LEGO® Education WeDo 2.0 Computational Thinking

Teacher's Guide

WeDo 2.0

LEGO education

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The LEGO® Education community is an online community for teachers, administrators and other professionals in education.
It is a place to connect and share ideas, engage in discussions and share lesson plans and projects.
The LEGO Education community is only in English.

Developing Computational Thinking with WeDo 2.0 Projects

In this chapter you will discover how you can use WeDo 2.0 to develop your pupils' computational thinking skills within a science context.

Develop Computational Thinking with LEGO® Education WeDo 2.0 Projects

LEGO® Education is pleased to present these projects, which have been specifically designed for use in primary school classrooms to develop pupils' computational thinking skills.

Computational thinking is a set of skills that everybody can use to solve everyday life problems. In WeDo 2.0, these skills are developed throughout each phase of every project. Development opportunities have been identified for you in each of the projects and it is up to you to focus on the ones that are most relevant to you and your pupils.

Every project in WeDo 2.0 combines the use of the LEGO® bricks with an iconic programming language, enabling your pupils to find solutions to problems as they are being introduced to programming principles.

WeDo 2.0 develops computational thinking through coding activities, which bring your pupils' creations to life, generating smiles and the desire to discover more.

Computer Science, Computational Thinking, Coding

While the science and engineering fields originated in the early ages of humankind, computer science has a much younger history. Nevertheless, this young discipline has influenced not only the way we approach science and engineering, but also the way in which we live our lives.

Computer Science is a STEM discipline, sharing attributes with science, technology, engineering and mathematics.

All of the STEM disciplines present opportunities for your pupils develop a mindset and a lifelong set of practices. Among these practices are the ability to ask questions, to design solutions and to communicate results.

Computational thinking is another one of these practices. It is a way in which we think and it is a way in which everybody can solve problems.

Computational thinking can be described as a group of skills, one of which is algorithmic thinking. 'Code' or 'coding' can be used to describe the action of creating an algorithm.

Coding is therefore one vehicle by which to develop your pupils' computational thinking within a STEM context.

STEM Disciplines

Science, Technology, Engineering, Mathematics, Computer Science

Develop a Mindset and a Lifelong Set of Practices

1. Ask questions and solve problems
2. Use models
3. Design prototypes
4. Investigate
5. Analyse and interpret data
6. Use computational thinking
   a. Decompose
   b. Abstract
   c. Think algorithmically (code)
   d. Evaluate
   e. Generalise
7. Engage in argument from evidence
8. Obtain, evaluate and communicate information

What is computational thinking ?

The expression 'computational thinking' was first used by Seymour Papert, but Professor Jeannette Wing is known to have popularised the idea. She defined computational thinking as:

'the thought processes involved in formulating problems and their solutions so that the solutions are represented in a form that can be effectively carried out by an information-processing agent.' (Wing, 2011)

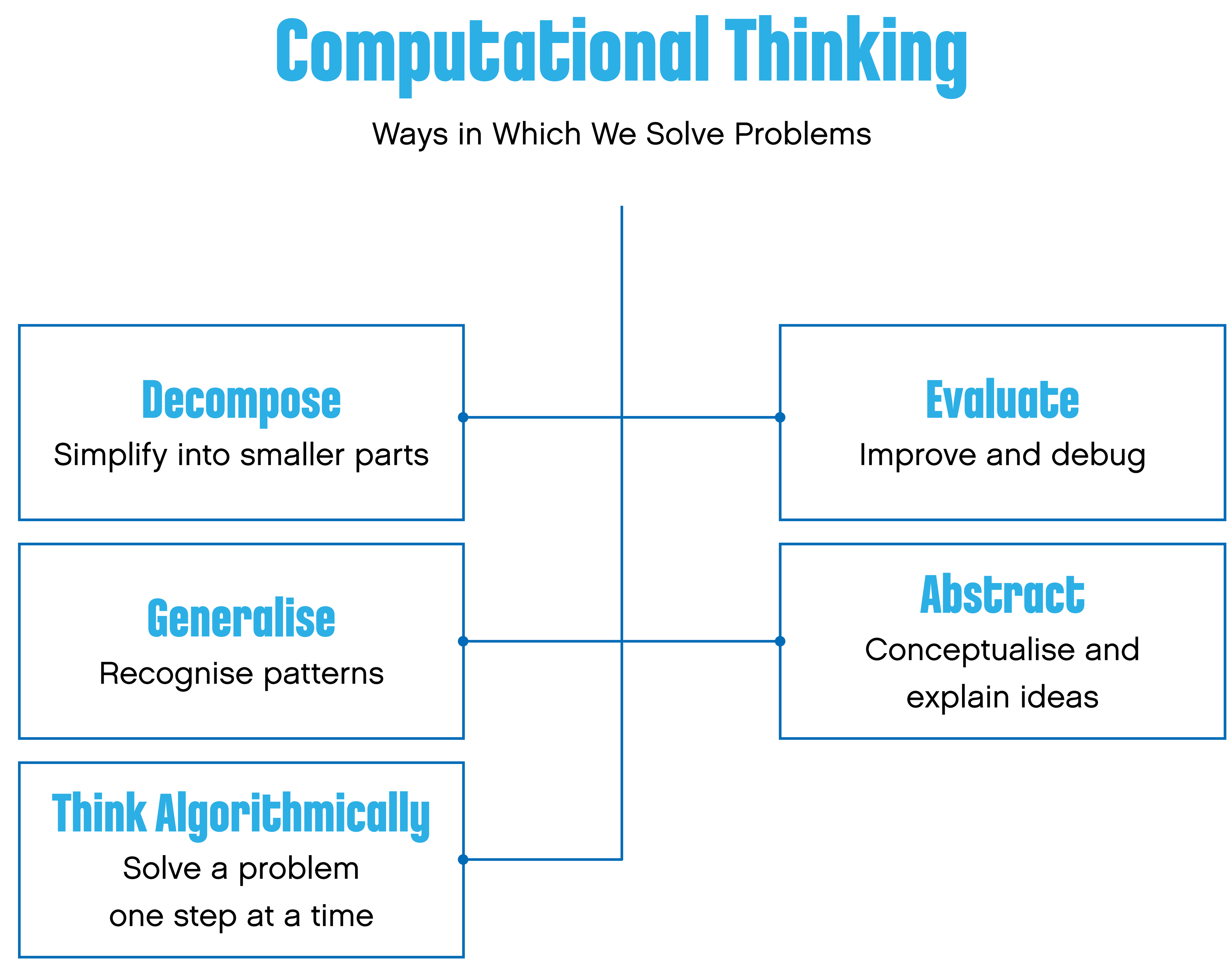
Computational thinking is used in various fields and situations, and we use it in our daily lives. Computational thinking skills are present in science, engineering and mathematics. These skills can be defined as the following:

Decomposition
Decomposition is the ability to simplify a problem into smaller parts in order to ease the process of finding a solution. By doing so, the problem becomes easier to explain to another person or to separate into tasks. Decomposition frequently leads to Generalisation.

Example: When you are going on holiday, the preparation (or project) can be separated into subtasks: booking the airfare, reserving a hotel, packing a suitcase, etc.

Generalisation (Pattern Recognition)
Generalisation is the ability to recognise the parts of a task that are known or that have been seen somewhere else. This frequently leads to easier ways of designing algorithms.

Example: Traffic lights work by repeating the same series of actions forever.



What is computational thinking ?

Algorithmic Thinking

Algorithmic Thinking is the ability to create an ordered series of steps with the purpose of solving a problem.

Example one: when we cook from a recipe, we are following a series of steps in order to prepare a meal.
Example two: when we are using computers, we can code a sequence of actions that tell the computer what to do.

Evaluating or Debugging

This is the ability to verify whether or not a prototype works as it was intended, and if not, the ability to identify what needs to be improved. It is also the process that a computer programmer goes through in order to find and correct mistakes within a program.

Example one: when we are cooking, we will periodically taste the dish to check whether or not it is seasoned correctly.
Example two: when we look for spelling mistakes and missing punctuation in our written work, we are debugging it so that it can be read correctly.

Abstraction

Abstraction is the ability to explain a problem or a solution by removing unimportant details. In other words, being able to conceptualise an idea.

Example: When we are describing a bicycle, we use only some details to describe it. We might mention its type and colour, and add more details for someone who has a real interest in bikes.

A Process for Developing Computational Thinking Skills

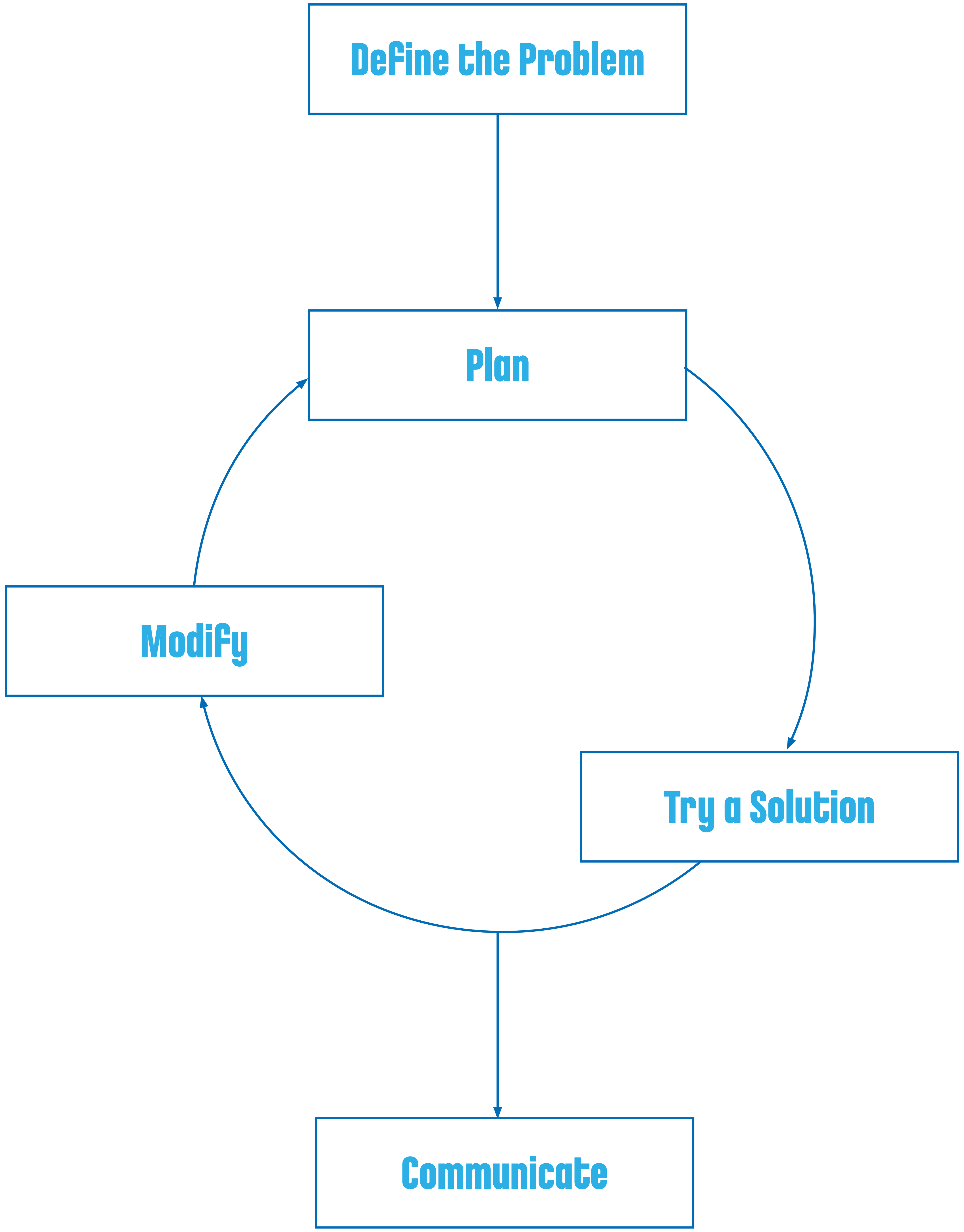
Using an Engineering Design Process
When they are looking for solutions to a problem, engineers use a design process. They go through a series of phases that guide them towars a solution. During each of these phases, some of their skills are used or developed. It is those skills that we we refer to as 'computational thinking skills'.

In WeDo 2.0, your pupils will follow a similar process:

Defining the Problem
The pupils are presented with a topic that guides them to a problem or to a situation that they wish to improve. Sometimes a problem can have a lot of details. In order to make it easier to solve, the problem can be broken down into smaller parts.

By defining the problem in a simple way and by identifying some success criteria, the pupils will develop a skill called 'Decomposition'.

In other words:
- *Is the pupil able to explain the problem by themselves?*
- *is the pupil able to describe how they will evaluate whether or not they were successful in solving the problem?*
- *Is the pupil able to break down the problem into smaller and more manageable parts?*



A Process for Developing Computational Thinking Skills

Planning
The pupils should spend some time imagining different solutions to the problem and then make a detailed plan for executing one of their ideas. They will define the steps that they will need to go through in order to reach the solution. By identifying the parts of the task they might have seen before, they will develop a skill called 'Generalisation'.

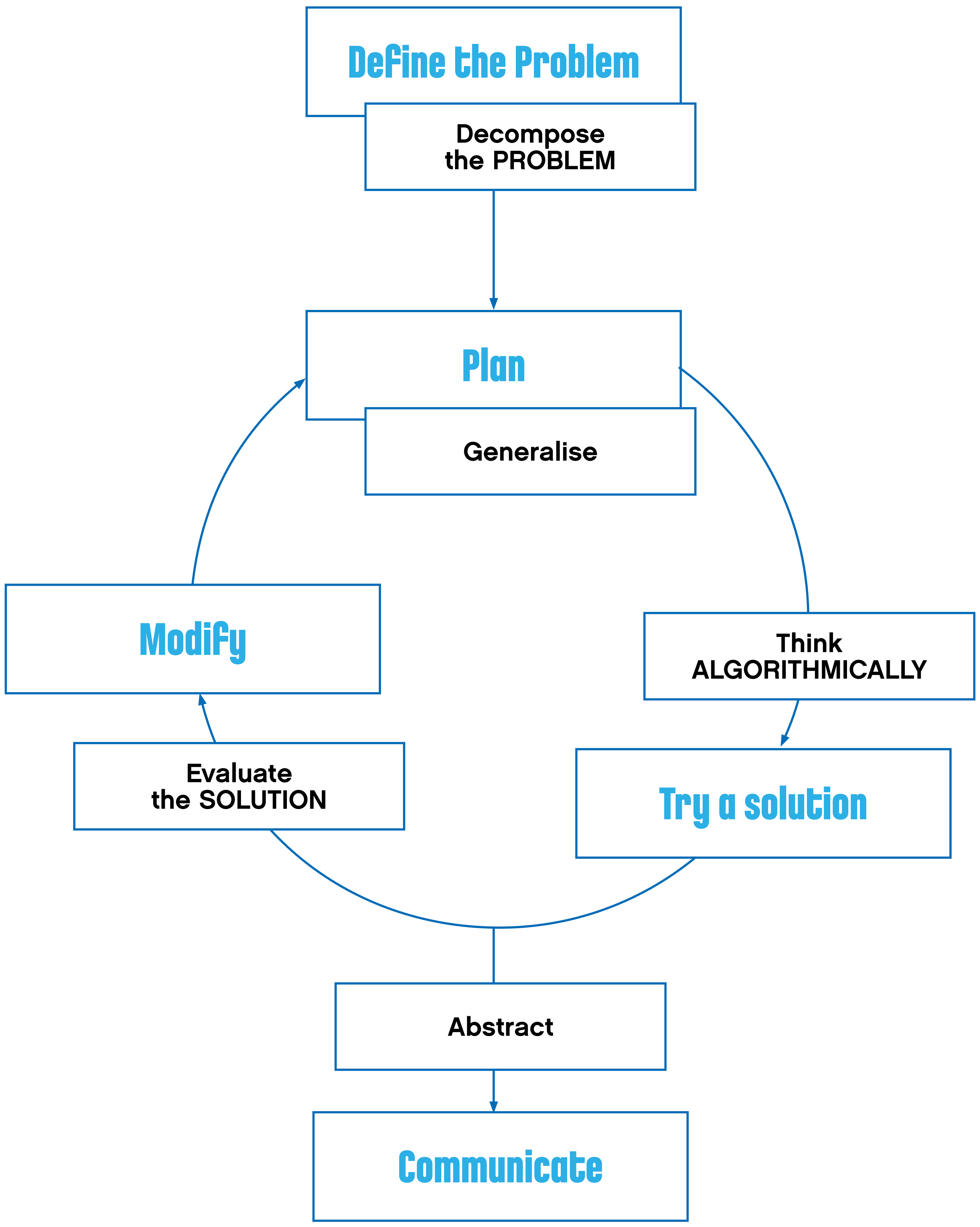
In other words:
- *Is the pupil able to make a list of actions to program?*
- *Is the pupil able to identify parts of existing programs that they could use?*
- *Is the pupil able to reuse parts of programs?*

Trying
Each pupil is then tasked with creating the final version of their solution. In this phase of the process, they use iconic programing language to activate their LEGO® models. As the pupils code their ideas, they develop their Algorithmic Thinking skills.

In other words:
- *Is the pupil able to program a solution to a program?*
- *Is the pupil able to use sequence, loops, conditional statements, etc.?*

Modifying
The pupils will evaluate their solutions according to whether or not their program and model meet the success criteria. Using their Evaluation skills, they will determine whether they need to change, fix, debug or improve some part of their program.

In other words:
- *Is the pupil making iterations of their program?*
- *Is the pupil fixing problems in their program ?*
- *Is the pupil able to judge if the solution is linked to the problem ?*



A Process for Developing Computational Thinking Skills

Communicating
Each pupil will present the final version of their solution to the class, explaining how their solution meets the success criteria. By explaining their solution with the right level of detail, they will develop their Abstraction and communication skills.

In other words:
- Is the pupil *explaining the most important part of their solution?*
- *Is the pupil giving enough detail to enhance comprehension?*
- *Is the pupil making sure to explain how their solution meets the success criteria*?

Developing Computational Thinking through Coding

In order to develop their Algorithmic Thinking skills the pupils will be introduced to some programming principles. As they develop their solutions, they will organise a series of actions and structures that will bring their models to life.

The most common WeDo 2.0 programming principles that your pupils will use are:

1. Output
Output is something that is controlled by the program that the pupils are writing. Examples of outputs for WeDo 2.0 are sounds, lights, display and turning motors on and off.

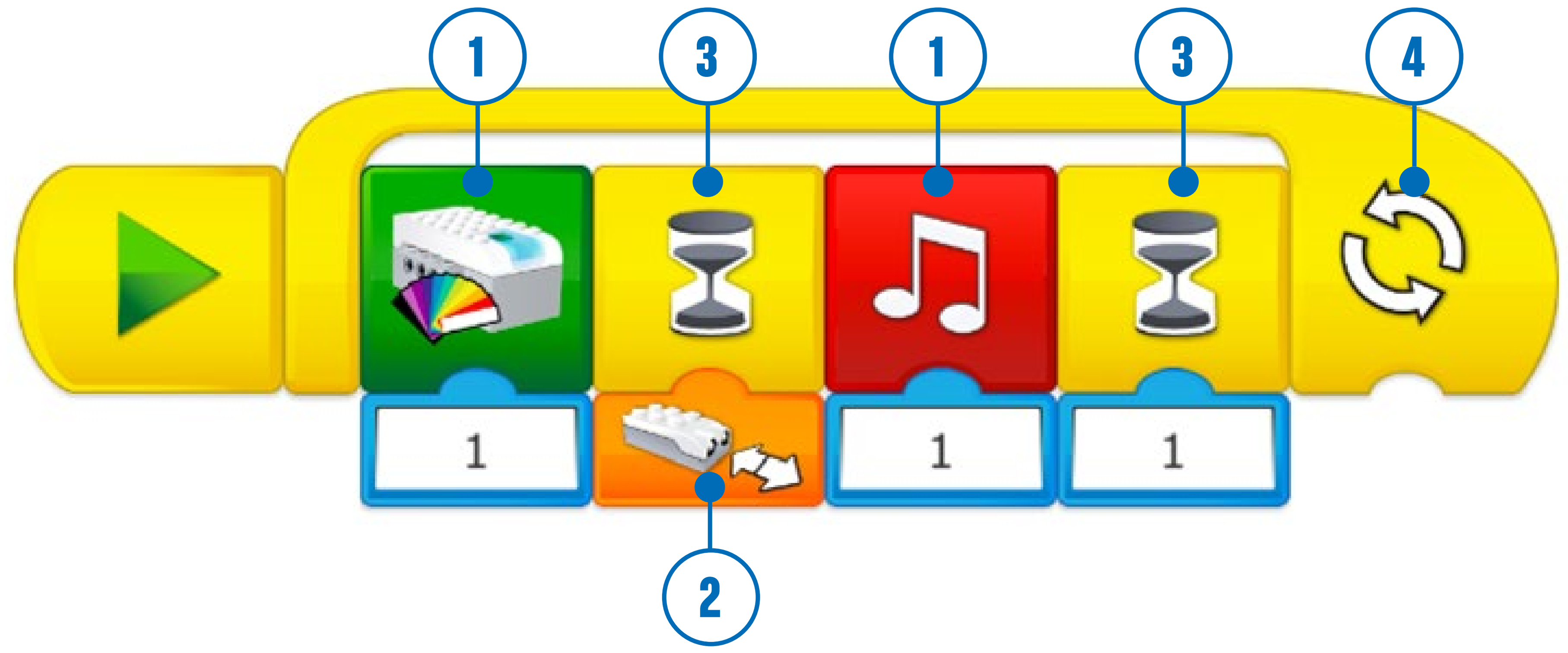
2. Input
Input is information that a computer or device receives. It can be entered through the use of sensors in the form of a numeric or text value. For example, a sensor that detects or measures something (such as distance) converts that value into a digital input signal so that it can be used in a program.

3. Events (Wait for)
The pupils can tell their program to wait for something to happen before continuing to execute the sequence of actions. Programs can wait for a specific length of time or wait for something to be detected by a sensor.

4. Loop
The pupils can program actions to be repeated either forever or for a specific number of times.

5. Functions
Functions are a group of actions that are to be used together in specific situations. For example, the group of blocks (actions) that can be used to make a light blink would together be called, 'the blink function'.

6. Conditions
Conditions are used by the pupils in order to program actions that are to be executed only under certain circumstances. Creating conditions within a program means that some part of the program will never be executed if the condition is never met. For example, if the Tilt Sensor is tilted left, the motor will start, and if the sensor is tilted right, the motor will stop; if the Tilt Sensor never tilts left, the motor will never start and if it never tilts right, then the motor will never stop.



WeDo 2.0 in the Curriculum

The Computing Curriculum for Key Stages 1 to 4 in England has a much stronger emphasis on programming and coding than ever before.

The LEGO® Education WeDo 2.0 solution combines LEGO® bricks with the expectations of the National Curriculum Science and Computing programmes of study. All of the WeDo 2.0 projects are designed to develop pupils' computational thinking skills.

Computational Thinking in the Curriculum

This material is aimed Key Stage 2 but can be adapted for any primary school year group.
The National Curriculum in England Computing Programme of Study aims to ensure that all pupils:

- can understand and apply the fundamental principles and concepts of computer science, including abstraction, logic, algorithms and data representation.
- can analyse problems in computational terms and have repeated practical experience of writing computer programs in order to solve such problems.
- can evaluate and apply information technology, including new or unfamiliar technologies, analytically to solve problems.
- are responsible, competent, confident, and creative users of information and communication technology.

To reach those goals, LEGO Education have developed further Projects with direct links to the requirements of the Computing Curriculum at Key Stage 2.

Using these materials, pupils will develop their skills and an understanding of these requirements.

Pupils should be taught to:

- design, write, and debug programs that accomplish specific goals, including controlling or simulating 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 problems.
- use search technologies effectively, appreciate how results are selected and ranked and be discerning in evaluating digital content.
- select, use, and combine a variety of software (including Internet services) on a range of digital devices to design and create a range of programs, systems and content that accomplish given goals, including collecting, analysing, evaluating and presenting data and information.
- use technology safely, respectfully and responsibly; recognise acceptable/unacceptable behaviour; identify a range of ways to report concerns about content and contact.
- understand computer networks including the Internet; how they can provide multiple services, such as the World Wide Web; and the opportunities they offer for communication and collaboration.

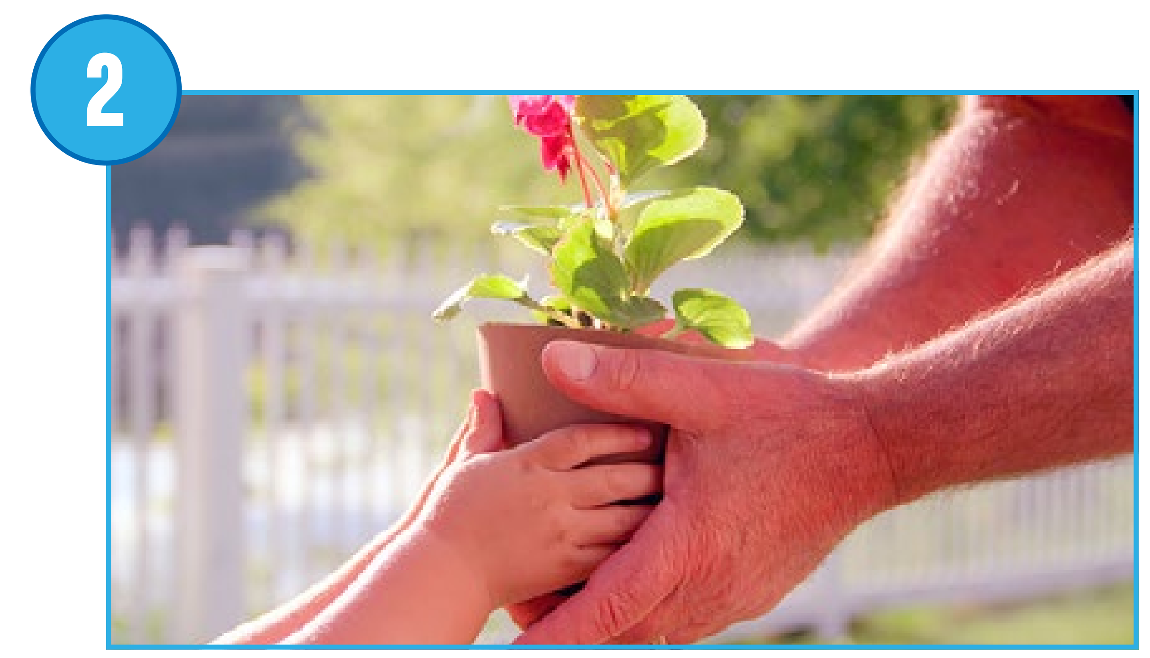
Visual Overview of the Guided Projects

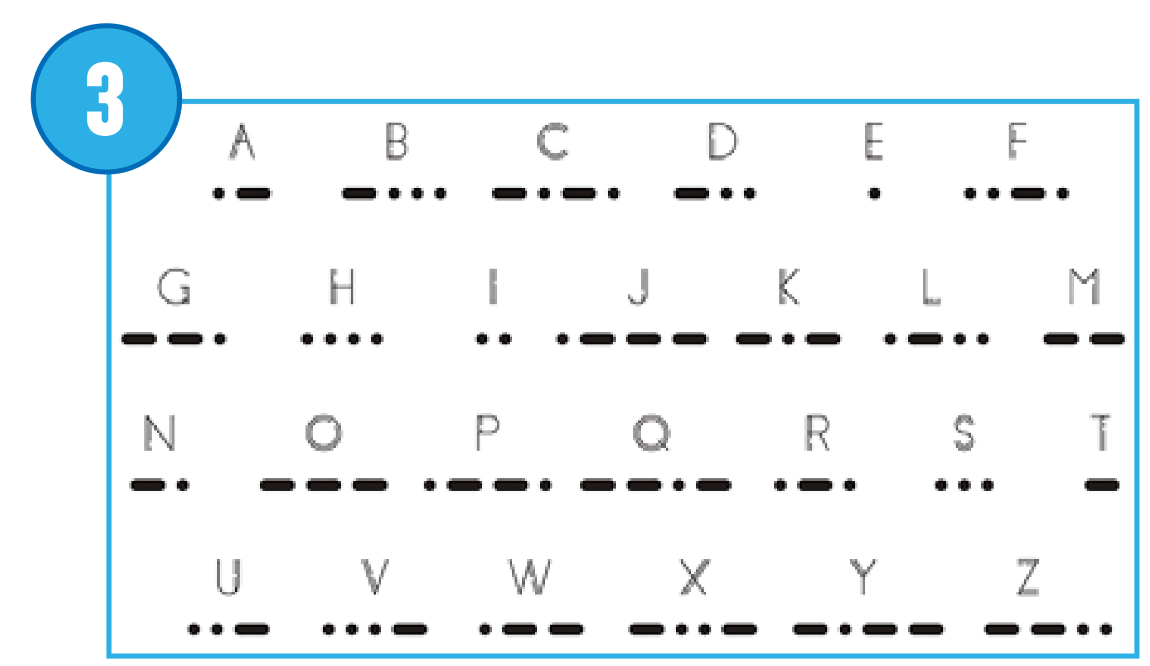
1. Moon Base
This project is about designing a solution in which a robot would be able to assemble a base on the moon.

2. Grabbing Objects
This project is about designing a solution for a prosthetic arm that is able to move small objects around.

3. Send Messages
This project is about designing a solution for exchanging information using a system of signals that are organised in patterns.

4. Volcano Alert
This project is about designing a device for improving the monitoring of volcanic activity in order to guide scientific exploration.





Visual Overview of the Open Projects

5. Inspection
This project is about designing a solution in which a robot is able to inspect narrow spaces, guiding its motion with sensors.

6. Emotional Design
This project is about designing a solution in which a robot can display positive emotions when it is interacting with people.

7. City Safety
This project is about designing a solution to improve safety in a city.

8. Animal Senses
This project is about modelling how animals use their senses to interact with their environment.

5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Potential Flow to Develop Computational Thinking Skills

You can organise the projects as you wish. Each project highlights opportunities for developing computational thinking skills and it is it up to you to focus on the ones that are most relevant to you and your pupils. Here is one suggested sequence, which is based on an increasing level of complexity in the programming concepts covered:

Getting Started

Use two lessons of 45 minutes each to introduce your pupils to WeDo 2.0.
Lesson 1, Milo, the Science Rover
Lesson 2, combine Milo's Motion Sensor, Milo's Tilt Sensor and Collaborating

Guided Projects

Use two lessons of 45 minutes each, during which your pupils will program a sequence of actions.
Lesson 3, Moon Base (Explore and Create phases)
Lesson 4, Moon Base (Test and Share phases)

Use two lessons of 45 minutes each, during which your pupils will use sensors (inputs).
Lesson 5, Grabbing Objects (Explore and Create phases)
Lesson 6, Grabbing Objects (Test and Share phases)

Use two lessons of 45 minutes each, during which your pupils will use sensors (inputs), loops and parallel programming.
Lesson 7, Send Messages (Explore and Create phase)
Lesson 8, Send Messages (Test and Share phase)

Use two lessons of 45 minutes each to introduce your pupils to conditions and how to integrate all of the other programming principles.
Lesson 9, Volcano Alert (Explore and Create phases)
Lesson 10, Volcano Alert (Test and Share phases)

Open Projects

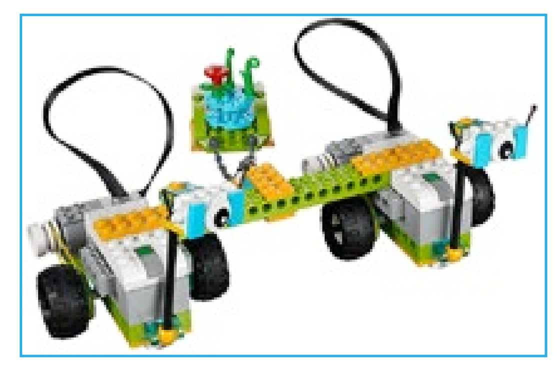
Use two or three lessons of 45 minutes each to make you own project that is based on one of the suggested Open Projects. This project should integrate all of the programming principles, as well as the computational thinking skills that were developed during the Guided Projects.

Potential Flow to Develop Computational Thinking Skills

Getting Started

Introduce your pupils to WeDo 2.0.

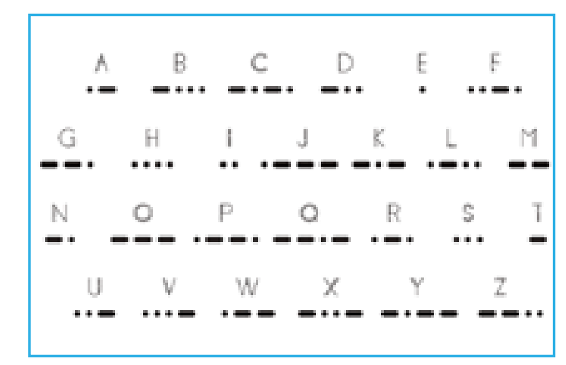


45 minutes | 45 minutes

Guided Project - Send Messages

Pupils will use sensors (inputs), loops and parallel programming.



Using a condensed lesson flow
2 x 45 minutes

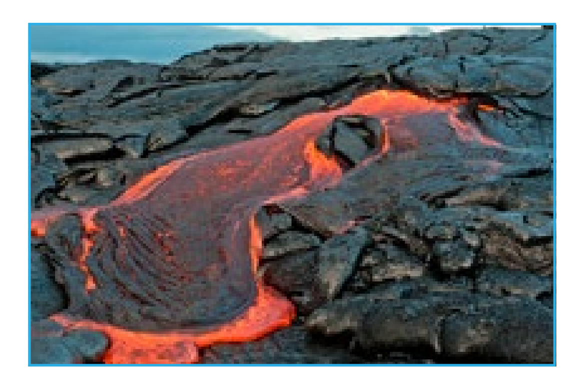
Guided Project - Moon Base

Pupils will program sequences of actions.

Using a condensed lesson flow
2 x 45 minutes

Guided Project - Volcano Alert

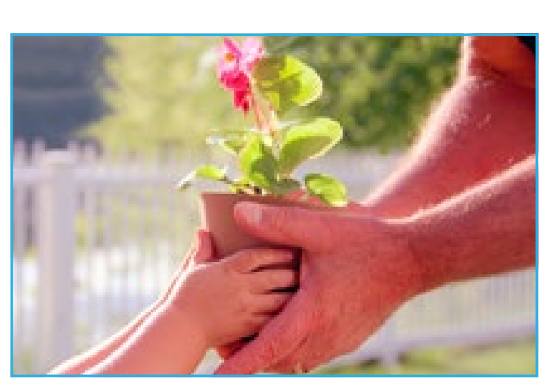
Pupils will be introduced to conditions and to other programming principles.



Using a condensed lesson flow
2 x 45 minutes

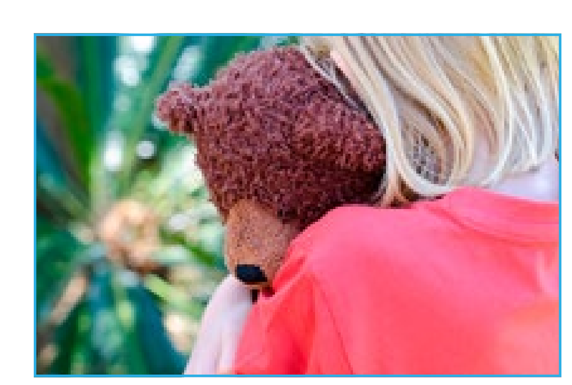
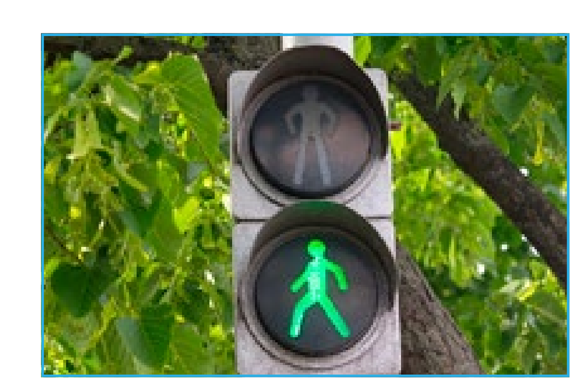
Guided Project - Grabbing Objects

Pupils will use sensors (inputs).



Using a condensed lesson flow
2 x 45 minutes

Open Projects


(Science*) Curriculum Overview of Guided Projects, Organised by Year Group

	Lower KS 2 - Working Scientifically	Year 3	Year 4	Upper KS 2 - Working Scientifically	Year 5	Year 6
17. Moon Base	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s6			UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5 UKS2.WS.s6	5.ES.s1 5.ES.s2 5.ES.s3 5F.s3	
18. Grabbing Objects	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s5 LKS2.WS.s6	3.FM.s2		UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5	5.F.s3	
19. Send Messages	LKS2.WS.s1 LKS2.WS.s2			UKS2.WS.s1 UKS2.WS.s4		
20. Volcano Alert	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s4		K-2-ETS1-3. 3-5-ETS1-1. 3-5-ETS1-2. 3-5-ETS1-3.	UKS2.WS.s1 UKS2.WS.s5		

***NB: Design & Technology and other relevant curriculum requirements are referenced in the Teacher's Notes for each project.**

(Science*) Curriculum Overview of Guided Projects, Organised by Year Group

	Lower KS 2 - Working Scientifically	Year 3	Year 4	Upper KS 2 - Working Scientifically	Year 5	Year 6
21. Inspection	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s4 LKS2.WS.s6 LKS2.WS.s7			UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5		
22. Emotional Design	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s4 LKS2.WS.s6 LKS2.WS.s7			UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5		
23. City Safety	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s4 LKS2.WS.s6 LKS2.WS.s7			UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5		
24. Animal Senses	LKS2.WS.s1 LKS2.WS.s2 LKS2.WS.s4 LKS2.WS.s6 LKS2.WS.s7		4.LTH.s3	UKS2.WS.s1 UKS2.WS.s4 UKS2.WS.s5		6.EI.S3

***NB: Design & Technology and other relevant curriculum requirements are referenced in the Teacher's Notes for each project.**

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Working Scientifically Lower Key Stage 2 (LKS2.WS)		
During years 3 and 4, pupils should be taught to use the following practical scientific methods, processes and skills through the teaching of the programme of study content:		
Statutory Requirements (S)	**Code**	
	LKS2.WS.s1	Asking relevant questions and use different types of scientific enquiries to answer them
	LKS2.WS.s2	Setting up simple practical enquiries, and comparative and fair tests
	LKS2.WS.s3	Making systematic and careful observations and where appropriate, take accurate measurements using standard units and a range of equipment, including thermometers and data loggers
	LKS2.WS.s4	Gathering, recording, classifying and presenting data in a variety of ways to help in answering questions
	LKS2.WS.s5	Recording findings using simple scientific language, drawings, labelled diagrams, keys, bar charts and tables
	LKS2.WS.s6	Reporting on findings from enquiries, including oral and written explanations, displays or presentations of results and conclusions
	LKS2.WS.s7	Using results to draw simple conclusions, make predictions for new values, suggest improvements and raise further questions
	LKS2.WS.s8	Identifying differences, similarities or changes that are related to simple scientific ideas and processes
	LKS2.WS.s9	Using straightforward scientific evidence to answer questions or to support their findings

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 3 Plants (3.P)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	3.P.s1	Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
	3.P.s2	Explore the requirements of plants for life and growth (air, light, water, nutrients from soil, and room to grow) and how they vary from plant to plant
	3.P.s3	Investigate the way in which water is transported within plants
	3.P.s4	Explore the part that flowers play in the life cycle of flowering plants, including pollination, seed formation and seed dispersal
NS	3.P.ns1	Pupils should be introduced to the relationship between structure and function: the idea that every part has a job to do. They should explore questions that focus on the role of the roots and stem in nutrition and support, leaves for nutrition and flowers for reproduction.
	3.P.ns2	Pupils might work scientifically by: comparing the effect of different factors on plant growth, for example, the amount of light, the amount of fertiliser; discovering how seeds are formed by observing the different stages of plant life cycles over a period of time; looking for patterns in the structure of fruits that relate to how the seeds are dispersed.
	3.P.ns3	They might observe how water is transported in plants, for example, by putting cut, white carnations into coloured water and observing how water travels up the stem to the flowers.

Year 3 Animals, including Humans (3.A)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	3.A.s1	Identify that animals, including humans, need the right types and amount of nutrition and that they cannot make their own food; they get nutrition from what they eat
		Identify that humans and some other animals have skeletons and muscles for support, protection and movement
NS	3.A.ns1	Pupils should continue to learn about the importance of nutrition and should be introduced to the main body parts that are associated with the skeleton and muscles, finding out how the different parts of the body have special functions.
	3.A.ns2	Pupils might work scientifically by: identifying and grouping animals with and without skeletons and observing and comparing their movement; exploring ideas about what would happen if humans did not have skeletons. They might compare and contrast the diets of different animals (including their pets) and decide ways of grouping them according to what they eat. They might research different food groups and how they keep us healthy, and design meals based on what they find out.

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 3 Rocks (3.R)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	3.R.s1	Compare and group together different kinds of rocks on the basis of their appearance and simple physical properties
	3.R.s2	Describe in simple terms how fossils are formed when things that have lived are trapped within rock
	3.R.s3	Recognise that soils are made from rocks and organic matter
NS	3.R.ns1	Linked with work in geography, pupils should explore different kinds of rocks and soils, including those in the local environment.
	3.R.ns2	Pupils might work scientifically by: observing rocks, including those used in buildings and gravestones, and exploring how and why they might have changed over time; using a hand lens or microscope to help them to identify and classify rocks according to whether they have grains or crystals, and whether they have fossils in them. Pupils might research and discuss the different kinds of living things whose fossils are found in sedimentary rock and explore how fossils are formed. Pupils could explore different soils and identify similarities and differences between them and investigate what happens when rocks are rubbed together or what changes occur when they are in water. They can raise and answer questions about the way soils are formed.

Year 3 Light (3.L)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	3.L.s1	Recognise that they need light in order to see things and that dark is the absence of light
	3.L.s2	Notice that light is reflected from surfaces
	3.L.s3	Recognise that light from the sun can be dangerous and that there are ways to protect their eyes
	3.L.s4	Recognise that shadows are formed when the light from a light source is blocked by an opaque object
	3.L.s5	Find patterns in the way that shadows change in size
NS	3.L.ns1	Pupils should explore what happens when light reflects off a mirror or other reflective surfaces, including playing mirror games to help them to answer questions about the behaviour of light. They should think about why it is important to protect their eyes from bright lights. They should look for and measure shadows, and find out how they are formed and what might cause the shadows to change.
	3.L.ns2	Pupils might work scientifically by looking for patterns in what happens to shadows when the light source moves or the distance between the light source and the object changes.

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 3 Forces and Magnets (3.FM)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	3.FM.s1	Compare how things move on different surfaces
	3.FM.s2	Notice that some forces need contact between two objects, but magnetic forces can act at a distance
	3.FM.s3	Observe how magnets attract or repel each other and attract some materials and not others
	3.FM.s4	Compare and group together a variety of everyday materials on the basis of whether they are attracted to a magnet, and identify some magnetic materials
	3.FM.s5	Describe magnets as having two poles
	3.FM.s6	Predict whether two magnets will attract or repel each other, depending on which poles are facing
NS	3.FM.ns1	Pupils should observe that magnetic forces can act without direct contact, unlike most forces, where direct contact is necessary (for example, opening a door, pushing a swing). They should explore the behaviour and everyday uses of different magnets (for example, bar, ring, button and horseshoe).
	3.FM.ns2	Pupils might work scientifically by: comparing how different things move and grouping them; raising questions and carrying out tests to find out how far things move on different surfaces and gathering and recording data to find answers their questions; exploring the strengths of different magnets and finding a fair way to compare them; sorting materials into those that are magnetic and those that are not; looking for patterns in the way that magnets behave in relation to each other and what might affect this, for example, the strength of the magnet or which pole faces another; identifying how these properties make magnets useful in everyday items and suggesting creative uses for different magnets.

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 4 Living Things and Their Habitats (4.LTH)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	4.LTH.s1	Recognise that living things can be grouped in a variety of ways
	4.LTH.s2	Explore and use classification keys to help group, identify and name a variety of living things in their local and wider environment
	4.LTH.s3	Recognise that environments can change and that this can sometimes pose dangers to living things
NS	4.LTH.ns1	Pupils should use the local environment throughout the year to raise and answer questions that help them to identify and study plants and animals in their habitats. They should identify how habitats change throughout the year. Pupils should explore possible ways of grouping a wide selection of living things that include animals, flowering plants and non-flowering plants. Pupils could begin to put vertebrate animals such as fish, amphibians, reptiles, birds and mammals; and invertebrates such as snails, slugs, worms, spiders and insects into groups.
	4.LTH.ns2	Pupils should explore examples of human impact (both positive and negative) on environments, for example, the positive effects of nature reserves, ecologically planned parks, or garden ponds, and the negative effects of population and development, litter or deforestation.
	4.LTH.ns3	Pupils might work scientifically by: using and making simple guides or keys to explore and identify local plants and animals; making a guide to local living things; raising and answering questions based on their observations of animals and what they have found out about other animals that they have researched.

Year 4 Animals, including Humans (4.A)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	4.A.s1	Describe the simple functions of the basic parts of the digestive system in humans
	4.A.s2	Identify the different types of teeth in humans and their simple functions
	4.A.s3	Construct and interpret a variety of food chains, identifying producers, predators and prey
NS	4.A.ns1	Pupils should be introduced to the main body parts associated with the digestive system, for example, mouth, tongue, teeth, oesophagus, stomach, and small and large intestine, and explore questions that help them to understand their special functions.
	4.A.ns2	Pupils might work scientifically by: comparing the teeth of carnivores and herbivores and suggesting reasons for differences; finding out what damages teeth and how to look after them. They might draw and discuss their ideas about the digestive system and compare them with models or images.

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 4 States of Matter (4.SM)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	4.SM.s1	Compare and group materials together, according to whether they are solids, liquids or gases
	4.SM.s2	Observe that some materials change state when they are heated or cooled, and measure or research the temperature at which this happens in degrees Celsius (°C)
	4.SM.s3	Identify the part played by evaporation and condensation in the water cycle and associate the rate of evaporation with temperature
NS	4.SM.ns1	Pupils should explore a variety of everyday materials and develop simple descriptions of the states of matter (solids hold their shape; liquids form a pool not a pile; gases escape from an unsealed container). Pupils should observe water as a solid, a liquid, and a gas and should note the changes to water when it is heated or cooled.
	4.SM.ns2	Pupils might work scientifically by: grouping and classifying a variety of different materials; exploring the effect of temperature on substances such as chocolate, butter and cream (for example, to make food such as chocolate crispy cakes and ice-cream for a party). They could research the temperature at which materials change state, for example, when iron melts or when oxygen condenses into a liquid. They might observe and record evaporation over a period of time, for example, a puddle in the playground or washing on a line, and investigate the effect of temperature on washing drying or snowmen melting.

National Curriculum for Science Requirements – Lower Key Stage 2 Programme of Study

Year 4 Sound (4.S)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	4.S.s1	Identify how sounds are made, associating some of them with something vibrating
	4.S.s2	Recognise that vibrations from sounds travel through a medium to the ear
	4.S.s3	Find patterns between the pitch of a sound and the features of the object that produced it
	4.S.s4	Find patterns between the volume of a sound and the strength of the vibrations that produced it
	4.S.s5	Recognise that sounds get fainter as the distance from the sound source increases
NS	4.S.ns1	Pupils should explore and identify the way sound is made through vibration in a range of different musical instruments from around the world; and find out how the pitch and volume of sounds can be changed in a variety of ways.
	4.S.ns2	Pupils might work scientifically by: finding patterns in the sounds that are made by different objects such as saucepan lids of different sizes or elastic bands of different thicknesses. They might make earmuffs from a variety of different materials to investigate which provides the best insulation against sound. They could make and play their own instruments by using what they have found out about pitch and volume.

Year 4 Electricity (4.E)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	4.E.s1	Identify common appliances that run on electricity
	4.E.s2	Construct a simple series electrical circuit, identifying and naming its basic parts, including cells, wires, bulbs, switches and buzzers
	4.E.s3	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
	4.E.s4	Recognise that a switch opens and closes a circuit and associate this with whether or not a lamp lights in a simple series circuit
	4.E.s5	Recognise some common conductors and insulators, and associate metals with being good conductors
NS	4.E.ns1	Pupils should construct simple series circuits, trying different components, for example, bulbs, buzzers, and motors, and including switches, and use their circuits to create simple devices. Pupils should draw the circuit as a pictorial representation, not necessarily using conventional circuit symbols at this stage.
	4.E.ns2	Pupils might work scientifically by: observing patterns, for example, that bulbs get brighter if more cells are added, that metals tend to be conductors of electricity, and that some materials can and some cannot be used to connect across a gap in a circuit.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Working Scientifically Upper Key Stage 2 (UKS2.WS)		
During years 5 and 6, pupils should be taught to use the following practical scientific methods, processes, and skills through the teaching of the programme of study content:		
Statutory Requirements	**Code**	**National Curriculum Statement**
	UKS2.WS.s1	Planning different types of scientific enquiries to answer questions, including recognising and controlling variables where necessary
	UKS2.WS.s2	Taking measurements, using a range of scientific equipment, with increasing accuracy and precision, taking repeat readings when appropriate
	UKS2.WS.s3	Recording data and results of increasing complexity using scientific diagrams and labels, classification keys, tables, scatter graphs, and bar and line graphs
	UKS2.WS.s4	Using test results to make predictions to set up further comparative and fair tests
	UKS2.WS.s5	Reporting and presenting findings from enquiries, including conclusions, causal relationships and explanations of and degree of trust in results, in oral and written forms such as displays and other presentations
	UKS2.WS.s6	Identifying scientific evidence that has been used to support or refute ideas or arguments

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 5 Living Things and Their Habitats (5.LTH)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	5.LTH.s1	Describe the differences in the life cycles of a mammal, an amphibian, an insect and a bird
	5.LTH.s2	Describe the life process of reproduction in some plants and animals
NS	5.LTH.ns1	Pupils should study and raise questions about their local environment throughout the year. They should observe life cycle changes in a variety of living things, for example, plants in a vegetable garden or flower border, and animals in the local environment. They should find out about the work of naturalists and animal behaviourists, for example, David Attenborough and Jane Goodall.
	5.LTH.ns2	Pupils should find out about different types of reproduction, including sexual and asexual reproduction in plants, and sexual reproduction in animals.
	5.LTH.ns3	Pupils might work scientifically by: observing and comparing the life cycles of plants and animals in their local environment with other plants and animals around the world (in rainforests, oceans, desert areas and in prehistoric times), asking pertinent questions and suggesting reasons for similarities and differences. They might try to grow new plants from different parts of the parent plant, for example, seeds, stem and root cuttings, tubers or bulbs. They might observe changes in an animal over a period of time (for example, by hatching and rearing chicks), comparing how different animals reproduce and grow.

Year 5 Animals, including Humans (4.A)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	5.A.s1	Describe the changes as humans develop to old age
NS	5.A.ns1	Pupils should draw a timeline to indicate stages in the growth and development of humans. They should learn about the changes experienced in puberty.
	5.A.ns2	Pupils could work scientifically by researching the gestation periods of other animals and comparing them with humans; by finding out and recording the length and mass of a baby as it grows.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 5 Properties and Changes of Materials (5.PCM)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	5.PCM.s1	Compare and group together everyday materials on the basis of their properties, including their hardness, solubility, transparency, conductivity (electrical and thermal) and response to magnets
	5.PCM.s2	Know that some materials will dissolve in liquid to form a solution, and describe how to recover a substance from a solution
	5.PCM.s3	Use knowledge of solids, liquids and gases to decide how mixtures might be separated, including through filtering, sieving and evaporating
	5.PCM.s4	Give reasons, based on evidence from comparative and fair tests, for the particular uses of everyday materials, including metals, wood and plastic
	5.PCM.s5	Demonstate that dissolving, mixing and changes of state are reversible changes
	5.PCM.s6	Explain that some changes result in the formation of new materials, and that this kind of change is not usually reversible, including changes associated with burning and the action of acid on bicarbonate of soda
NS	5.PCM.ns1	Pupils should build a more systematic understanding of materials by exploring and comparing the properties of a broad range of materials, including relating these to what they learnt about magnetism in year 3 and about electricity in year 4. They should explore reversible changes, including, evaporating, filtering, sieving, melting, and dissolving, recognising that melting and dissolving are different processes. Pupils should explore changes that are difficult to reverse, for example, burning, rusting, and other reactions, for example, vinegar with bicarbonate of soda. They should find out about how chemists create new materials, for example, Spencer Silver, who invented the glue for sticky notes or Ruth Benerito, who invented wrinkle-free cotton.
	5.PCM.ns2	Pupils might work scientifically by: carrying out tests to answer questions, for example, 'Which materials would be the most effective for making a warm jacket, for wrapping ice cream to stop it melting, or for making blackout curtains?' They might compare materials in order to make a switch in a circuit. They could observe and compare the changes that take place, for example, when burning different materials or baking bread or cakes. They might research and discuss how chemical changes have an impact on our lives, for example, cooking, and discuss the creative use of new materials such as polymers, super-sticky and super-thin materials.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 5 Earth and Space (5.ES)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	5.ES.s1	Describe the movement of the Earth and other planets relative to the sun in the solar system
	5.ES.s2	Describe the movement of the moon relative to the Earth
	5.ES.s3	Describe the sun, Earth, and moon as approximately spherical bodies
	5.ES.s4	Use the idea of the Earth's rotation to explain day and night and the apparent movement of the sun across the sky
NS	5.ES.ns1	Pupils should be introduced to a model of the sun and Earth that enables them to explain day and night. Pupils should learn that the sun is a star at the centre of our solar system and that it has eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune (Pluto was reclassified as a 'dwarf planet' in 2006). They should understand that a moon is a celestial body that orbits a planet (Earth has one moon; Jupiter has four large moons and numerous smaller ones).
	5.ES.ns2	Pupils should learn how ideas about the solar system have developed, understanding how the geocentric model of the solar system gave way to the heliocentric model by considering the work of scientists such as Ptolemy, Alhazen and Copernicus.
	5.ES.ns3	Pupils might work scientifically by: comparing the time of day at different places on the Earth through Internet links and direct communication; creating simple models of the solar system; constructing simple shadow clocks and sundials, calibrated to show midday and the start and end of the school day; finding out why some people think that structures such as Stonehenge might have been used as astronomical clocks.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 5 Forces (5.F)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	5.F.s1	Explain that unsupported objects fall towards the Earth because of the force of gravity acting between the Earth and the falling object
	5.F.s2	Identify the effects of air resistance, water resistance and friction, that act between moving surfaces
	5.F.s3	Recognise that some mechanisms, including levers, pulleys and gears allow a smaller force to have a greater effect
NS	5.F.ns1	Pupils should explore falling objects and raise questions about the effects of air resistance. They should explore the effects of air resistance by observing how different objects such as parachutes and sycamore seeds fall. They should experience forces that make things begin to move, accelerate or slow down. Pupils should explore the effects of friction on movement and find out how it slows or stops moving objects, for example, by observing the effects of a brake on a bicycle wheel. Pupils should explore the effects of levers, pulleys and simple machines on movement. Pupils might find out how scientists, for example, Galileo Galilei and Isaac Newton helped to develop the theory of gravitation.
	5.F.ns2	Pupils might work scientifically by: exploring falling paper cones or cupcake cases, designing and making a variety of parachutes and carrying out fair tests to determine which designs are the most effective. They might explore resistance in water by making and testing boats of different shapes. They might design and make products that use levers, pulleys, gears and/or springs and explore their effects.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 6 Living Things and Their Habitats (6.LTH)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	6.LTH.s1	Identify and describe the functions of different parts of flowering plants: roots, stem/trunk, leaves and flowers
	6.LTH.s2	Explore the requirements of plants for life and growth (air, light, water, nutrients from soil and room to grow) and how they vary from plant to plant
NS	6.LTH.ns1	Pupils should build on their learning about grouping living things in year 4, by looking at the classification system in more detail. They should be introduced to the idea that broad groupings, such as micro-organisms, plants and animals can be subdivided. Through direct observations where possible, they should classify animals into commonly found invertebrates (such as insects, spiders, snails, worms) and vertebrates (fish, amphibians, reptiles, birds and mammals). They should discuss reasons why living things are placed in one group and not another.
	6.LTH.ns2	Pupils might find out about the significance of the work of scientists such as Carl Linnaeus, a pioneer of classification.
	6.LTH.ns3	Pupils might work scientifically by: using classification systems and keys to identify some animals and plants in the immediate environment. They could research unfamiliar animals and plants from a broad range of other habitats and decide where they belong in the classification system.

Year 6 Animals, including Humans (6.A)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	6.A.s1	Identify and name the main parts of the human circulatory system, and describe the functions of the heart, blood vessels and blood
	6.A.s2	Recognise the impact of diet, exercise, drugs and lifestyle on the way their bodies function
	6.A.s3	Describe the ways in which nutrients and water are transported within animals, including humans
NS	6.A.ns1	Pupils should build on their learning from years 3 and 4 about the main body parts and internal organs (skeletal, muscular and digestive system) to explore and answer questions that help them to understand how the circulatory system enables the body to function.
	6.A.ns2	Pupils should learn how to keep their bodies healthy and how their bodies might be damaged – including how some drugs and other substances can be harmful to the human body.
	6.A.ns3	Pupils might work scientifically by: exploring the work of scientists and scientific research about the relationship between diet, exercise, drugs, lifestyle and health.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 6 Evolution and Inheritance (6.EI)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	6.EI.s1	Recognise that living things have changed over time and that fossils provide information about living things that inhabited the Earth millions of years ago
	6.EI.s2	Recognise that living things produce offspring of the same kind, but normally offspring vary and are not identical to their parents
	6.EI.s3	Identify how animals and plants are adapted to suit their environment in different ways and that adaptation may lead to evolution
NS	6.EI.ns1	Building on what they learned about fossils in the topic on rocks in year 3, pupils should find out more about how living things on earth have changed over time. They should be introduced to the idea that characteristics are passed from parents to their offspring, for instance by considering different breeds of dogs, and what happens when, for example, labradors are crossed with poodles. They should also appreciate that variation in offspring over time can make animals more or less able to survive in particular environments, for example, by exploring how giraffes' necks became longer, or the development of insulating fur on the arctic fox. Pupils might find out about the work of palaeontologists such as Mary Anning and about how Charles Darwin and Alfred Wallace developed their ideas on evolution.
	6.EI.ns2	Pupils might work scientifically by: observing and raising questions about local animals and how they are adapted to their environment; comparing how some living things are adapted to survive in extreme conditions, for example, cactuses, penguins and camels. They might analyse the advantages and disadvantages of specific adaptations, such as being on two feet rather than four, having a long or a short beak, having gills or lungs, tendrils on climbing plants, or brightly coloured and scented flowers.

National Curriculum for Science Requirements – Upper Key Stage 2 Programme of Study

Year 6 Light (6.L)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	6.L.s1	Recognise that light appears to travel in straight lines
	6.L.s2	Use the idea that light travels in straight lines to explain that objects are seen because they give out or reflect light into the eye
	6.L.s3	Explain that we see things because light travels from light sources to our eyes or from light sources to objects and then to our eyes
NS	6.L.ns1	Pupils should build on the work on light from year 3, exploring the way that light behaves, including light sources, reflection and shadows. They should talk about what happens and make predictions.
	6.L.ns2	Pupils might work scientifically by: deciding where to place rear-view mirrors on cars; designing and making a periscope, and using the idea that light appears to travel in straight lines to explain how it works. They might investigate the relationship between light sources, objects and shadows by using shadow puppets. They could extend their experience of light by looking at a range of phenomena including rainbows, colours on soap bubbles, objects appearing to bend when viewed through water, and coloured filters (they do not need to explain why these phenomena occur).

Year 6 Electricity (6.E)		
	Code	**National Curriculum Statement** *Pupils should be taught to:*
S	6.E.s1	Associate the brightness of a lamp or the volume of a buzzer with the number and voltage of cells used in the circuit
	6.E.s2	Compare and give reasons for variations in how components function, including the brightness of bulbs, the loudness of buzzers and the on/off position of switches
	6.E.s3	Use recognised symbols when representing a simple circuit in a diagram
NS	6.E.ns1	Building on their work in year 4, pupils should construct simple series circuits, to help them to answer questions about what happens when they try different components, for example, switches, bulbs, buzzers and motors. They should learn how to represent a simple circuit in a diagram using recognised symbols.
	6.E.ns2	Pupils might work scientifically by: systematically identifying the effect of changing one component at a time in a circuit; designing and making a set of traffic lights, a burglar alarm or some other useful circuit.

Computing Curriculum Requirements

Learning Outcome / Curriculum Link	17. Moon Base	18. Grabbing Objects	19. Send Messages	20. Volcano Alert	21. Inspection	22. Emotional Design	23. City Safety	24. Animal Senses
Design programs that accomplish specific goals	●	●	●	●	●	●	●	●
Write programs that accomplish specific goals	●	●	●	●	●	●	●	●
Use sequences in programs		●		●	●	●	●	●
Work with various forms of input		●	●	●	●	●	●	●
Work with various forms of output	●	●	●	●	●	●	●	●
Debug programs that accomplish specific goals		●	●	●	●	●	●	●
Use repetition in programs		●	●		●	●	●	●
Control or simulate physical systems	●	●	●	●	●	●	●	●
Solve problems by decomposing them into smaller parts	●	●		●	●	●	●	●
Use selection in programs	●	●	●	●	●	●	●	●
Work with variables			●	●	●	●	●	●
Use logical reasoning to explain how simple algorithms work		●	●	●	●	●	●	●
Use logical reasoning to detect and correct errors in algorithms	●	●			●	●	●	●
Create a range of programs, systems and content that can accomplish specific goals, including collecting, analysing, evaluating, and presenting data and information	●	●	●	●	●	●	●	●
Use search technologies effectively, appreciate how results are selected and ranked, and be discerning in evaluating digital content	●	●	●	●	●	●	●	●
Use technology safely, respectfully and responsibly; recognise acceptable/unacceptable behaviour; identify a range of ways to report concerns about content and contact	●	●	●	●	●	●	●	●

Assessing Computational Thinking Skills

There are many ways in which you can monitor and assess your pupils' progress through a WeDo 2.0 project.

This section offers the following tools to help you in your assessments:

- Documentation pages
- Self-assessment statements
- Anecdotal record grid
- Observation rubrics grid

Pupil-Led Assessment

Documentation Pages

Each project will ask your pupils to create documents to summarise their work. To have a complete science report, it is essential that your pupils:

- Document their work using various types of media
- Document every step of the process
- Take the time to organise and complete their document

It is most likely that the first document that your pupils will complete will not be as comprehensive as the next one. You can support them by:

- Giving feedback and allowing them time to see where and how they can improve some parts of their document.
- Allowing them to share their documents with each other. By communicating their scientific findings, your pupils will be engaged in the work of scientists.

Self-Assessment Statements

After each project, your pupils should reflect on the work that they have done. Use the following page to encourage reflection and to set goals for the next project.

Pupil Self-Assessment Rubric

Name: Class: Project:

Directions: Circle the brick that shows how well you did. The bigger brick, the better you did.				
I defined the question or problem.				
I built a LEGO® model and programmed a solution.				
I tested my solution and made improvements.				
I documented and shared my ideas.				

Project Reflection

One thing I did really well was:

One thing I want to improve on for next time is:

Teacher-Led Assessment

Developing your pupils' science, engineering and computational thinking skills requires time and feedback. Just as in the design cycle, in which the pupils should understand that failure is part of the process, assessment should provide feedback in terms of what they did well and where they can improve. Problem-based learning is not about succeeding or failing. It is about being an active learner and continually building upon and testing ideas.

Giving feedback to your pupils in order to help them to develop their skills can be done in various ways. At each phase of the WeDo 2.0 projects, we have provided examples of rubrics that can be used by:

- Observing your pupils' behaviour reactions and strategies
- Asking questions about their thought processes

As pupils often work in groups, you can give feedback both on a team level and on an individual level.

Anecdotal Record Grid

The anecdotal record grid allows you to record any type of observation that you believe is important for each pupil's development. Use the template on the next page to provide feedback to your pupils as needed.

Anecdotal Record Grid

Name: Class: Project:

1. Emerging	2. Developing	3. Proficient	4. Accomplished

Notes:

Teacher-Led Assessment

Observation Rubrics

Examples of rubrics have been provided for every Guided Project. For every pupil or every team, you can use the observation rubrics grid to:

- Evaluate your pupils' performance at each step of the process
- Provide constructive feedback to help the your pupils progress

The observation rubrics that are provided in the Guided Projects can be adapted to fit your needs. The rubrics are based on these progressive stages:

1. Emerging
The pupil is at the beginning stages of development in terms of content knowledge, ability to understand and apply content, and/or demonstration of coherent thoughts about a given topic.

2. Developing
The pupil is able to present basic knowledge only (e.g., vocabulary) and cannot yet apply their content knowledge or demonstrate comprehension of the concepts being presented.

3. Proficient
The pupil has concrete levels of comprehension of the content and concepts, and can adequately demonstrate the topics, content or concepts that are being taught. The pupil's ability to discuss and apply this knowledge outside of the required assignment is lacking.

4. Accomplished
The pupil can take concepts and ideas to the next level, apply concepts to other situations, and synthesise, apply and extend their knowledge to discussions that include extensions of ideas.

Suggestion

Use the observation rubrics grid on the next page to keep track of your pupils' progress.

Observation Rubrics Grid

Class:		Project:															
	Pupils' Names	Explore	Create	Test	Share												
1																	
2																	
3																	
4																	
5																	
6																	
7																	
8																	
9																	
10																	
11																	
12																	
13																	
14																	
15																	

To be used with the rubrics that are described on the following page: (1) emerging, (2) developing, (3) proficient, (4) accomplished.

Assessing Project Phases - General Rubrics

You can use these assessment rubrics to give general feedback to your pupils on a scale of 1 to 4 at the end of each phase of a project.

Explore Phase

In the Explore phase, feedback should relate to whether or not the pupil is actively involved in the discussion by asking and answering questions, and their level of understanding of the problem.

1. The pupil is unable to provide answers to questions or adequately participate in discussions.
2. The pupil is able, with prompting, to provide answers to questions or adequately participate in discussions.
3. The pupil is able to provide adequate answers to questions and participate in class discussions.
4. The pupil is able to extend explanations in class discussions.

Test Phase

During the Test phase, make sure that the pupil works well as part of a team, justifies their best solution and uses the information that they collected in the Explore phase.

1. The pupil is unable to work well as part of a team, justify solutions and use the information that they collected for further development.
2. The pupil is able to work as part of a team, collect and use information with guidance or with help, to justify solutions.
3. The pupil is able to work as part of a team and contribute to the team discussions, justify solutions, and collect and use information about the content.
4. The pupil can justify and discuss solutions that allow for the collection and use of information.

Share Phase

During the Share phase, make sure that the pupil is able to describe their solution using the right vocabulary and the right level of detail.

1. The pupil does not use evidence from their findings in connection with the ideas that they share during the presentation and the pupil does not follow established guidelines.
2. The pupil uses some evidence from their findings, but the justification is limited. Established guidelines are generally followed but may be lacking in one or more areas.
3. The pupil provides adequate evidence to justify their findings and the pupil follows established guidelines for presenting.
4. The pupil fully discusses their findings and thoroughly utilises appropriate evidence to justify their reasoning while following all established guidelines.

Assessing Computational Thinking Skills

Name: Class:

Decomposition	1. Emerging	2. Developing	3. Proficient	4. Accomplished	Notes
Describe the problem in your own words.	The pupil is unable to describe the problem in their own words.	The pupil is able, with prompting, to describe the problem in their own words.	The pupil is able to describe the problem in their own words.	The pupil is able to describe the problem in their own words and starts to decompose the problem into smaller parts.	
Describe how you will know whether or not you have found a successful solution to the problem.	The pupil is unable to describe success criteria.	The pupil is able, with prompting, to describe success criteria.	The pupil is able to describe success criteria.	The pupil is able to describe success criteria with a high level of detail.	
Describe how you can break the problem down into smaller parts.	The pupil is unable to break down the problem.	With prompting, the pupil is able to break down the problem into smaller parts.	The pupil is able to break down the problem into smaller parts.	The pupil is able to break down the problem into smaller parts and can describe the links between each of the parts.	

Assessing Computational Thinking Skills

Name: Class:

Generalization	1. Emerging	2. Developing	3. Proficient	4. Accomplished	Notes
Describe which program you have used from the Program Library (or elsewhere) and why.	The pupil is unable to describe which program has been used and why. ☐	The pupil is able to identify which program has been used. ☐	The pupil is able to describe which program has been used and why. ☐	The pupil is able to describe, in detail, which program has been used and what modifications have been made to it. ☐	
Observe how your pupils recognise patterns or reuse concepts that they have seen before.	The pupil is unable to recognise patterns or reuse concepts seen before. ☐	With prompting, the pupil is able to recognise patterns or reuse concepts seen before. ☐	The pupil is able to recognise patterns or reuse concepts seen before. ☐	The pupil is able to recognise patterns or reuse concepts of their own. ☐	

Assessing Computational Thinking Skills

Name: Class:

Algorithmic Thinking	1. Emerging	2. Developing	3. Proficient	4. Accomplished	Notes
Describe the list of actions to program.	The pupil is unable to make a list of actions. ☐	With prompting, the pupil is able to make a list of actions. ☐	The pupil is able to make a list of actions. ☐	The pupil is able to make a detailed list of actions to help them develop their program. ☐	
Describe how you have programmed your solution.	The pupil is unable to describe the program. ☐	With prompting, the pupil is able to describe the program. ☐	The pupil is able to describe the program. ☐	The pupil is able to describe the program, providing extensive details about each component. ☐	
Describe the programming principles used in your solution (e.g., output, inputs, events, loops, etc.).	The pupil is unable to describe the programming principles used in their solution. ☐	With prompting, the pupil is able to describe the programming principles used in their solution. ☐	The pupil is able to describe the programming principles used in their solution. ☐	The pupil is able to describe, with extensive comprehension, the programming principles used in their solution. ☐	

Assessing Computational Thinking Skills

Name: Class:

Evaluation	1. Emerging	2. Developing	3. Proficient	4. Accomplished	Notes
Describe what happened when you executed your program and whether or not it was what you expected.	The pupil cannot describe what happened. ☐	With prompting, the pupil is able to describe what happened and compare it to what was expected. ☐	The pupil is able to describe what happened and compare it to what was expected. ☐	The pupil is able to describe what happened, compare it to what was expected and is already finding solutions. ☐	
Describe how you have fixed the problems in your program.	The pupil cannot describe how they have fixed the problems. ☐	With prompting, the pupil can describe how they have fixed the problems. ☐	The pupil can describe how they have fixed the problems. ☐	The pupil can describe, in extensive detail, how they have fixed the problems. ☐	
Describe how your solution is linked to the problem.	The pupil is unable to describe how their solution is linked to the problem. ☐	With prompting, the pupil is able to describe how their solution is linked to the problem. ☐	The pupil is able to describe how thier solution is linked to the problem. ☐	The pupil is able to describe, in extensive detail, how their solution is linked to the problem. ☐	
Describe some of the different ways in which you have tried to solve the problem.	The pupil is unable to describe different ways in which they have tried to solve the problem. ☐	With prompting, the pupil is able to describe the different ways in which they have tried to solve the problem. ☐	The pupil is able to describe the different ways in which they have tried to solve the problem. ☐	The pupil is able to describe the different ways in which they have tried to solve the problem and can explain why each of the options wasn't viable. ☐	

Assessing Computational Thinking Skills

Name: Class:

Abstraction	1. Emerging	2. Developing	3. Proficient	4. Accomplished	Notes
Describe the most important part of your solution.	The pupil is not able to describe their solution. ☐	With prompting, the pupil is able to describe their solution. ☐	The pupil is able to describe their solution. ☐	The pupil is able to describe their solution, focusing on the most important part of the solution. ☐	
Describe the most important details of your solution.	The pupil is not able to provide any details about their solution. ☐	With prompting, the pupil is able to provide details about their solution. ☐	The pupil is able to discuss details of their solution, but some of the details are not essential. ☐	The pupil is able to discuss the most important details of their solution. ☐	
Describe how your solution met the initial criteria.	The pupil is unable to describe how their solution met the initial criteria. ☐	With prompting, the pupil is able to describe how their solution met the initial criteria. ☐	The pupil is able to describe how their solution met the initial criteria. ☐	The pupil is able to describe, with extraordinary clarity, how their solution met the initial criteria. ☐	

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