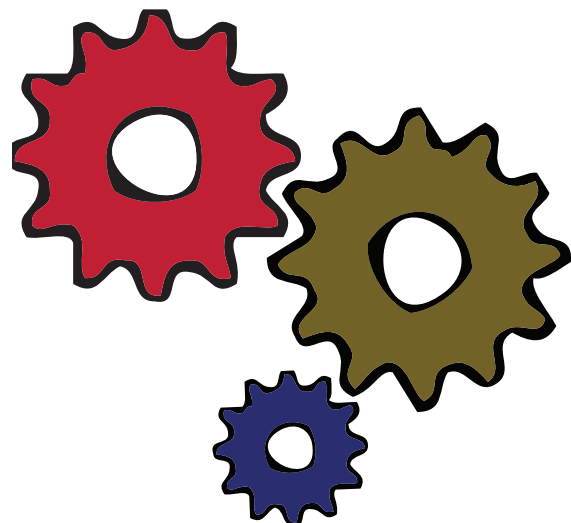**TEACHER'S GUIDE**

HALLÉOOJAMAFLIPAPHONE
EPISODE 2 OF 3
MAKE IT, MAKE IT USEFUL
Thinking as an Engineer

CONTEXT

This suite of three episodes have been written to enable pupils to respond creatively to the Halléoojameflipaphone. They are designed to inspire curiosity, discussion and collaboration between pupils and teachers, and to encourage an appreciation of how science and engineering come together to make a difference in the world around us.

The three episodes are sequential and develop ideas and skills from previous learning opportunities.

Children will be able to work as an engineer by:

• identifying what inputs and outputs devices require
• tinkering with a digital device
• engineering their robot to make it fulfil a purpose

Children will learn:

• about a range of input and output devices
• to write and debug a program
• to use a variety of inputs and outputs within a computer program

RESOURCES

An audiobot made from Episode 1 (one per group)

Crumble Controller kits that include (one per group)
• Crumble   • Crumble battery box
• Micro USB lead   • Ultrasonic sensor
• LDR   • Sparkle
• Pack of croc leads

Crumble software downloaded to PC or Mac (https://redfernelectronics.co.uk/crumble-software/)

This Episode is comprised of 4 parts. Unless taking a full day to work this through, the episode can be spread over a series of sessions. Each session is sequential so must be completed in order.

Part 1: Introduction – setting the content
Part 2: Sequencing and Coding – developing skills
Part 3: Modifying and Refining – applying skills
Part 4: Plenary – elaborating on learning

EPISODE SUMMARY

As a scientist pupils previously made and tested different sounds by experimenting with an audiobot. They explored whether the audiobot had the potential to be a useful device and to solve a real problem or dilemma.

In this episode pupils will work again with the audiobot but this time engineering the simple device to give it a real purpose in an everyday setting. Pupils will experience at first-hand how the Computer Science skills of coding enable us to control a 'physical device'.

EPISODE DETAIL

PART 1: INTRODUCTION

SLIDE 1:

This scene setter encourages pupils to consider the what it means to be an engineer, and how it is different to the practice of science in Episode 1. (Refer to the Pupil Challenge sheet 2:1). In pairs, pupils are asked to discuss and justify which bubbles would best match the thoughts of the scientist and which would best match the thoughts of an engineer. It is intended that there will be an equal number of phrases for each group (scientist and engineer). This is designed to be a relatively short activity with no defined answers, aimed to prompt engagement.

SLIDE 2:

Move the children onto thinking about their own senses – sight, hearing, touch, smell and taste. Explore with the children what types of information their body receives through their senses. Build their understanding that the information they receive can be described as an 'input' – something being received into the body and their senses receive this information, e.g to see they use their eyes, to hear they use their ears.

Some digital devices work in the same way – they receive an input from a sensor and they use this information to produce an output from an output device, such as a buzzer creating an alarm sound.

An example: Street lamps

A light sensor (input device) detects the changes in light levels throughout the day. This data is sent to a digital device which will activate a bulb (output device) to shine (output) when it gets dark.

Now watch the video clip. Ask pupils to identify from the video clip what information the football playing robots are sensing. Encourage them to use the language of outputs, input device and output device.

For this example consider:
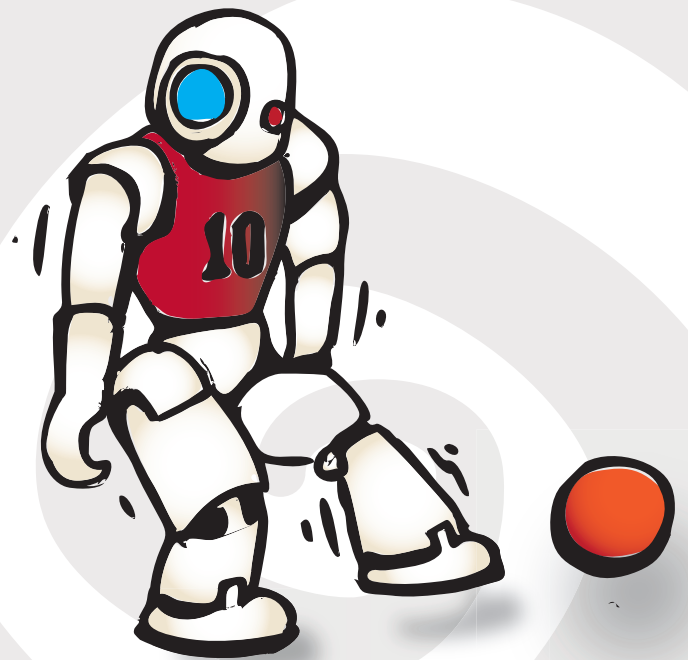*The ball is sensed coming closer to the robot using a sensor.*
Input device = distance sensor
Output device = motor
Output = swing of the leg to kick the ball
Use Challenge Sheet 2-2 to explore the concepts of input, output etc.

Use Pupil Challenge Sheet 2:2 to engage the children in a card sorting activity, where they identify and sort more examples of inputs, outputs etc.

PART 2: SEQUENCING AND CODING

SLIDE 3:

Before pupils begin to work with sensors on their audiobot they need to appreciate the importance of correctly sequencing the code they write, similar to the order in which a recipe order makes for a good outcome. This will be done through drama – where the children are actively demonstrating how simple tasks are undertaken.

Organise the class into six groups. Each group should l be given a different sequence card to act out in mime (Refer to Pupil Challenge Sheet 2:3). Note that the scnearios are look similar but there are changes in the sequence. Pupils perform their sequence (one minute maximum). Based upon all the performances, pupils are asked to work out which group relates closest to them but in doing so explain the difference. One group is a 'buggy' sequence (one with errors in it) and the other a debugged one (error-free).

SLIDE 4:

The pupils now have understanding of different inputs and outputs on digital devices and how the information they receive in code has to be correctly sequenced in order to work. This part of the activity encourages them to become familiar with the Crumble Controller. This is a digital device that takes inputs and gives outputs in a range of ways when connected to different sensors such as light sensors, temperature sensors and distance sensors.

Provide the pupils with a Crumble Controller (recommended one between three/four pupils maximum). Allow them to experiment and tinker with the kit, responding to the list of Challenges set on Slide 4. The Crumble Controller is coded in a very similar way to Scratch so pupils should be able to transfer knowledge and create code by dragging together command blocks.

Note: Use the Pupil Hint Sheet 2:1 if required. It is important that pupils are confident to code the Crumble so that they can apply to the audiobot.

PART 3: MODIFYING AND REFINING

SLIDE 5:

The knowledge and skills developed so far lead pupils to being confident to modify their audiobot. The purpose of this part of the episode is to understand how modifying the audiobot can result in a device that is even more useful to us in everyday life.

Watch the film produced by the Institute of Engineering (http://www.engineer-a-better-world.org/). Encourage the children to think about their home, school and community where engineering makes a difference to our lives. Explain to the children that engineering is the thinking about a problem and planning how to create a solution that makes a difference to our lives and wellbeing. It doesn't happen by chance – it comes through thoughtful exploration and observing what happens and asking the questions – how, why and what if?

SLIDE 6 AND 7:

The pupils now have the opportunity to modify their audiobot, responding to the two problems they are faced with. Pupils carry out the modification by deciding on what inputs and outputs they need to see happen, and the devices that will help them achieve this. Using the Crumble Controller and by dragging command blocks, they should create the code to make the modification to the audiobot. Pupil Hint Sheet 2:2

Encourage the pupils to demonstrate the habits of mind of an engineer and to persevere, collaborate and being open minded.

PART 4: PLENARY

SLIDE 8:

As a plenary use the laminated placemat (Pupil Challenge 2:4). Ask pupils, in pairs, to discuss and write the names of five other useful digital devices that could be made from the audiobot on each finger of the hand. Ask the group to decide which is their 'top' idea and to write it on the palm. If desirable, task the pupils with writing an email or letter to the Halleoojameflipaphone team to justify why their top devices should be explored further

HOMELINK:

A chat challenge - list five devices in the home that make a sound but would be even better if they could be controlled with an input device other than the on/ off button, e.g. it could be controlled by a light sensor, temperature sensor, movement sensor etc..

WEBSITES:

Football robots: www.youtube.com/watch?v=GuXLvrBrO3s

IET film: www.engineer-a-better-world.org/

Crumble software download: https://redfernelectronics.co.uk/crumble-software/

GLOSSARY:

A **digital device** may be considered any computer system, including programmable hardware or computer systems such as a desktop PCs, laptops or tablet devices.

Coding is expressing an algorithm in a programming language

Control is creating instructions that change the physical world, which might include the use of sensors to influence what needs to be done.

Input is data sent to a computer system.

Output is data or information sent from a computer system to the outside world.

Buggy code contains errors and will not work as expected.

Debugged code has had any errors removed and will work as expected.

Input devices enable information from the outside world to get into a computer. Examples include a keyboard, mouse, microphone, camera or distance sensor.

Output devices enable the computer system to communicate information to the outside world. Examples include a screen, speakers, a printer or control devices like motors, lights and buzzers.

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