Programming with Scratch

A step-by-step guide, linked to the English National Curriculum, for primary school teachers

Revision 3.0 (Summer 2018)

Revised for release of Scratch 3.0, including:
- updated screenshots and descriptions
- micro:bit physical computing extension activities

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Contents

License

Acknowledgements

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Programming with Scratch

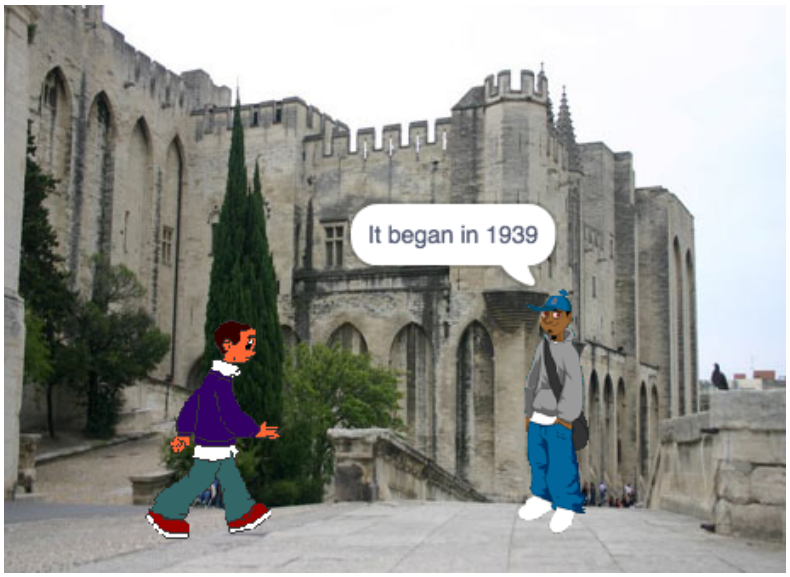
Activity 1 – Scratch Conversations

Computing National Curriculum areas covered (all Key Stage 2):

- 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 programs

Task overview:

- Familiarisation with the Scratch interface
- Create a conversation between two characters using *Say* blocks



Possible cross-curricular links:

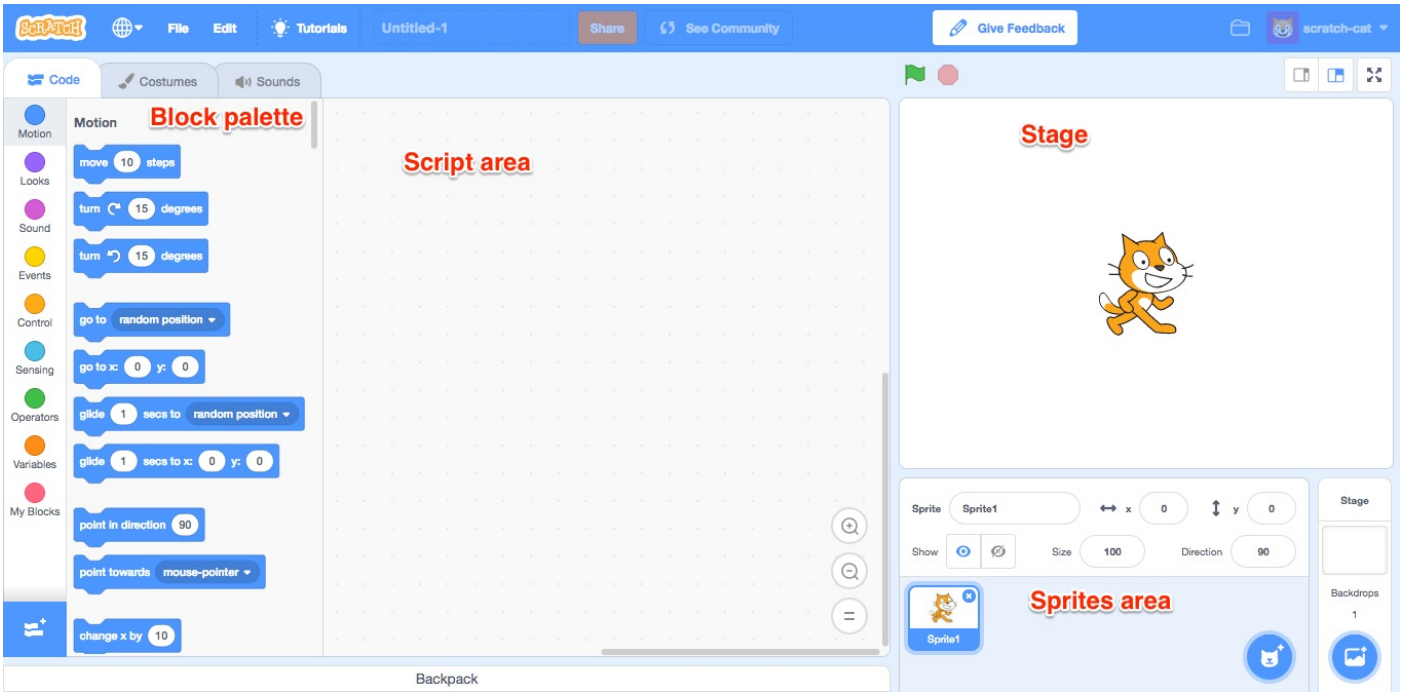
- Literacy – speaking and listening; drama; speech punctuation; feelings and emotions of characters
- History – interviewing historical figures
- Geography – conversation between two people from contrasting environments
- PSHCE – discussing feelings towards an issue, such as bullying
- Science – highlighting misconceptions about a particular topic

Activity 1 – Scratch Conversations

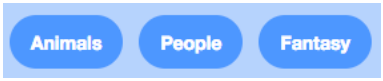
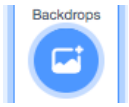
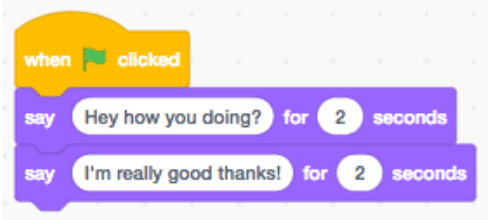
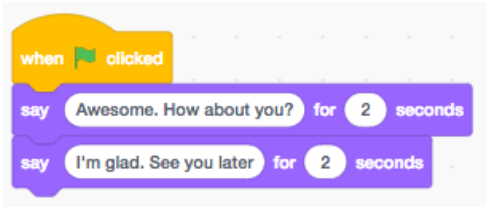
The Scratch website can be accessed at: http://scratch.mit.edu/

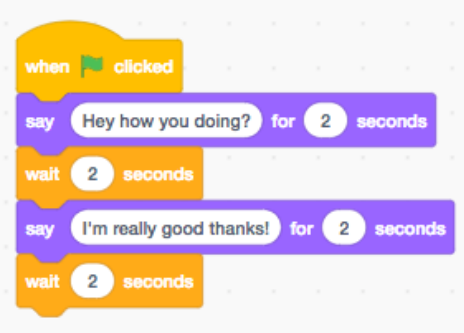
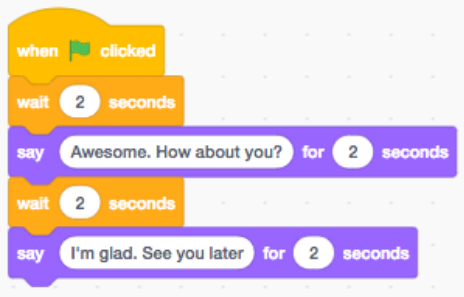
The Scratch programming environment has four screen sections:

- *Script Area* – contains your program's code
- *Block Palette* – contains sections of code (called *Blocks*), which can be dragged into the *Script Area*
- *Stage* – where your program's actions take place
- *Sprites Area* – contains details of the characters (called *Sprites*) in your program



Our first task is to create a conversation between two characters. Before working at the computer, you may wish to get the children to think about what their characters will say. In class, it is useful to model the first few instructions on an Interactive Whiteboard at the same time as the children.

Task explanation	**Required steps**	**Screenshots**
Firstly, delete the cat sprite so we can use something more interesting	Click on the cross to the top right of the cat in the *Sprites Area* and select *Delete*	
Next, we're going to choose our characters You can move the characters around the screen so they're where you want them	Click on the *Choose a sprite* button at the bottom right of the *Sprites Area* Find a sprite from either the *Animals*, *Fantasy* or *People* sections and click on your selection Repeat to add a second *Sprite*	 
We now need a more exciting background Make sure you select a background to make the *Sprites* stand out	Click on the *Choose a backdrop* button (right hand side of the *Sprites Area)* Select a suitable backdrop	
It's now time for our sprites to have a conversation. To do this, we need a *Green flag* to start the program (*Script*) and a number of instructions in order	Click on your first *Sprite* in the *Sprites Area.* Click on *Code* at the top of the *Block Pallet* if the *Script Area* is not visible On the left of the *Block Pallet*, click on *Events* and drag a *when Green Flag clicked* block into the *Script Area* (in the middle of the screen) Drag two *Say, for, seconds* blocks from *Looks* into the *Script Area* and attach them to the *when Green Flag clicked* block Enter some text for the sprite to say Click on your other *Sprite* and repeat the above Click on the *Green Flag* at the top of the *Stage* to run your program	 *Sprite 1*  *Sprite 2*  

You will have noticed the *Sprites* talk over each other! To rectify this problem, we need to use a *Wait* instruction	Click on your first *Sprite* and drag two *Wait* blocks from *Control* into your existing *Script* Change the *Wait* time to two seconds for each block Click on your other *Sprite* and repeat the process (note the location of the *Wait* blocks within the *script* is different for the two *Sprites*) Run your program again using the *Green Flag*	*Sprite 1*  *Sprite 2*  

Congratulations! You've created your first program in Scratch. You've written a program to achieve a specific goal, sequenced instructions and worked with outputs (the text displayed on the screen). You've also probably corrected errors in your program, which is known as *debugging*.

Extension activities

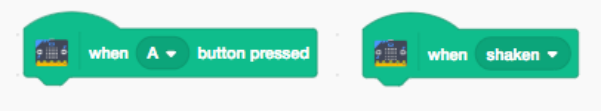
For each of the activities below, feel free to experiment with a range of features to make your program as engaging as possible.

- Get the *Sprite* to move towards the character (Hint: have a look in *Motion*)
- Play a sound instead of using a *Say* block (Hint: try looking in *Sound*)
- Change the appearance of the *Sprite* after they've spoken (Hint: use a *Next Costume* block in *Looks*)
- Alter the background after one of the characters has spoken (Hint: the required block is in *Looks*)
- Add a third character (*Sprite*) to the conversation

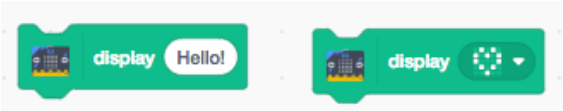
Physical computing extension activities

If you have access to a micro:bit, you could include additional functionality within your program.

- Enable a button press or an action to start your program (Hint: replace the *when Green Flag clicked* block with one of the blocks below)



- Have some text or an image display at the end of the program (Hint: add one of the blocks below after your existing instructions)



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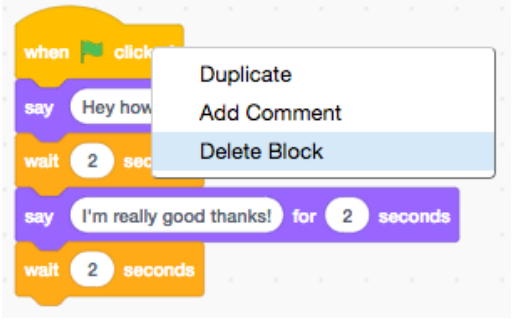
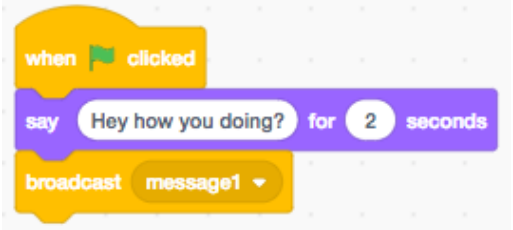
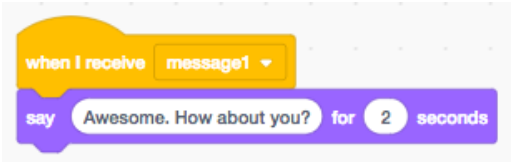
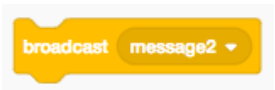
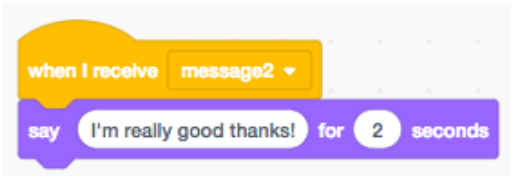
Optional activity – Broadcast messages

In Activity 1, *Wait* blocks were used to ensure the characters spoke in turn. Using *Wait* blocks in this way is quite inefficient and creates lots of extra work if we want to add additional events, such as movement, sound or further speech. We're now going to alter each *Sprite's script* to use *Broadcast* messages, which pass a message to a *Sprite* to ensure it only undertakes an action when it receives a specified command (rather than relying on a certain period of time).

When working with children, this can be effectively demonstrated by whispering to a few pupils that when they hear a specified code word, such as "Dave", they have to get up and do five star jumps. "Dave" is then shouted out (i.e. *Broadcast*) to the class, but only the children given the code word know to act upon it.

We need to modify our program from Activity 1 to remove the *Wait* blocks and use *Broadcast* messages instead	For each of your *Sprites*, delete your existing *Script* by clicking with the right mouse button and selecting *Delete Block*	
	Click on your first *Sprite* and drag a *Broadcast* block from *Events*, along with a *Say, for, seconds* block and a *when Green Flag clicked* block	*Sprite 1* 
	Click on your second *Sprite* and drag a *When I receive* block from *Events*, followed by a *Say, for, seconds* block	*Sprite 2* 
	Continue the conversation, by adding a *Broadcast* block to your second *Sprite's* script (you'll need to create a *new message* with a suitable name, such as *message2)*…	
	followed by adding a separate *When I receive* block to your first *Sprite* and another *Say, for, seconds* block	*Sprite 1* 
	Continue the conversation by repeating the process	

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Activity 2 – Maths Quiz

Computing National Curriculum areas covered (all Key Stage 2):

- 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 programs

Task overview:

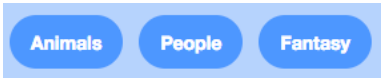
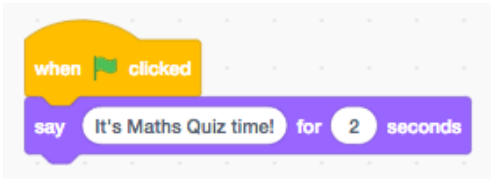
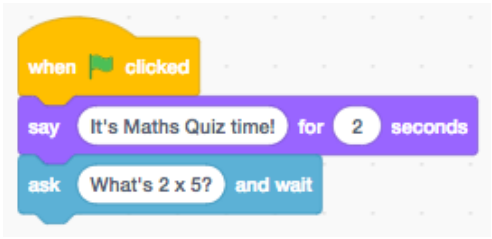
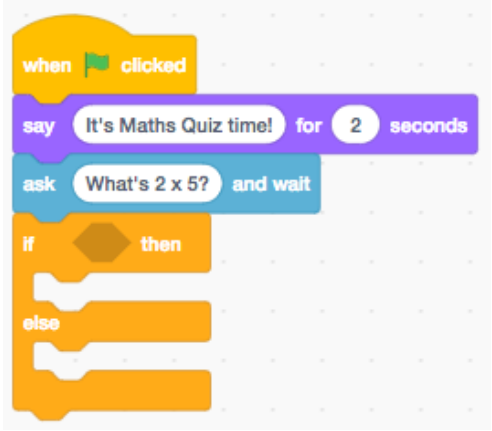
- Create a Maths game containing a range of multiplication questions
- Add a score to the game using a variable

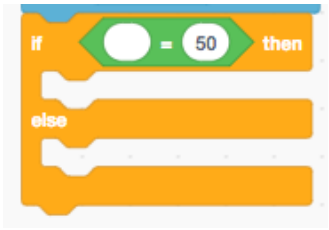
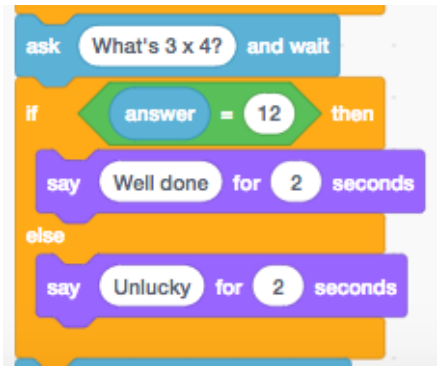
Possible cross-curricular links:

- All subjects – assessment activities (formative and summative; peer assessment)
- Science – predicting outcomes of experiments

Activity 2 – Maths Quiz

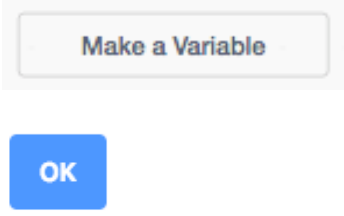
Initially, we need to ask the user a question and allow them to *Input* the answer. Although quizzes can be produced for any topic, it's best to initially only ask questions with numerical answers, which minimises errors relating to spelling or typing.

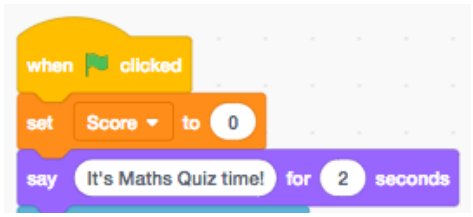
Task explanation	Required steps	Screenshots
As with the first task, delete the cat *Sprite* so we can use something else	Click on the cross to the top right of the cat in the *Sprites Area* and select *Delete*	
Next, we're going to choose our character (you only need one!)	Click on the *Choose a sprite* button at the bottom right of the *Sprites Area* Find a sprite from either the *Animals*, *Fantasy* or *People* sections and click on your selection Feel free to also change the background	 
We need our character to introduce the game when the program starts	Drag a *when Green Flag clicked* block and a *Say, for, seconds* block into the *Script Area* (if you can't see the *Script Area*, click on the *Code* tab at the top of the window) Change the text to introduce your game	
Our quiz needs a question to ask the user	Drag an *Ask* block from *Sensing* and attach it to your *Script* Change the text to ask a multiplication question	
The program has to display a different message depending on whether the answer is correct or incorrect. We do this using *Selection*	Drag an *if, then, else* block from *Control* and attach it to your *Script*	

Following this, we need to check the *Input* and use *Selection* to choose the route through our program, which is: *If* the answer is correct (2x5=10), *then* display a "well done" message, *else* display an "unlucky" message	Drag an *equals* block from *Operators* into the top of the *if, then, else* block Place *Answer* from *Sensing* in one side of the *equals* block, followed by the correct answer on the other side Drag a *Say, for, seconds* block into the first half of the *if, then, else* block. Change the text to "Well done" Drag another *Say, for, seconds* block into the second half of the *if, then, else* block. Change the text to "Unlucky" Run your program using the *Green Flag* (you enter your answer in the box that appears at the bottom of the *Stage*)	   
Add some additional questions using the same process	Add further *Ask* and *if, then, else* blocks to your *Script* containing different questions and answers Run your program and check it behaves as expected	

Well done! You've made another program in Scratch. This time you've also used *selection* and worked with both *inputs* and *outputs*. We're now going to add a score to our game using a *variable*.

A *variable* is similar to a box. It can contain anything the computer can store, such as numbers or text. Its contents can be changed, or varied (hence the name *variable*), and we can find out the contents of the box at any time.

We first need to create a *variable* to store the score	Click on *Variables* on the left of the *Block Palette* and select *Make a Variable* Give the variable a name, such as "Score" and click *OK*	

	If the tick box next to the variable name is selected in the *Block Palette*, the variable's value is shown in the corner of the *Stage*	
When the quiz starts, we have to ensure the score starts at zero, rather than continuing from the previous game	Drag the *set, to* block from *Data* to immediately below the *when Green Flag clicked* block in your *script* (this ensures it's the first instruction run)	
Every time the user gets an answer correct, we need to increase the score by one	Drag a *shange, by* block from *Data* into the first half of your *if, then, else* blocks. Place it before the "Well done" message Repeat the process for the other *if, then, else* blocks in your *Script* Run your program and check the score starts at zero and it increases by one when a question is answered correctly	

Good work! You've now used a *variable* to record the score. You have also *output* the *variable* to the screen for the user to see.

Extension activities

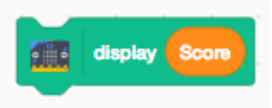
For each of the activities below, feel free to experiment with a range of features to make your program as engaging as possible.

- Adjust the score to decrease when the user gets a question wrong (Hint: change the score by -1)
- Make the character move or dance when an answer is correct (Hint: look in *Motion*)
- Get the character to include the user's answer when they speak – e.g. "Well done. The answer was 10" (Hint: you'll need to use a *Join* block from *Operators*)
- Change the background when the score reaches ten (Hint: add an *if, then* block to check the score and perform an action if *Score* = 10)

Physical computing extension activities

If you have access to a micro:bit, you could include additional functionality within your program.

- Make the micro:bit display the score (Hint: add the block below before each question is asked)



- Ask different questions depending on whether the user starts the game using button A or B (Hint: you could have separate question blocks for each button, or have the buttons alter the times table used to ask questions)

Programming with Scratch

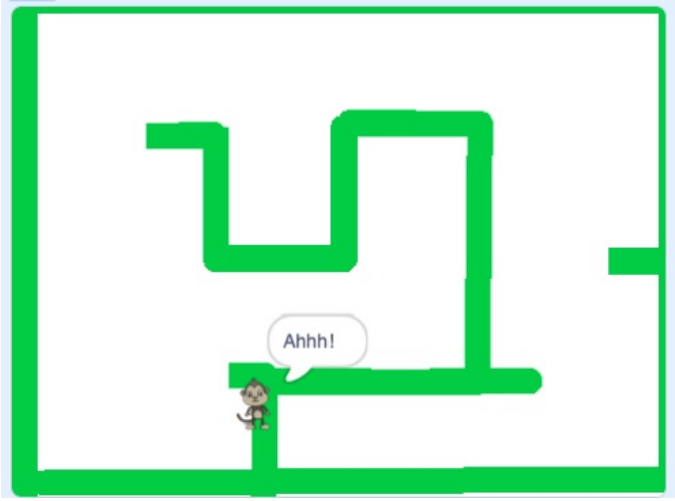
Activity 3 – Maze Game

Computing National Curriculum areas covered (all Key Stage 2):

- 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 programs

Task overview:

- Guide a character around a maze without bumping into the sides

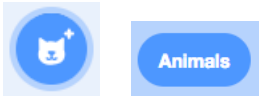
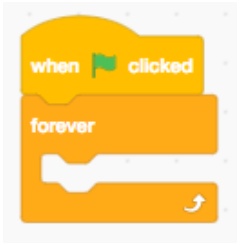
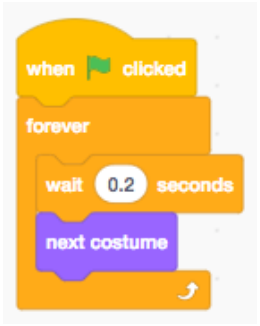
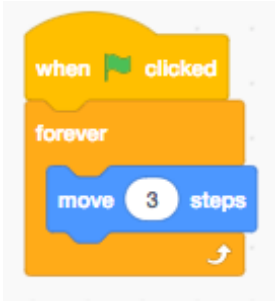


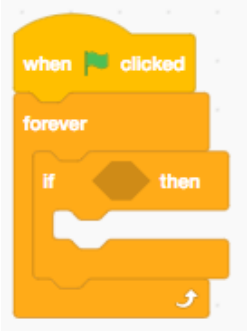
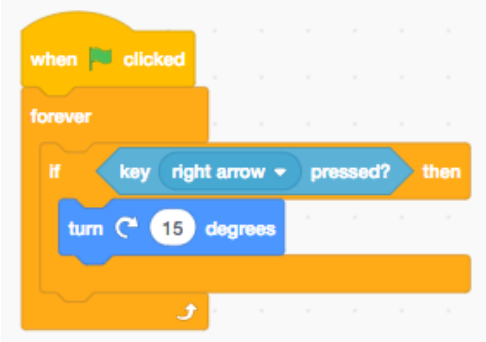
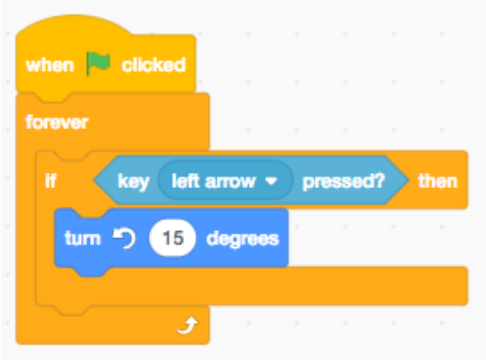
Possible cross-curricular links:

- Maths – angles and lines of symmetry (within the maze design)
- Art – sprite and maze design
- History / Literacy – famous mazes (e.g. Hampton Court); Myths and Legends (e.g. Theseus and the Minotaur)

Activity 3 – Maze Game

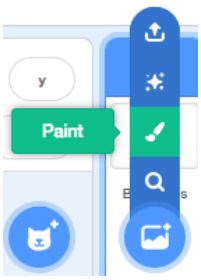
Our first task is to make our character look like they're moving as they travel around the maze. We also need to control the character using the keyboard.

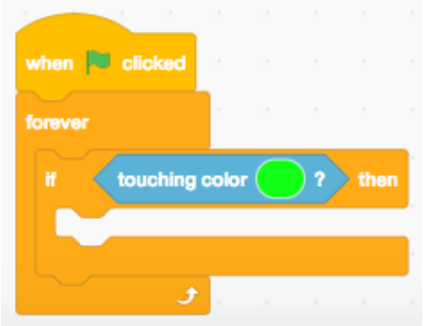
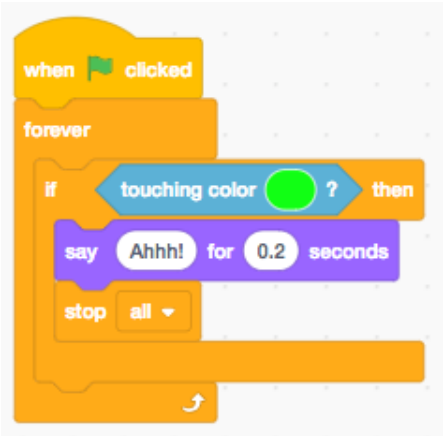
Task explanation	Required steps	Screenshots
We need to choose a *sprite* with more than one look / appearance, or *Costume*. This allows us to make the *sprite* appear as if it's moving	Delete the Cat *sprite.* Click on the *Choose a sprite* button at the bottom right of the *Sprites Area* Select a sprite from *Animals* containing more than one costume (possible *Sprites* include Crab, Rabbit, Monkey, Dinosaur4) Leave the background white	  Monkey
To give the impression of movement, we need to use *repetition* to constantly switch between *costumes*. We do this using a *forever* loop	Drag a *when Green Flag clicked* block into the *Script Area*. Attach a *forever* block from *Control* Place a *wait* block from *Control* and a *next costume* block from *Looks* inside your *forever* loop Run your program using the *Green Flag*. Alter the number of seconds in the *wait* block so it looks like your *sprite* is moving	  
During the maze game, our *sprite* is going to constantly move forward. We also use *repetition* through a *forever* loop to achieve this	Drag a second *when Green Flag clicked* block and a *forever* block into the *Script Area* Insert a *Move* block from *Motion* into the *forever* loop Run your program. You can alter the number of steps in the *Move* block if your *sprite* is moving too fast	

Next, we need to move the character when certain keys are pressed. We use both *repetition* and *selection* to check for keyboard *input*	Drag a further *when Green Flag clicked* block and a *forever* block into the *Script Area* Place the *forever* loop after the *when Green Flag clicked* block, followed by an *if, then* block inside the loop Put a *key pressed* block from *Sensing* in the top of the *if, then* block and change the key to the *right arrow* Put a *turn right* block within the *if, then* block Repeat this process to make the *left arrow* turn the sprite left when pressed Run your program using the *Green Flag* and experiment with the key presses. You can adjust the amount of turn in the *turn degrees* block if required	  

You've produced yet another program in Scratch. Within the program, you've used *repetition* to make the character move across the screen. *Repetition* has been combined with *selection* to enable keyboard *input*, which alters the location of the *sprite output* to the screen.

The next stage in producing our game is to create the maze. We also need to program our *sprite* to perform a *sequence* of instructions if it touches the maze wall.

Firstly, we need to draw our maze	Hover the mouse over the *Choose a Backdrop* button to the right of the *Sprites Area* and select *Paint* from the menu Select the *Backdrops* tab at the top of the *Blocks Palette* Choose either the *Brush* or *Line* tools from the icons on the left of the window Change the thickness of the line by altering the value in the box at the top of the window	  

	Draw your maze by clicking and dragging with the left mouse button on the backdrop (don't worry if your sprite is too big at this stage) Ensure your maze has a coloured border all the way around the edge	
Your *Sprite* is probably too large to move around the maze, so we need to make it smaller	Change the value in the *Size* box at the top of the *Sprites Area* to reduce the size of the *Sprite*	
We now need to modify the game so the *Sprite* cannot go through the maze's walls. We can again use *repetition* and *selection* to check whether the *Sprite* is touching the wall: *If* the *Sprite* is touching the wall, *then* we want it to say "Ahhh" for a period of time, followed by ending the game	Once again, drag a *when Green Flag clicked* block Place a *forever* loop after the *when Green Flag clicked* block, followed by an *if, then* block inside the loop Drag a *touching color* block from *Sensing* into the top of the *if, then* block Click on the colour within the *touching color* block, followed by clicking on your *color picker* tool at the bottom of the box. Click on maze outline on the *Stage* (this will alter the *touching color* to be the same as your maze) Place a *Say, for, seconds* block within the *if, then* block and modify the block to say "Ahhhhh" for 0.2 seconds Add a *Stop* block from *Control* into the *if, then* block (this will end the game) Run your program using the *Green Flag.* You may wish to adjust some of the game's parameters, such as the *Sprite's* speed, size or the layout of the maze	    

The *Sprite* currently remains in the same position when we restart the game. Each time the game starts, we ideally want the *sprite* to return to a specific starting position and point upwards	Drag your *Sprite* to your preferred starting position on the *Stage* Add a *go to x, y* block from *Motion* to the start of your last script, which now contains the starting point's co-ordinates (the co-ordinates are also displayed at the bottom right of the *Stage*) You should also add a *Point in direction* block from *Motion* Run your program using the *Green Flag. Debug* your program as appropriate	 

Brilliant! You've created a game involving a *Sprite* interacting with the background, that responds to a number of *inputs* (the keyboard and touching a colour). *Repetition* and *selection* have again been used, along with instructions in *sequence*. You'll be beginning to see how programs can be built by *decomposing* them into smaller parts.

Extension activities

For each of the activities below, feel free to experiment with a range of features to make your program as engaging as possible.

- Include sound effects when the character moves / hits the wall (Hint: look in *Sound*)
- Change the *Sprite* to a ghost if it touches the wall (Hint: you'll need to add a new *Costume*)
- Add a score that increases for every second the character avoids touching the side (Hint: combine a *variable* for the score with a *Wait* block)
- Instead of ending the game when the character touches the wall, get it to automatically change direction (Hint: remove the *Stop* block and look in *Motion*)
- Add objects (e.g. coins) to collect (Hint: add some extra *Sprites* and *Hide* them when touched)
- Include a second level (Hint: you'll need an end point, of a different colour, in your first maze, which, when touched, should change to your second maze background)

Physical computing extension activities

If you have access to a micro:bit, you could include additional functionality within your program.

- Instead of using the keyboard to control your *Sprite,* tilt the micro:bit to make it move (Hint: replace the *key, pressed* blocks with the blocks below)

- Program the buttons to alter various parts of the game, such as the speed of the *Sprite* (Hint: have buttons A and B increase / decrease the amount the *Sprite* moves, by changing a new *Speed* variable)

Programming with Scratch

Activity 4 – Moving sprite game

Computing National Curriculum areas covered (all Key Stage 2):

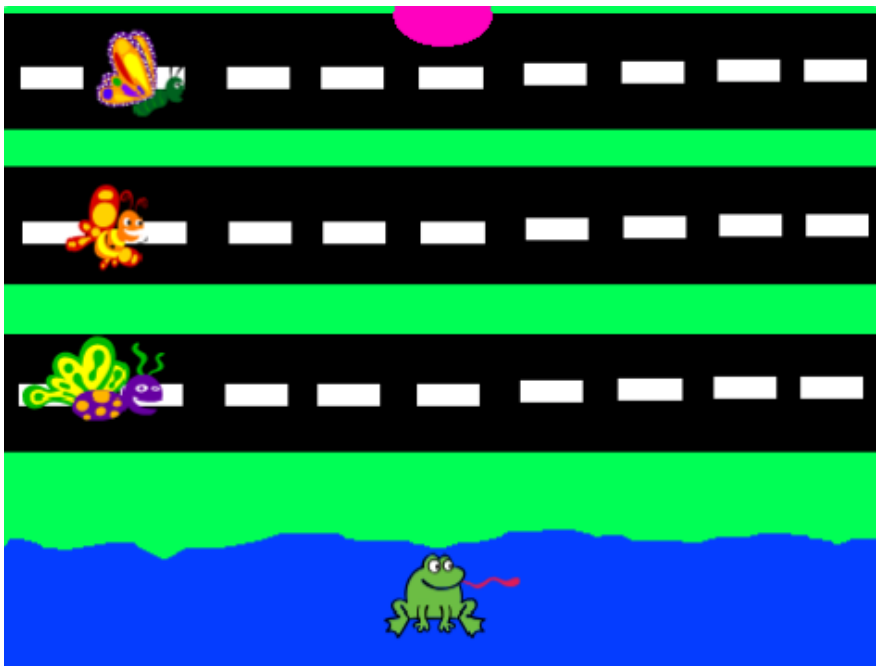
- design, write and debug programs that accomplish specific goals, including controlling or simulating physical systems; solve problems by decomposing them into smaller parts
- use sequence, selection, and repetition in programs; work with variables and various forms of input and output
- use logical reasoning to explain how some simple algorithms work and to detect and correct errors in algorithms and programs

Task overview:

A leading game manufacturer wants to see how well you can program.

They have asked you to design a game that involves moving a character around obstacles or away from enemies.

Your game can be for one or two players.



Activity 4 – Moving sprite game

If you wish, you can plan your moving sprite game and start programming immediately. Alternatively, you can use the *example game specification* below, or the more detailed instructions overleaf, which break down the necessary steps for each requirement.

Within school, pupils should be given a planning template and asked to solve the programming challenge by splitting it into smaller parts. This is known as *decomposing*. This would typically involve specifying the required steps, or *script*, to complete each section of the program.

Example game specification

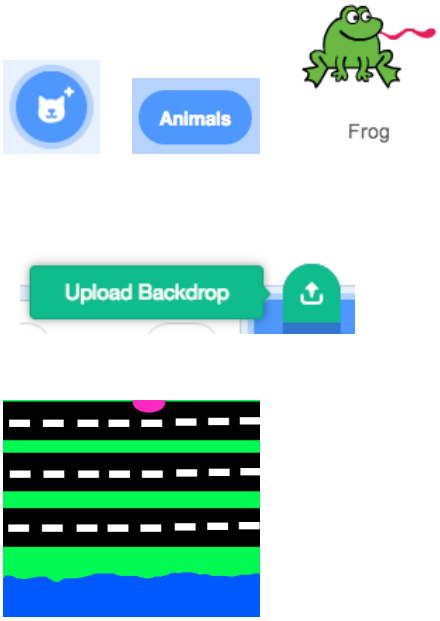
Basic: A frog has to move across the road from his pond. The frog is controlled using the keyboard. Butterflies automatically move along the road. If the frog collides with a butterfly, he becomes injured and the game ends. The frog should always start from his pond at the bottom of the screen.

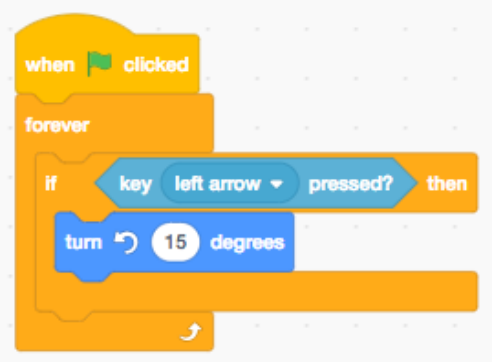
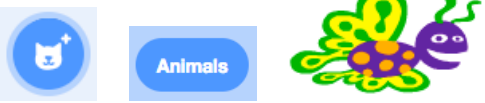
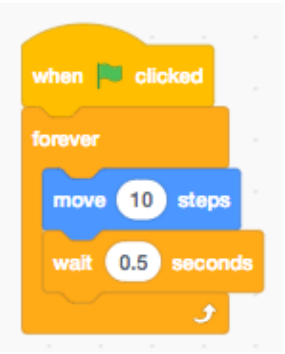
Intermediate: The frog starts with a score of 100, which should decrease by 5 for every second it takes to cross the road. The frog starts with three lives. Every time the frog collides with a butterfly, he loses a life. Once the frog has lost all his lives, the game ends. A "game over" message or screen should be displayed, along with an appropriate sound.

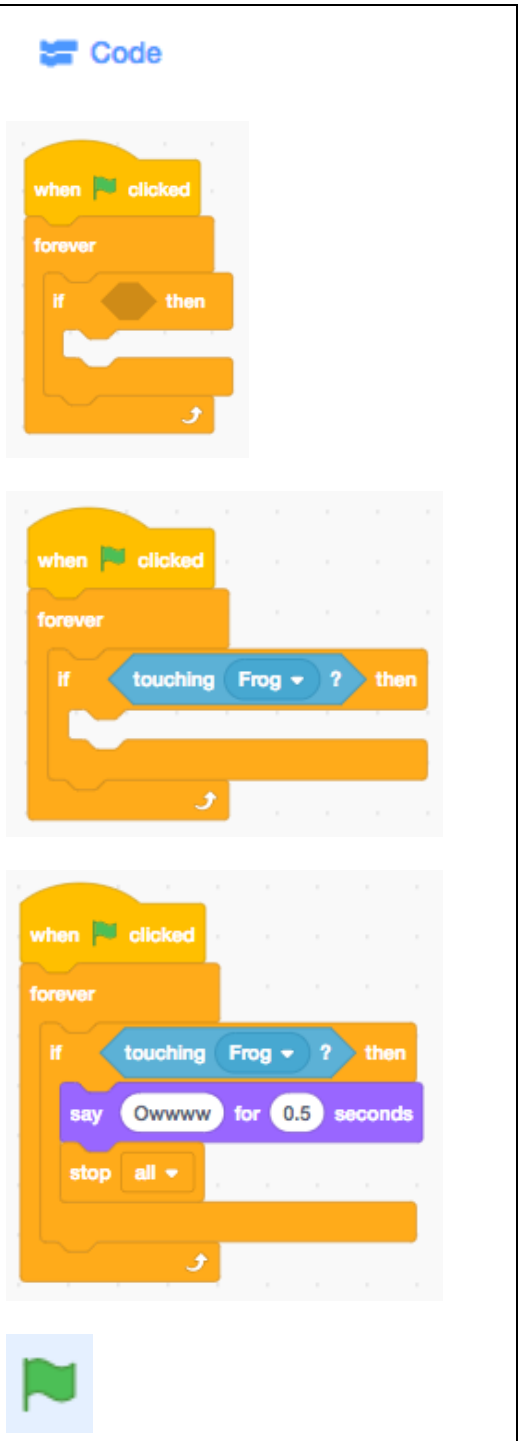
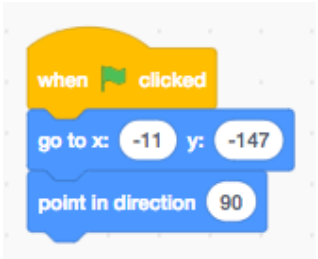
Advanced: Each butterfly's speed should increase as the game progresses. Once the frog crosses the road and reaches a certain point on the other side, he should progress to the next level. He should also get an extra 100 points.

Detailed instructions

For each sentence of the *Basic example game specification*, the required steps are outlined below, although a similar result can often be achieved using other *blocks* or *scripts*

Task explanation	Required steps	Screenshots
Text: A frog has to move across the road from his pond *Required steps:* We need a frog *sprite*, in addition to a suitable background	Delete the Cat *sprite.* Click on the *Choose a sprite* button at the bottom right of the *Sprites Area* Select the *Frog* sprite from *Animals* Click on the *Stage* (right-hand side of the *Sprites Area*) Hover over the *Choose a Backdrop* button and click on the *Upload backdrop* button Select the file containing the game's background and click *Open*	
Text: The frog is controlled using the keyboard *Required steps:* Our *sprite* is going to constantly move forward using a *forever* loop. We also need to move the character when certain keys are pressed	Drag a *when Green Flag clicked* block and a *forever* block into the *Script Area* Insert a *Move* block from *Motion* into the *forever* loop Drag a further *when Green Flag clicked* block into the *Script Area* Place a *forever* loop after the *when Green Flag clicked* block, followed by an *if, then* block inside the loop Put a *key pressed* block from *Sensing* in the top of the *if, then* block and change the key to the *right arrow* Put a *turn right* block within the *if, then* block	

	Repeat this process to make the *left arrow* turn the *sprite* left when pressed Run your program using the *Green Flag* and experiment with the key presses. You can adjust the amount of turn in the *turn degrees* block. You also can alter the number of steps in the *Move* block if your *sprite* is moving too fast	 
Text: Butterflies automatically move along the road *Required steps:* We need to add some additional butterfly *sprites* to move horizontally across the screen. When they reach the edge of the screen, they should turn around and continue moving	Click on the *Choose a sprite* button at the top of the *Sprites Area* Select the *Butterfly2* sprite from *Animals* Drag a *when Green Flag clicked* block and a *forever* block into the *Script Area* Insert a *Move* block from *Motion* into the *forever* loop, in addition to a *wait* block from *Control* Add an *if on edge, bounce* block from *Motion* to your *forever* loop Finally, add a *set rotation style* block from *Motion* before your *forever* loop (this stops our butterfly turning upside down when it touches the stage edge) Run your program using the *Green Flag* and ensure your butterfly moves automatically. Experiment with altering the value of the *move* and *wait* blocks Additional *sprites* can be added by repeating the process above	     

Text: If the frog collides with a butterfly, he becomes injured and the game ends *Required steps:* We need to detect if the frog is touching a butterfly using *repetition* and *selection*: *If* the frog *sprite* is touching the butterfly *sprite*, *then* we want the frog to say "Owwww" for a period of time, followed by ending the game	Click on the new *sprite* in the *Sprites Area* and click on the *Code* tab at the top of the *Block Palette* Drag a *when Green Flag clicked* block into the *Script Area* Place a *forever* loop after the *when Green Flag clicked* block, followed by an *if, then* block inside the loop Put a *touching* block from *Sensing* in the top of the *if, then* block and change the *sprite* to *Frog* Put a *say, for, seconds* block from *Looks* into your *if, then* block and alter the block to say "Owwww" for 0.5 seconds Add a *stop* block from *Control* into the *if, then* block (this will end the game) Run your program using the *Green Flag* and ensure your *script* works as expected. Repeat this process for your other *sprites*	
Text: The frog should always start from his pond at the bottom of the screen *Required steps:* The frog *Sprite* currently remains in the same position when we restart the game. Each time the game starts, we ideally want the *sprite* to return to a specific starting position and point upwards	Drag your frog *Sprite* to your preferred starting position on the *Stage* (in the pond) Place a *when Green Flag clicked* block in the *Script Area* Add a *go to x, y* block from *Motion* below the *when Green Flag clicked* block. You should also add a *point in direction* block from *Motion* You may wish to set the starting position for other *sprites*	

Brilliant! You now have a moving sprite game, which has been produced by *decomposing* the program specification into smaller tasks. A child undertaking a task such as this independently has met the coding requirements of the Key Stage Two Computing National Curriculum.

For the *Intermediate* and *Advanced example game specification*, step-by-step instructions are not provided. However, guidance for how to complete each part of the specification is outlined below. As with the *Basic* guidance, similar results can often be achieved in a number of ways.

Intermediate example game specification

Text	**Required steps**
The frog starts with a score of 100, which should decrease by 5 for every second it takes to cross the road	• Create a *variable* for the score • *Set* the *variable* to 100 when the game starts • Use a *forever* loop to *change* the score by -5 and *wait* one second
The frog starts with three lives. Every time the frog collides with a butterfly, he loses a life	• Create a *variable* for the lives • *Set* the *variable* to 3 when the game starts • When the frog *touches* a butterfly, change the score by -1
Once the frog has lost all his lives, the game ends	• If the lives *variable* is zero, *stop* the game
A "game over" message or screen should be displayed	When the lives *variable* reaches zero, either: • *Say* a specific message • Change the *backdrop* to a special “game over” screen
Along with an appropriate sound	• *Play* a sound when the lives *variable* reaches zero

Advanced example game specification

Text	**Required steps**
Each butterfly’s speed should increase as the game progresses	• Create a *variable* for the speed for each butterfly *sprite* • *Set* the *variable* to 0 when the game starts • Use a *forever* loop to *change* the *move* speed by a certain amount after a specific period of time, such as every few seconds
Once the frog crosses the road and reaches a certain point on the other side, he should progress to the next level	• Create a *sprite* or coloured area at the top of the screen • When the frog *touches* the area or *sprite,* the *backdrop* should change • The starting position of both the frog and butterflies may also need to be altered
He should also get an extra 100 points	• When changing the backdrop, *change* the score *variable* by 100

Extension activities

For each of the activities below, feel free to experiment with a range of features to make your program as engaging as possible.

- Include sound effects when the character moves / hits the enemies (Hint: look in *Sound*)
- Change the *Sprite* to something different if it touches a butterfly (Hint: you'll need to add a new *Costume*)
- Get the butterflies to change direction (Hint: use a *turn* block)
- Make the frog bounce across the *stage* if he touches the side (Hint: look in *Motion*)
- Add objects, such as food, for the character to collect (Hint: add some extra *Sprites* and *Hide* them when touched)
- Have different enemies, such as dogs or dinosaurs, on each level (Hint: only *show* certain *sprites* when a certain *backdrop* is selected)
- Rather than your frog automatically moving forward, program the up and down arrows to move the *sprite* forwards and backwards respectively
- Include additional levels

Physical computing extension activities

If you have access to a micro:bit, you could include additional functionality within your program.

- Make the micro:bit display a timer showing you how long it took the frog to reach the finish
- Alter the controls to use either the micro:bit's buttons or tilt sensor to move the frog
- Use the buttons to alter the difficulty at the start of the game

Programming with Scratch

Activity 5 – Platform Game

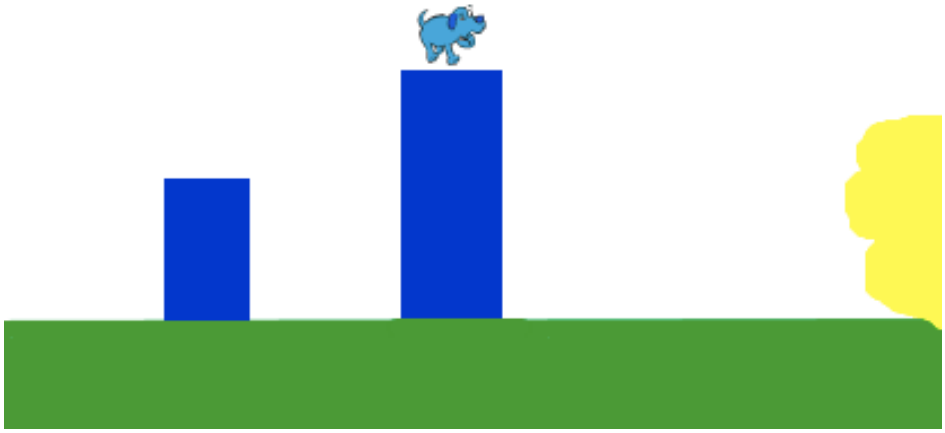
Computing National Curriculum areas covered (all Key Stage 3):

- use two or more programming languages, at least one of which is textual, to solve a variety of computational problems
- design and develop modular programs that use procedures or functions
- understand simple Boolean logic [for example, AND, OR and NOT] and some of its uses in circuits and programming

Task overview:

A leading game manufacturer was impressed with your moving sprite game. They now want you to produce a platform game.

They have asked you to make a one-player game, which involves moving a sprite along various platforms. The sprite is likely to have to jump over gaps between platforms, in addition to avoiding obstacles and enemies.



Activity 5 – Platform game

If you wish, you can plan your platform game and start programming immediately. Alternatively, you can use the *example game specification* below, or the more detailed instructions overleaf, which break down the necessary steps for each requirement.

Within school, pupils should be given a planning template and asked to solve the programming challenge by splitting it into smaller parts. This is known as *decomposing*. This would typically involve specifying the required steps, or *script*, to complete each section of the program. They should also identify sections of code that can be reused and included within a *procedure.*

Example game specification

Basic: A sprite has to move along the ground or on platforms. The sprite is controlled using the keyboard. The sprite should fall to the ground if not on a platform. The sprite should be able to jump onto platforms and be able to jump a range of different heights. The sprite should start on the left hand side of the screen and move right along the ground / platforms. The code should be implemented using procedures where possible.

Intermediate: The sprite should move realistically, including when jumping or falling. The sprite starts with three lives. The sprite should have to avoid enemies and lose a life if he collides with an enemy. Once the sprite has lost all his lives, the game ends. A "game over" message or screen should be displayed, along with an appropriate sound.

Advanced: Once the sprite reaches a certain point on the right hand side of the screen, a "congratulations" message must appear and he should progress to the next level. The sprite has a set amount of time to complete the level. Levels should scroll over more than one screen where possible.

Detailed instructions

For each sentence of the *Basic example game specification*, the required steps / blocks are outlined below, although a similar result can often be achieved using other *blocks* or *scripts*

<table>
<tr><th>Task explanation</th><th>Required steps</th><th>Screenshots</th></tr>
<tr><td>Text: A sprite has to move along the ground or on platforms

Required steps: We need a suitable sprite to control and also a sprite to act as our ground / platforms. The background should be kept to a single colour</td><td>Delete the Cat sprite

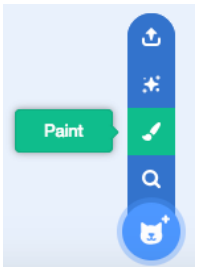
Click on the Choose a sprite from library button at the top of the Sprites Area

Select a suitable the sprite

Hover the mouse on Choose a sprite and select the Paint button

Draw a simple sprite containing a flat ground and a number of coloured obstacles. The sprite should fill the whole screen

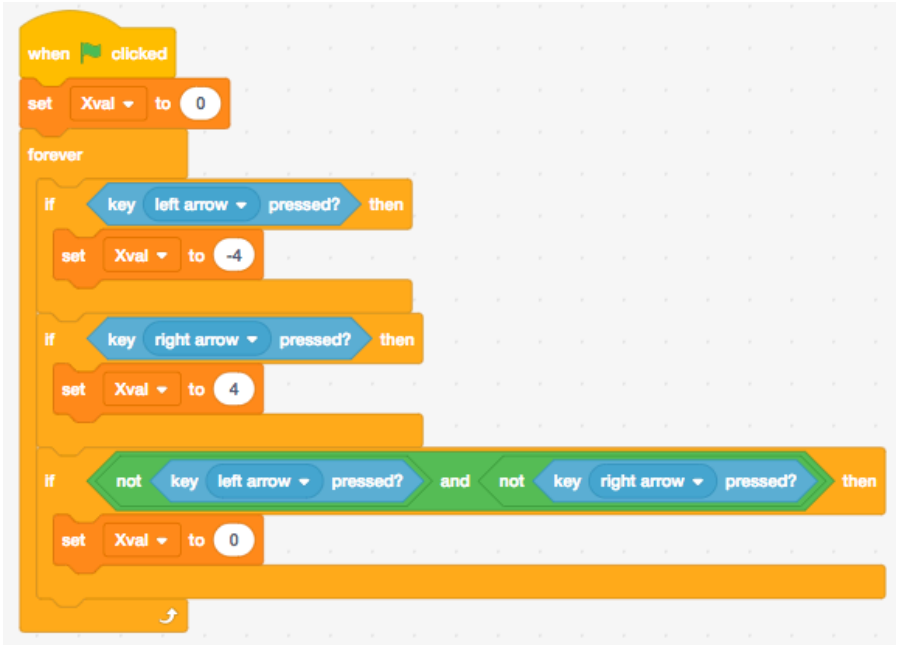
Rename the sprite appropriately, such as "ground"</td><td> 

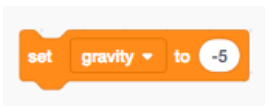
 

  </td></tr>
<tr><td>Text: The sprite is controlled using the keyboard

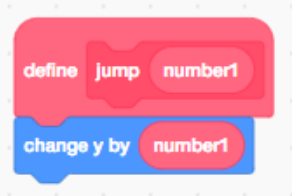
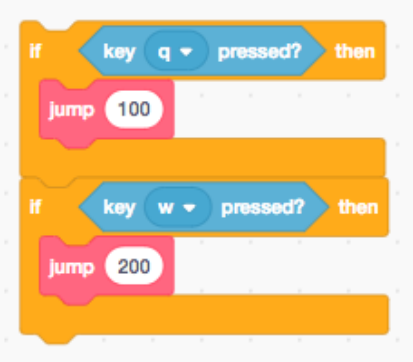
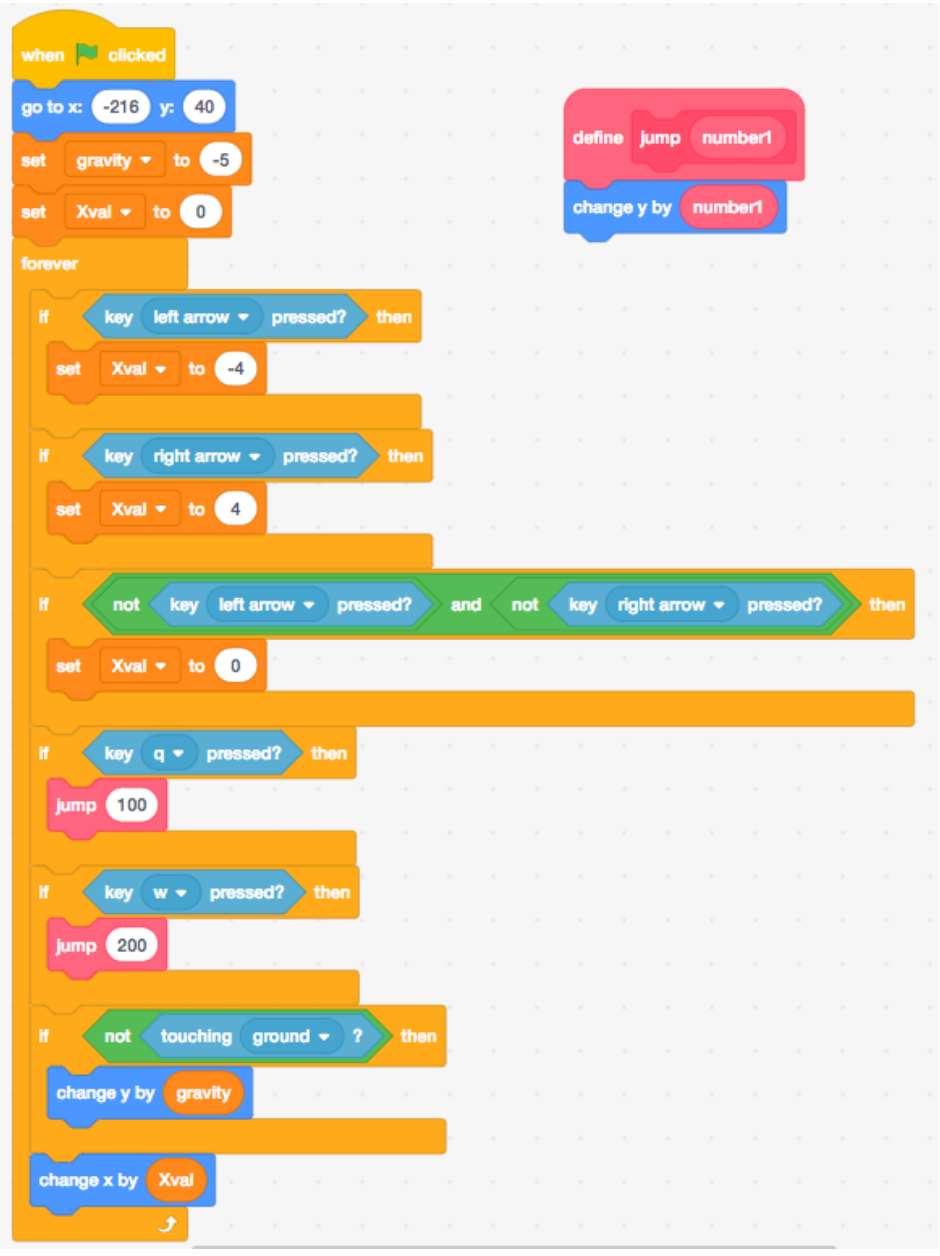
Required steps: Our program is going to constantly check for when certain keys are pressed

Unlike previous programs, we're going to manually alter the X co-ordinates, rather than using move

To move the sprite left and right, we can use the following code. Note the use of both not and and operators in the final if statement</td><td colspan="2"> 
</td></tr>
<tr><td>Text: The sprite should fall to the ground if not on a platform

Required steps: We need to create and set a variable for the "gravity". We also need an extra if statement in the forever loop to check if the sprite is on the ground and reduce the Y co-ordinate appropriately if not</td><td colspan="2"> 

 
</td></tr>
</table>

Text: The sprite should be able to jump onto platforms and be able to jump a range of different heights. The code should be implemented using procedures where possible *Required steps:* We can create a *block,* or *procedure (*in *More Blocks)* named "jump" to reuse the same code for different height jumps We can assign different key presses to pass different values to the *procedure*	 
Text: The sprite should start on the left hand side of the screen and move right along the ground / platforms *Required steps:* We can define the *Sprite's* starting position at the beginning of our program using *goto x y* The final code is shown on the right	

Well done! You now have a platform game, which includes the use of *procedures* and *Boolean operators*. A child undertaking a task such as this independently has met some of the coding requirements of the Key Stage Three Computing National Curriculum.

For the *Intermediate* and *Advanced example game specification*, blocks of code are not provided. However, guidance for how to complete each part of the specification is outlined below. As with the *Basic* guidance, similar results can often be achieved in a number of ways.

Intermediate example game specification

Text	**Required steps**
The sprite should move realistically, including when jumping or falling	• Give the impression of movement using *next costume* • Slowly increase and decrease the value of the Y co-ordinates during the jump
The sprite starts with three lives. The sprite should have to avoid enemies and lose a life if he collides with an enemy. Once the sprite has lost all his lives, the game ends	• Create a *variable* for the lives • *Set* the *variable* to 3 when the game starts • When the sprite *touches* an enemy, change the score by -1
Once the sprite has lost all his lives, the game ends	• If the lives *variable* is zero, *stop* the game
A "game over" message or screen should be displayed	When the lives *variable* reaches zero, either: • *Say* a specific message • Change the *backdrop* to a special “game over” screen
Along with an appropriate sound	• *Play* a sound when the lives *variable* reaches zero

Advanced example game specification

Text	**Required steps**
Once the sprite reaches a certain point on the right hand side of the screen, a "congratulations" message must appear and he should progress to the next level	• Create a *sprite* or coloured area at the right hand side of the screen • When the main *sprite touches* the area, the message *sprite* should be displayed, followed by changing the ground / platforms *sprite*
The sprite has a set amount of time to complete the level	• Create a *variable* for the time and reduce it by one every second • When the *variable* reaches zero, display the "game over" message / screen
Levels should scroll over more than one screen where possible	• Create the adjoining part of the level sprite and *hide* it when the game starts • As the sprite moves right, move both the background sprite left at the same rate as the sprite

Extension activities

For each of the activities below, feel free to experiment with a range of features to make your program as engaging as possible.

- Include sound effects when the character moves / hits the enemies (Hint: look in *Sound*)
- Change the *Sprite* to something different if it touches an enemy (Hint: you'll need to add a new *Costume*)
- Allow the player to select their *Sprite* at the start of the game (Hint: you could use a range of *Costumes* or independent sprites)
- Get the enemies to move at random (Hint: look in *Operators*)
- Add objects, such as food, for the character to collect (Hint: add some extra *Sprites* and *Hide* them when touched)
- Have an end of level boss to get past (Hint: only *show* certain *sprites* when certain co-ordinates are reached)
- Give the *sprite* ability to fire custard pies or a similar, non-threatening, weapon at enemies (Hint: add an additional *sprite*, which moves from the main *sprite* when a certain key is pressed)
- Include additional levels

Physical computing extension activities

If you have access to a micro:bit, you could include additional functionality within your program.

- Make the micro:bit display the number of lives the dog has left
- Alter the controls to use either the micro:bit's buttons or tilt sensor to move the frog
- Use the buttons to alter the difficulty at the start of the game