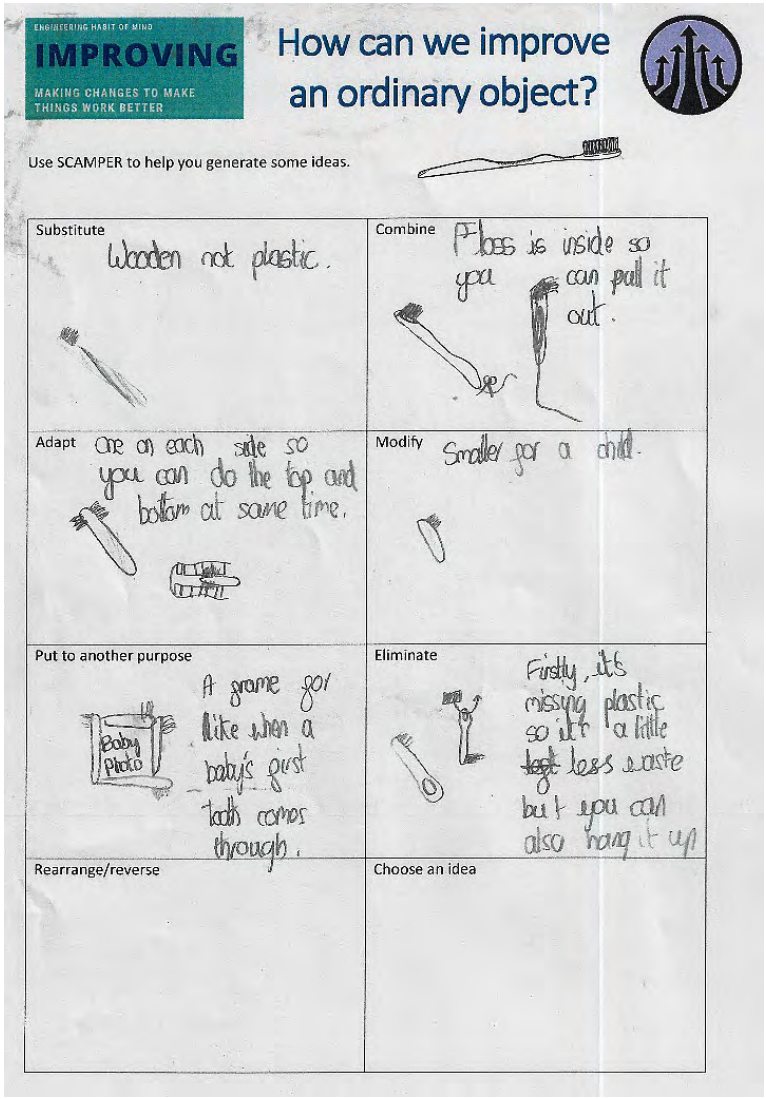



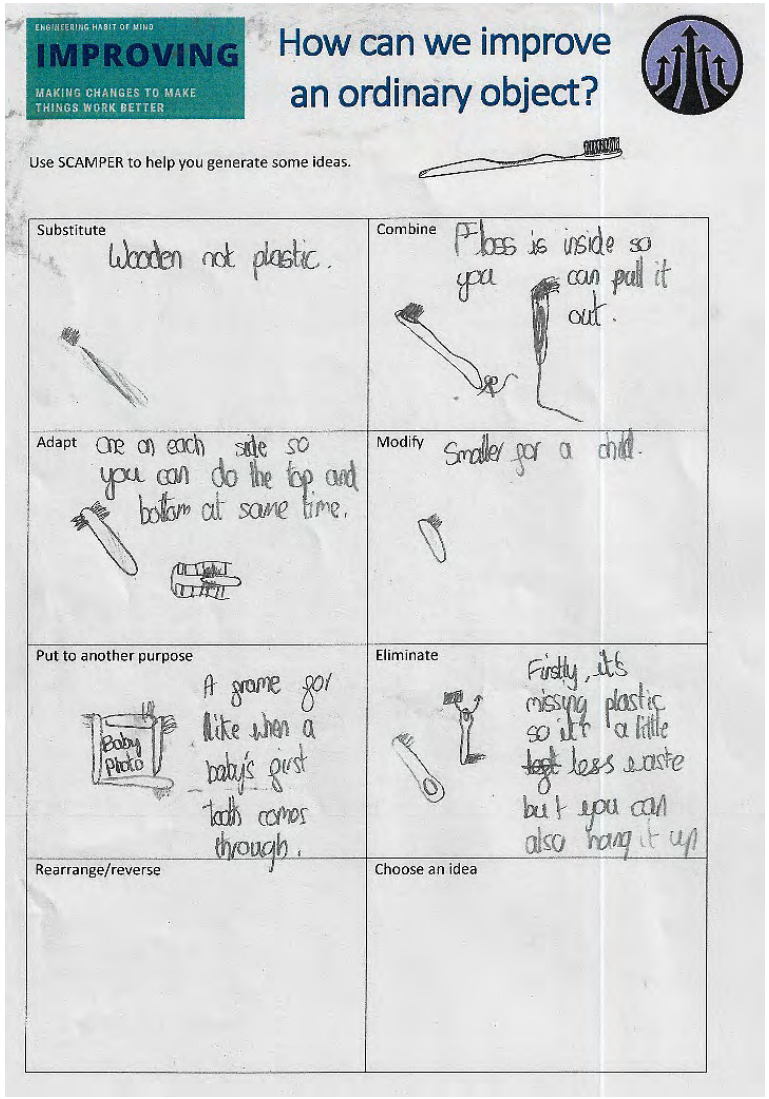




"The students really enjoyed this activity. They spent a lot of time discussing on their tables how they could make improvements to a pen. They thought deeply about the issues someone may have with the pen and how they could improve this."

# Generic task

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




"Pupils were generally unfamiliar with the SCAMPER concept and needed a lot of scaffolding to come up with original ideas. Next time we would consider reducing the number of categories or giving groups a single aspect to work on."

# Embedded task

## Exploring Improve – Improving in context

### Activity 3: The evolution of the bicycle

Pupils were asked to research and identify the improvements that have been made to different bicycle models over the years and explain the reasoning behind the changes. As a stimulus they were shown Pathe videos of the birth of the bike and given a timeline as a starting point. This activity tended to be carried out as a class discussion.

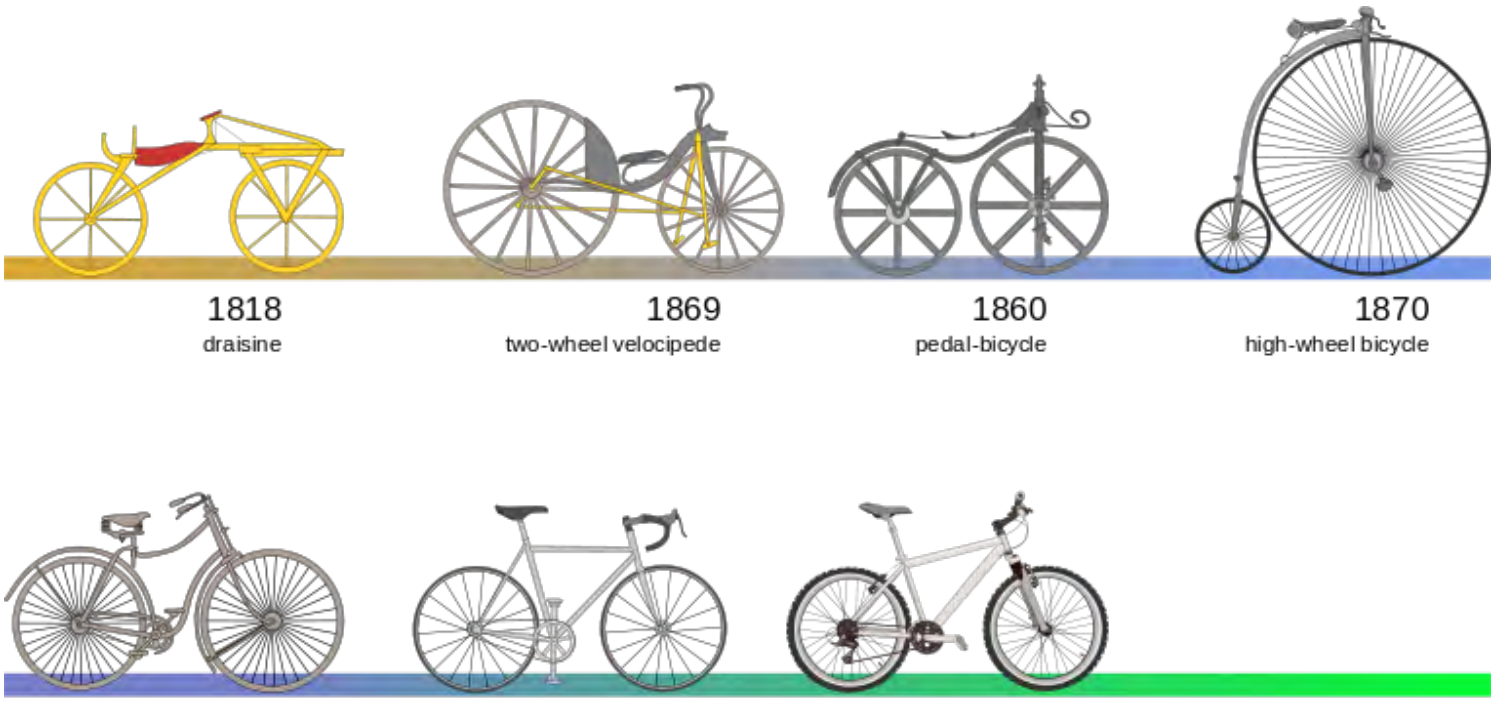



Image courtesy of https://commons.wikimedia.org

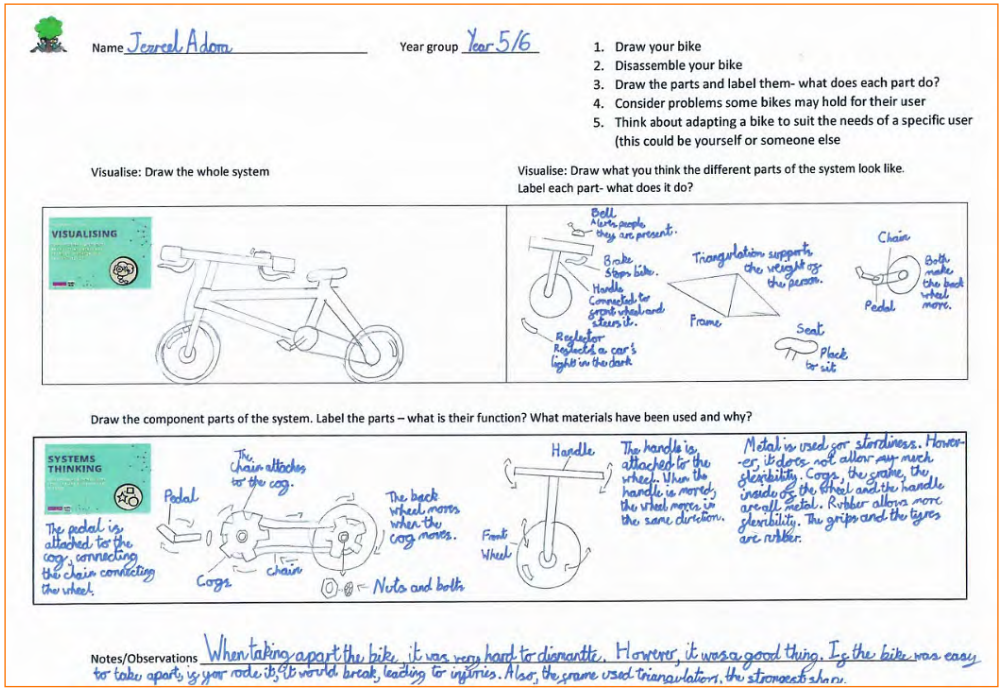
"I found out there are many different types of bike and was astounded at the evolution of the bicycle and how ridiculous some of the bicycles were (example- penny farthing). It was really easy to plot the reasons why engineers made adaptations and I was interested in how their brains worked to solve these problems."

# Embedded task

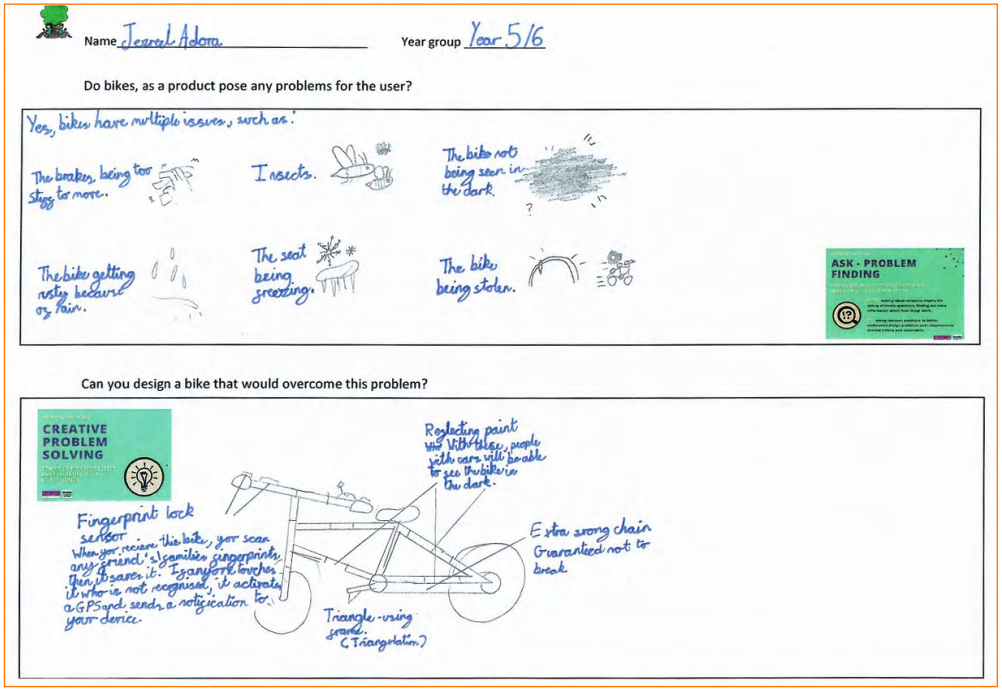
## Exploring Improve – Improving in context

### Activity 3: The evolution of the bicycle

Some schools extended their pupils' learning by providing a modern bicycle for them to dismantle. This helped when thinking about how the bicycle could be improved. The pupils were asked to consider the potential problems faced by cyclists before building in improvements to overcome these problems.




"Pupils applied previous work on systems thinking when disassembling the bike. They also used some of the vocabulary taught during a design technology unit (triangulation) and many of the children were fascinated that the project they had already carried out was linked to this engineering activity,"



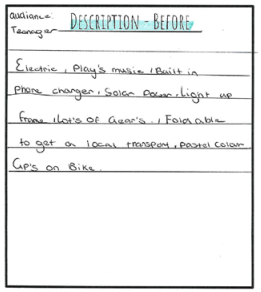

"Most of the pupils opted to modify the bike with which they were familiar, considering the user, rather than consider the evolution of the bike as a machine. They were, however, able to place their designs on the timeline of bikes and understood that they had improved rather than recreated or invented."

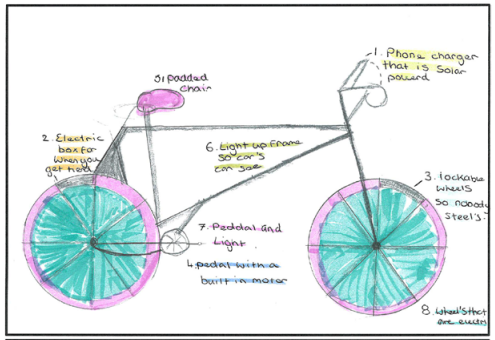
# Embedded task

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

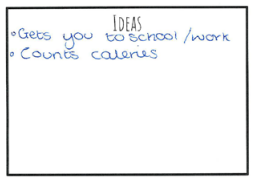
### Activity 4: Improving the design

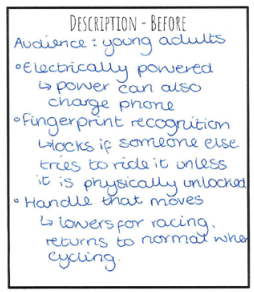
Pupils were asked to use the information they had learned about how bicycles have been enhanced and add to the timelines by designing their own bike for the future which improved on current models. They were given some examples of future bikes to stimulate their imagination.

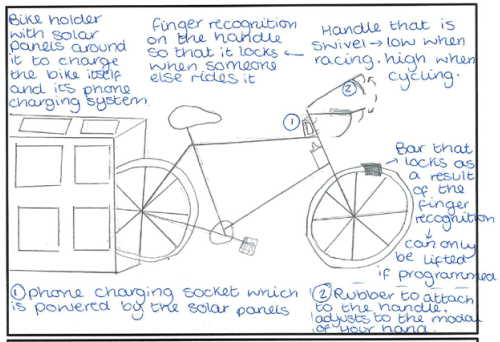



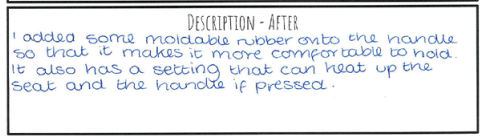



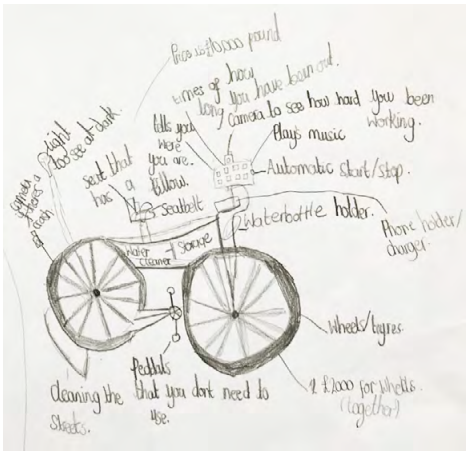


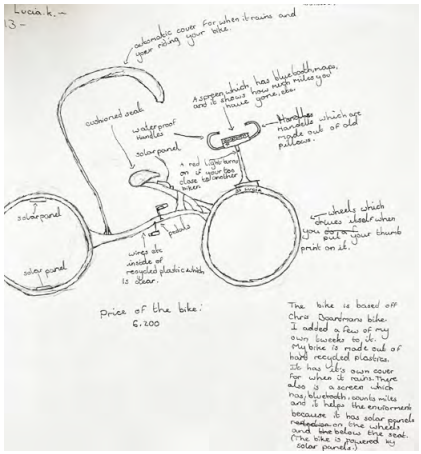


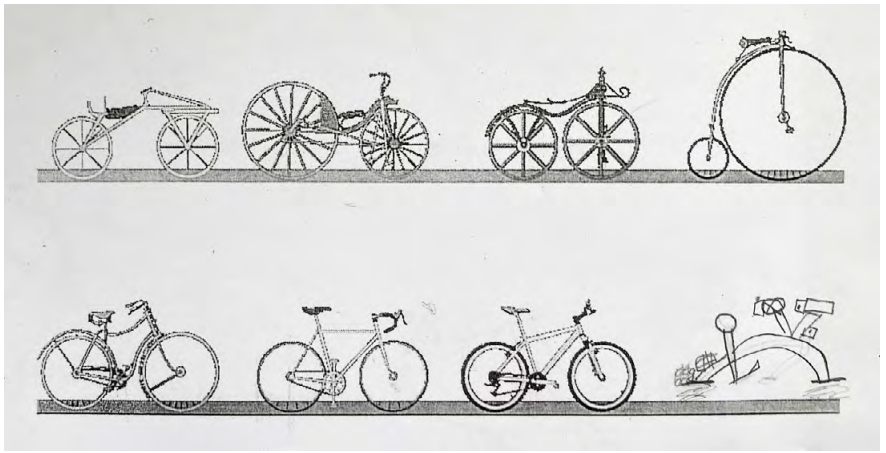



# Teachers' ideas to extend and support thinking

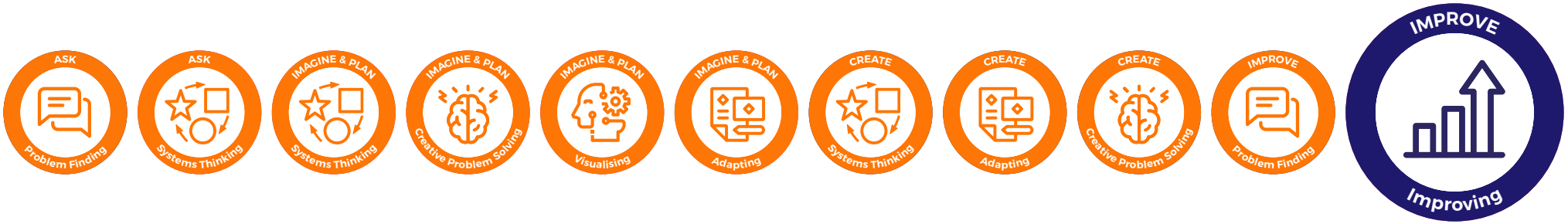
## Extending

Give pupils access to a real bicycle which they can dismantle. This will give a better understanding of how the bicycle works and what the different parts do.

Allow pupils to present their future bikes to their peers. Encourage critical evaluation and questioning. Are these bikes feasible? Would the improvements actually work?

## Further support

**Pupils may struggle** to draw a bike. If this is the case then an outline sketch could be provided for the pupils to add their improvements to.




# Improve – Improving

## Making changes to make things work better

**FROM** – identifying areas for improvement in a product and suggesting changes to make it work better.

**TO** – identifying areas for improvement in a product and suggesting changes to make it work better.

**TOWARDS** – identifying areas for improvement in a product and describing changes to enhance the design, recognising the ideas that are most feasible and desirable.