**Year 4 Autumn 1 – Summer 1 Art Bot Design and Technology (Computing & Electronics)**

As Designers we will explore how electrical components can be used to create different products. We will use motors to create an art bot, and we will use various components of the Crumble Kit to create a programmable electric car. We will then use our knowledge of circuits to create a working intruder alarm.

NC Content

* develop the creative, technical and practical expertise needed to perform everyday tasks confidently and to participate successfully in an increasingly technological world

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| **Materials required for this unit:*** A range of materials (card, cardboard, recycled plastic, lego, plastic cups, straws etc)
* Batteries

Art bot:* Motors
* Pens
* Battery holders
* Wires

Electric Car:* Crumble Buggy Chassis (buy from Redfern website [here](https://redfernelectronics.co.uk/product/crumble-card-buggy-chassis-pack-of-10/) or use template in 365)
* Crumble Kit (request loan of kit from NCCE for duration of episode 2 [here](https://docs.google.com/forms/d/e/1FAIpQLSfAHlpTc4lZOKxsfnsMQHOmCMkKsawNsEoNiYHmrf1O0ZoZ3g/viewform) by filling out form and selecting ‘physical computing’)

Intruder Alarm:* Intruder alarm kit. ([Amazon](https://www.amazon.co.uk/Science-Museum-4132SM-Intruder-Alarm/dp/B000FCM0B0/ref%3Dsr_1_6?crid=5MKRO8X4REGQ&keywords=intruder+alarm+kit+for+kids&qid=1643719003&sprefix=intruder+alarm+kit+for+kids%2Caps%2C69&sr=8-6))
 | **Tools and equipment required for this unit:*** Glue
* Sellotape
* Electrical tape
* Scissors
* Glue guns
* Screwdrivers
* ????
 | **Vocabulary**seriesparallelcircuitmotorsinputsoutputsprogrammingdebuggingsensoralgorithmselection (computing)intruderbuzzereffective |

* build and apply a repertoire of knowledge, understanding and skills in order to design and make high-quality prototypes and products for a wide range of users
* critique, evaluate and test their ideas and products and the work of others
* understand and apply the principles of nutrition and learn how to cook.

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| Episode 1 - Art BotBy the end of this learning sequence, children will know:* About how the invention of robots has impacted upon society.
* How series circuits compare to parallel circuits and the benefits of each.
* How to create a series circuit as part of a design, using this with a motor to create a purposeful product.
* How to create an exploded diagram to represent design ideas. This will be labelled with materials and measurements to the nearest millimetre.
* How to create purposeful products selecting appropriate materials and tools.
* How to work with electrical components safely.
* How to evaluate a product against its design criteria to determine whether or not it is fit for purpose. Use this evaluation to suggest and implement adjustments to the product to improve its effectiveness.
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| Research:Procedural skill:Create series and parallel circuits.Identify some of the great designers in all of the areas of study (including pioneers in horticultural techniques) to generate ideas for designs.Disassemble products to understand how they work.NC links: Pupils should be taught to:Investigate and analyse a range of existing products.Understand how key events and individuals in design and technology have helped shape the world. Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Science NC:identify common appliances that run on electricity.Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Identify whether or not a lamp will light in a simple series circuit, based on whether or not the lamp is part of a complete loop with a battery.Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit.Recognise some common conductors and insulators, and associate metals with being good conductors.Research –What is a robot?Who invented the first robot?How have robots changed over time?How have robots impacted society? (e.g. start to think about self-checkouts, self-driving cars)What is artificial intelligence? Who invented it? How is it being used now?Recap understanding of series circuits from Y3. Children to construct a simple series electrical circuit and identify the basic parts: cell, wires, bulbs, switches and buzzers. (Note: children have not used a ‘typical’ circuit kit in Year 3 – this was done using the MakeyMakey so they may be unfamiliar with some of the terminology). Identify whether or not the bulb will light up based on whether or not it is part of a complete loop with a battery. Add a switch into the circuit and acknowledge that this completes/breaks the circuit and therefore turns on/off the light.Introduce children to parallel circuits. How do they work in comparison to a series circuit? What would be the benefits of a parallel circuit?Identify some appliances that use circuits. Which materials should be used in circuits? Explore with common conductors and insulators.Explore motors in different products. Recognise that a motor allows us to convert electrical energy into physical movement. These can be connected to circuits and can be used to make products move.Children to experiment with different types of motors and explore how to connect these into a circuit to make them move. Explore electricity safety. Why is it important to use electrical tape? Why must the battery pack be turned off when we are connecting wires? | DesignProcedural skill:Design with purpose by identifying opportunities to design.NC Links:Pupils should be taught to:use research and develop design criteria to inform the design of innovative, functional,appealing products that are fit for purpose, aimed at particular individuals or groups.Generate, develop, model and communicate their ideas through discussion, annotatedsketches, cross-sectional and exploded diagrams, prototypes, pattern pieces andcomputer-aided design.Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Recognise some common conductors and insulators, and associate metals with being good conductors.Design criteria:You need to create a small robot that can be used to create different art designs using pens. It must use a simple circuit and be made from everyday materials. The Art Bot must be safe for young children to use.Use [this video](https://www.youtube.com/watch?v=daWU2Oh_xlg) to help you with this unit. Allow children time to explore and come up with their own ideas, but have this in mind when guiding them.Carefully consider which materials would be the most appropriate for creating the Art Bot. Will it work effectively if the body of the product is heavy? Why/why not? Explore which materials would be the most suitable.Use research from how a motor works to identify how the art bot should be constructed, relating back to its purpose. Create an exploded diagram to develop and communicate ideas. Note: children do NOT need to use the scientific circuit symbols as these will be introduced in Y6. Label the exploded diagram with materials and measurements (to the nearest millimetre) and explain how the product will work. Children to explore with different joining methods for how they will secure the electrical components to the art bot so that the force of the motor does not detach them from the robot. Build on understanding from strengthening materials in Y2/3. Edit the design as necessary.  | MakeProcedural skill:Cut materials accurately and safely by selecting appropriate tools. Measure and mark out to the nearest millimetre.Apply appropriate cutting and shaping techniques that include cuts within the perimeter of the material (such as slots or cut outs).Select appropriate joining techniques.Create series and parallel circuits.Choose suitable techniques to construct products.Strengthen materials using suitable techniques.Make products by working efficiently (such as by carefully selecting materials).Refine work and techniques as work progresses, continually evaluating the product design.NC Links:Pupils should be taught to:select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately.Select from and use a wider range of materials and components, including constructionmaterials, textiles and ingredients, according to their functional properties and aestheticqualities.Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Recognise some common conductors and insulators, and associate metals with being good conductors.Make the Art Bot. Ensure that materials are measured and cut accurately to the nearest millimetre. Cut and shape the materials using appropriate techniques (e.g. how will children make slots or cut outs to allow for the motor?). Use appropriate joining techniques to secure the components together.  | EvaluateProcedural skill:Improve upon existing designs, giving reasons for choices.Refine work and techniques as work progresses, continually evaluating the product design.NC Links: Pupils should be taught to:evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Recognise some common conductors and insulators, and associate metals with being good conductors.Recognise that a switch opens and closes a circuitEvaluate the product against the design criteria. Is the design fit for purpose? Does it work as expected? Children to suggest improvements to their design (e.g. can the children alter the design to add a working switch/light?) Implement the adjustments to the product and then re-test and evaluate again. Have the amendments improved the overall effectiveness of the product? |

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| Episode 2 - Electric CarUse this video to help with ideas for the design of the car: <https://youtu.be/fcCn-s7BmrQ> <https://ukstem.uk/product/cub/> By the end of this learning sequence, children will know:* How the invention of cars (and electric cars) has impacted upon the world. Why are people creating more electric cars now?
* How the Crumble kit can be programmed using computer software and how inputs (light sensors, button presses) and outputs (sparkles, motors) work with the kit.
* How to design, write and debug programs that can be used to control physical systems. (Computing)
* How to select and use appropriate materials to create a structure, using appropriate cutting, shaping and joining techniques and measuring and marking out to the nearest millimetre.
* How to create a programmable electric car that is fit for purpose, and evaluate this against the design criteria, suggesting and implementing improvements.
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| Research:Procedural skill:Create series and parallel circuits.Identify some of the great designers in all of the areas of study (including pioneers in horticultural techniques) to generate ideas for designs.Disassemble products to understand how they work.Control and monitor models using software designed for this purpose.NC links: Pupils should be taught to:Investigate and analyse a range of existing products.Understand how key events and individuals in design and technology have helped shape the world. Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Apply their understanding of computing to program, monitor and control their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Computing NC:Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs.Research into how cars have changed over time and the invention of electric cars. (e.g. Tesla). Who invented the first car? Who invented the first electric car? Why are people pushing the invention of electric cars? How have cars shaped the world?Explore how a motor can be used to power wheels on a car. Look at examples of motor-powered electric cars. How do they work? (Look at this as part of Robot visit)Explore the Crumble software. Link this to understanding of circuits – can the children investigate with programming the crumble software to light up the sparkles? Link this to computing objectives from the [computing curriculum](https://hcat.sharepoint.com/%3Aw%3A/s/Longhill/EZUuUwu2vHhHsFW_kbj3AgwBWMAmCcl9_fYP8h6lK4XHVA?e=0ChVw1). Explore using the motors with the crumble kit and software. How can these be programmed? How can they move faster/slower/turn/reverse? Will the car be supported with just two wheels? How can we add further support to a vehicle? (Note: with the crumble, only two wheels are programmable. Children will need to add additional wheel(s) for stability). | DesignProcedural skill:Design with purpose by identifying opportunities to design.Control and monitor models using software designed for this purpose.NC Links:Pupils should be taught to:use research and develop design criteria to inform the design of innovative, functional,appealing products that are fit for purpose, aimed at particular individuals or groups.Generate, develop, model and communicate their ideas through discussion, annotatedsketches, cross-sectional and exploded diagrams, prototypes, pattern pieces andcomputer-aided design.Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Apply their understanding of computing to program, monitor and control their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Computing NC:Design, write and debug programs that accomplish specific goals, including controlling physical systems; solve problems by decomposing them into smaller parts.Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs.Design criteria:You need to create a programmable electric car. It should work using 2 motors and you should be able to program it to move around a given area using a computer. The design needs to be sturdy. The car should be able to be driven both during the daytime and at night time.Note: children will create a cart/buggy that can be controlled by the crumble software. It will have 2 wheels controlled by motors and 1/2 other wheels for support. The car should use sparkles as ‘lights’ to allow it to be used at night time. This can be linked with using light sensors for them to come on automatically. Use [this video](https://youtu.be/mlj6uM1c9Wo) to help you with using light sensors. Remember, when using sparkles the first sparkle in the chain is always ‘sparkle 0’.Acknowledge the light sensor as a form of input (build on knowledge of inputs/outputs from Y3 computing). Children to investigate with [how to use the light sensor](https://hcat.sharepoint.com/%3Ab%3A/s/Longhill/EV7FOL0q7jlPslLXK5xznv0BZxHPSvNnvfknWzeg49FoTw?e=X7pxVN) to automatically control the lights (sparkles) on the crumble kit. How does the equipment need to be connected? What algorithm needs to be used?Explore which materials would be the most appropriate for creating the body of the car (e.g. lego/recycled plastic / cardboard etc). Will it work effectively if the body of the product is heavy? Why/why not? Explore which components of the crumble kit will be necessary.Use research from how a motor works and how cars move to identify how the electric car should be constructed, relating back to its purpose. Create an exploded diagram to develop and communicate ideas. Note: children do NOT need to use the scientific circuit symbols as these will be introduced in Y6. Label the exploded diagram with materials and measurements (to the nearest millimetre) and explain how the product will work, remembering to link this back to the purpose.Explore with different joining methods for how they will secure the electrical components to the body of the car so that it is secured in place. Build on understanding from strengthening materials in Y2/3. Edit the design as necessary. Create a prototype of the car to support creating a plan for the program to control the electric car. It must be able to move forward, reverse and turn around a given space, as well as use a light sensor to control the sparkles. Children to create a floor map for the car to move around and plan an algorithm that will allow the car to move in the right directions. (At this stage, it may not be accurate with how many seconds to wait however children will have a rough outline of the algorithm that will be used). Use Seesaw alongside their exploded diagrams and algorithm plans to explain how their car will work.  | MakeProcedural skill:Cut materials accurately and safely by selecting appropriate tools. Measure and mark out to the nearest millimetre.Apply appropriate cutting and shaping techniques that include cuts within the perimeter of the material (such as slots or cut outs).Select appropriate joining techniques.Create series and parallel circuits.Choose suitable techniques to construct products.Strengthen materials using suitable techniques.Make products by working efficiently (such as by carefully selecting materials).Refine work and techniques as work progresses, continually evaluating the product design.Control and monitor models using software designed for this purpose.NC Links:Pupils should be taught to:select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately.Select from and use a wider range of materials and components, including constructionmaterials, textiles and ingredients, according to their functional properties and aestheticqualities.Understand and use mechanical systems in their products.Understand and use electrical systems in their products.Apply their understanding of computing to program, monitor and control their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Computing NC:Design, write and debug programs that accomplish specific goals, including controlling physical systems; solve problems by decomposing them into smaller parts.Use sequence, selection, and repetition in programs; work with variables and various forms of input and output.Use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs.Make the electric car. Ensure that materials are measured and cut accurately to the nearest millimetre. Cut and shape the materials using appropriate techniques. Use appropriate joining techniques to secure the components together. Create the program for the car and make adjustments to the programming throughout – this process is called debugging (finding and resolving errors).  | EvaluateProcedural skill:Improve upon existing designs, giving reasons for choices.Refine work and techniques as work progresses, continually evaluating the product design.Control and monitor models using software designed for this purpose.NC Links: Pupils should be taught to:evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. 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Children to suggest improvements to their design (e.g. does the light sensor need to be in a different place? Do they need to add further stability? Can they program the car to move faster/manoeuvre more obstacles?) Implement the adjustments to the product and then re-test and evaluate again. Have the amendments improved the overall effectiveness of the product? |

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| Episode 3 – Intruder AlarmBy the end of this learning sequence, children will know:* How the invention of the intruder alarm impacted upon the world.
* How intruder alarms use circuits and a range of inputs/outputs.
* How to create an exploded diagram to communicate ideas about creating an intruder alarm.
* How to use screwdrivers and screws to join materials together.
* How to make an intruder alarm using circuits and evaluate this against the design criteria, suggesting improvements to improve the design.
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| Research:Procedural skill:Create series and parallel circuits.Identify some of the great designers in all of the areas of study (including pioneers in horticultural techniques) to generate ideas for designs.Disassemble products to understand how they work.NC links: Pupils should be taught to:Investigate and analyse a range of existing products.Understand how key events and individuals in design and technology have helped shape the world. .Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Research into the purpose of an intruder alarm and how they work. How have intruder alarms changed overtime? Consider how lots of motion cameras link to smart phones – what are the benefits of this?Research into the inputs (e.g. light/motion/noise sensors) and outputs (light, sound) of intruder alarms. Which are more effective and why? How do they work? Explore these inputs and outputs.Disassemble existing intruder alarms to explore how the product is made up. How can it be recreated? How would it be improved upon? | DesignProcedural skill:Design with purpose by identifying opportunities to design.NC Links:Pupils should be taught to:use research and develop design criteria to inform the design of innovative, functional,appealing products that are fit for purpose, aimed at particular individuals or groups.Generate, develop, model and communicate their ideas through discussion, annotatedsketches, cross-sectional and exploded diagrams, prototypes, pattern pieces andcomputer-aided design.Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Design criteria:You need to create an intruder alarm that uses inputs and outputs to warn you of someone’s presence.Provide children with the components required to create the intruder alarm (intruder alarm kit). Explore how this will need to be put together to work effectively. How will the circuit be completed?Practise using screws and screwdrivers to join materials together. Create an exploded diagram to develop and communicate ideas. Note: children do NOT need to use the scientific circuit symbols as these will be introduced in Y6. Label the exploded diagram with materials and explain how the product will work, remembering to link this back to the purpose.Use Seesaw alongside their exploded diagrams to explain how their car will work.  | MakeProcedural skill:Select appropriate joining techniques.Create series and parallel circuits.Choose suitable techniques to construct products.Strengthen materials using suitable techniques.Make products by working efficiently (such as by carefully selecting materials).Refine work and techniques as work progresses, continually evaluating the product design.NC Links:Pupils should be taught to:select from and use a wider range of tools and equipment to perform practical tasks [for example, cutting, shaping, joining and finishing], accurately.Select from and use a wider range of materials and components, including constructionmaterials, textiles and ingredients, according to their functional properties and aestheticqualities.Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Make the intruder alarm using appropriate joining techniques to secure the components together and use knowledge of circuits to ensure the circuit is complete.  | EvaluateProcedural skill:Improve upon existing designs, giving reasons for choices.Refine work and techniques as work progresses, continually evaluating the product design.NC Links: Pupils should be taught to:evaluate their ideas and products against their own design criteria and consider the views of others to improve their work. Understand and use electrical systems in their products.Science NC:Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers.Test the intruder alarm. Evaluate the product against the design criteria. Is the design fit for purpose? Does it work as expected? Children to suggest improvements to their design (e.g. what would make the alarm more effective? Which other inputs/outputs could be used?) |