Scratch programming and Numeracy in Senior Primary Classes

Scratch is a free application, developed by the MIT Media Lab, which allows users to create and share their own interactive stories, animations and games.

It is easier to use than traditional programming languages as it consists of graphical blocks which snap together.

This course enables teachers to learn how to use Scratch and introduce it to their pupils to help them explore aspects of the curriculum in an exciting and engaging manner. The course focuses on using Scratch to create projects which support the concepts, content and skills of the mathematics curriculum.

Participants completing this course will be enabled to:

- Use Scratch programming to support the teaching and learning of the primary maths curriculum covering algebra, number, shape and space, measures and data
- Use Scratch programming to support the development of problem solving skills
- Develop a numeracy project using Scratch
- Develop lesson outlines for classroom use of Scratch
- Describe how Scratch can be used to support other curricular areas
- Develop an e-Learning action plan describing how they will use Scratch to support numeracy development

Module 1

National Centre for Technology in Education
Ionad Náisiúnta don Teicneolaíocht san Oideachas

Module 1

Scratch programming and Numeracy in Senior Primary Classes (NCTE/Lero)

Course Notes

Suggested Duration of Module

4 Hours

Objectives

Module 1 will cover:

1. Introduction to the Scratch Interface and Scratch projects
2. Introduction to some resources available online for Scratch
3. Installing Scratch
4. Review of the Mathematical Skills from the Mathematics Curriculum
5. The use of Scratch to explore x y coordinates and directed numbers
6. The use of Scratch to explore variables
7. The use of Operators block, sensing and broadcast
8. Discussion on how Scratch can support Numeracy in the classroom

1. Introduction to the Scratch Interface and Scratch Projects

Once Scratch has been downloaded and opened, the following Scratch interface will appear.

SCRATCH 1.4 INTERFACE

Stage – This is where your sprites and backgrounds appear. This is where you see a program running.

Sprite List – Thumbnails of all your sprites

Scripts Area – This is where you will place code to create programs

Blocks Palette – The blocks of code are grouped into different categories; motion, control, looks, sensing, sound, operators, pen and variables.

1.1 Activity

- Click on the cat in the Sprite List
- Drag out “move 10 steps” block
- Double click on the block to see the cat move
- Add a control block e.g. “When space key pressed”. Now the cat will move when you press the space key
- Experiment with the Blocks Palette for a few minutes

1.2 Educational Advantages of Scratch Programming

- Scratch enables children to create games, stories and animations.
- Scratch facilitates higher order thinking skills such as problem solving, information- processing, Metacognition (self-assessment), creative thinking and reasoning.
- While using Scratch children are actively engaged in their learning.
- Scratch has been shown to increase motivation.
- While creating in Scratch, children take part in meaningful conversation and collaboration.

1.3 When using Scratch to support the Mathematics Curriculum the emphasis must be that:

- The children are active in the lesson – creating editing, reviewing
- The children are constantly communicating – giving and receiving feedback. To facilitate this, children could work in pairs or small groups. It is also helpful to conclude each lesson with a group discussion.
- The teacher is focussed on Mathematical skills, not just mathematical content.

2. Introduction to some resources available online for Scratch

scratch.mit.edu is the main website for Scratch. You can download the Scratch software for free from this website. Here, you can upload your own projects and view and download other projects. There is a section for teachers and also for researchers.

scratch.ie is an Irish-based website, run by Lero. It provides updates about Scratch and information about the National Competition. It has a large store of teaching materials aimed at both primary and secondary level, and also has a students' area.

info.scratch.mit.edu/Support provides video tutorials and guides.

scratch.mit.edu/forums is a support forum for Scratch users.

scratched.media.mit.edu is an online community where Scratch educators share stories, exchange resources, ask questions and find other educators.

3. Installing Scratch

Scratch can be downloaded free of charge from scratch.mit.edu/download. There are different versions for Windows, Mac and Ubuntu. The website provides step by step instructions for download.

4. Review of the Mathematical Skills from the Mathematics Curriculum

Scratch can support mathematical skills development in the following ways:

Skill	How Scratch supports this skill	Example
Applying and Problem-solving	• Using maths concepts in realistic settings • Debugging errors • Selecting and applying appropriate strategies • Reflect upon and evaluate work	All projects involve some degree of problem solving e.g. http://scratch.mit.edu/projects/ballns/2365930
Communicating and Expressing	• Discussing, explaining and presenting projects to group • Pair work • Group feedback and problem solving	Pupils create project notes, present their work and provide suggestions for others
Integrating and Connecting	• Connecting informally acquired maths tasks in Scratch to formal maths ideas • Carrying out mathematical activities which involve other areas of the curriculum	See Lesson 10 in Lesson Pack and also this project which integrates with science. http://scratch.mit.edu/projects/Marg68/112670
Reasoning	• Experimentation to test ideas	The children must create realistic effects in their

	• Reason systematically to complete a game/ animation	projects e.g. when the shark catches the fish, the fish loses a life. http://scratch.mit.edu/projects/ballns/2503887
Implementing	• Use appropriate tools/ programs to execute standard procedures	When given a task such as the lesson challenges children must plan appropriate coding to create a solution.
Understanding and recalling	• Understand and recall Scratch terminology, formulae for creating programs	Use the basic scratch code to solve tasks, scratch cards or lesson challenges

Very often, you will find that the children are using these skills in Scratch without any explicit teaching. Any activities in Scratch should aim to support to use and development of these skills in children.

5. The use of Scratch to explore x y coordinates and directed numbers

5.1 Curriculum Requirements

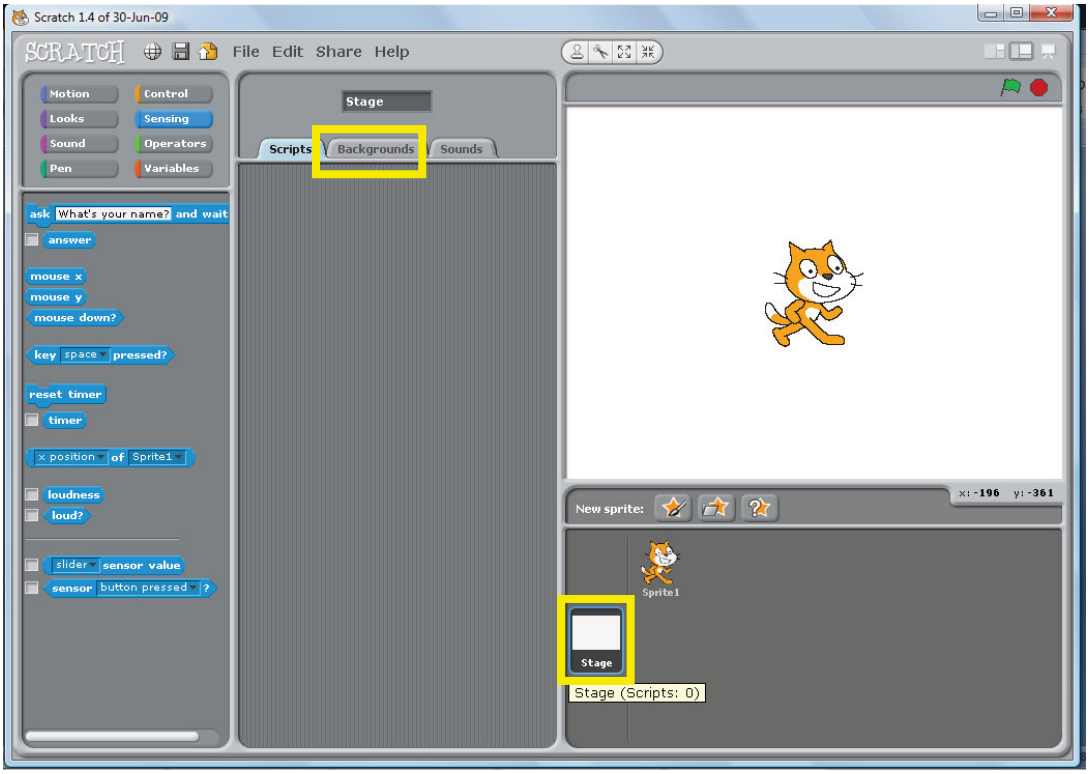
The child should be enabled to:

- Identify positive and negative numbers
- Add simple positive and negative numbers on the number line

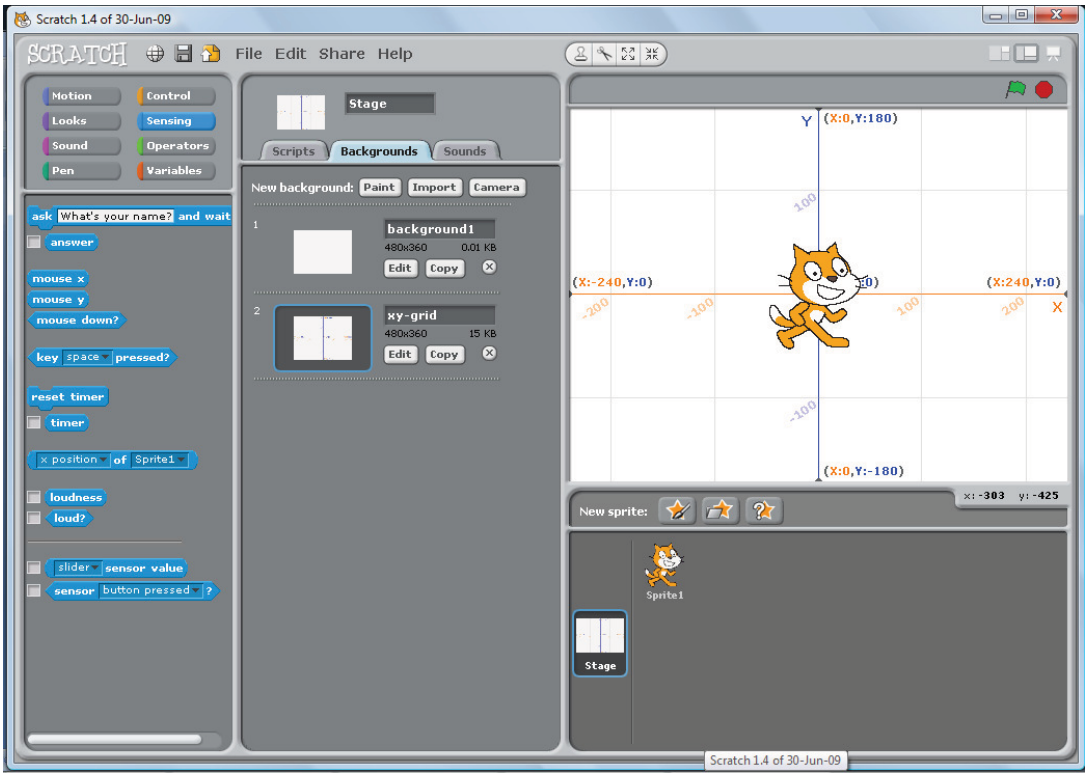
5.2 Activity

Please create these projects using your own ideas as much as possible. If time allows you will be asked to show your projects to the other course participants.

Click on stage in the Sprite List, then click on Backgrounds



Click on Import and choose the x y grid



This grid can be used to point out different coordinates to children.

Note the Mouse x y display at the bottom right hand corner of the screen. Ask the children to try and put the mouse at exactly x=0, y=0. This is the centre of

the stage and is where the cat is positioned when you open the Scratch interface.

5.3 Moving Left and Right

When moving a sprite to left and right we are moving along the x axis. This can be achieved in a number of ways. Make sure you have clicked on the sprite in the Sprite List.

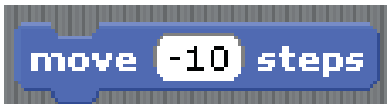
1. Use the "move 10 steps" block

This will move the sprite 10 steps to the right.

To increase the number of steps click on the number 10. This will be highlighted in blue.

You can then type in how many steps the sprite will move.

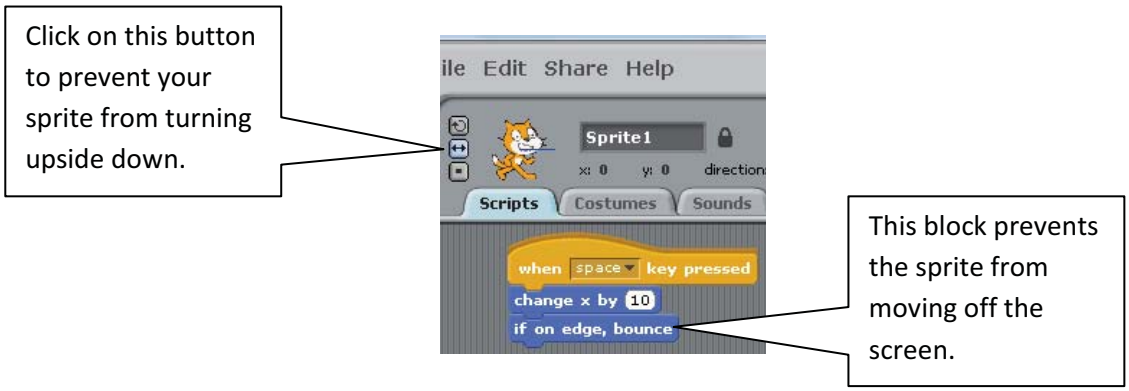
Now, if +10 steps will move the sprite to the right, as above, how can we move the sprite to the left? We type in -10 steps.



2. Use the "change x by 10" block

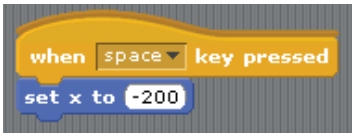
This will move the sprite to the right along the x axis. As above you can change how many steps the sprite takes and use negative numbers to move left.

Remember to add a control to your script.



3. Use the "set x to 0" block

This block will move your sprite to the x coordinate you plot.



4. Use the "glide 1 sec to x: 0 y: 0" block

This will allow the sprite to move smoothly from one position to another.

Increase the gliding speed by decreasing the number of seconds. Decrease the gliding speed by increasing the number of seconds.

5. Use the "go to x: 0 y: 0" block

5.4 Moving Up and Down

When moving a sprite up and down we are moving along the y axis. This can be achieved in a number of ways. First, make sure you have clicked on the sprite in the Sprite List.

1. Use the "change y by 10" block

This will move the sprite to the right along the x axis. As above you can change how many steps the sprite takes and use negative numbers to move left.

Remember to add a control to your script.

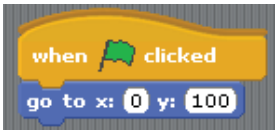
2. Use the "set y to 0" block

This block will move your sprite to the y coordinate that you plot.

3. Use the "glide 1 sec to x: 0 y: 0" block

This will allow the sprite to move smoothly from one position to another.

4. Use the "go to x: 0 y: 0" block

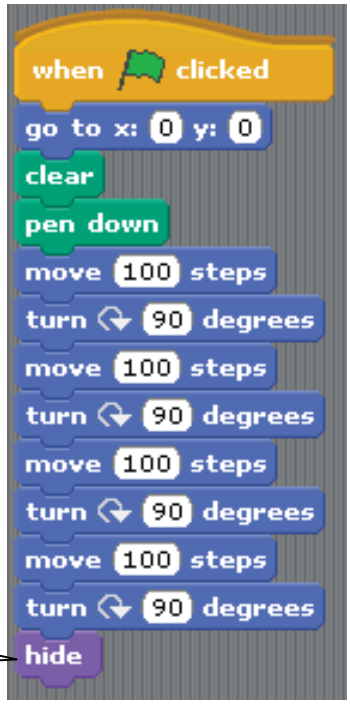


5.5 Participant Activity

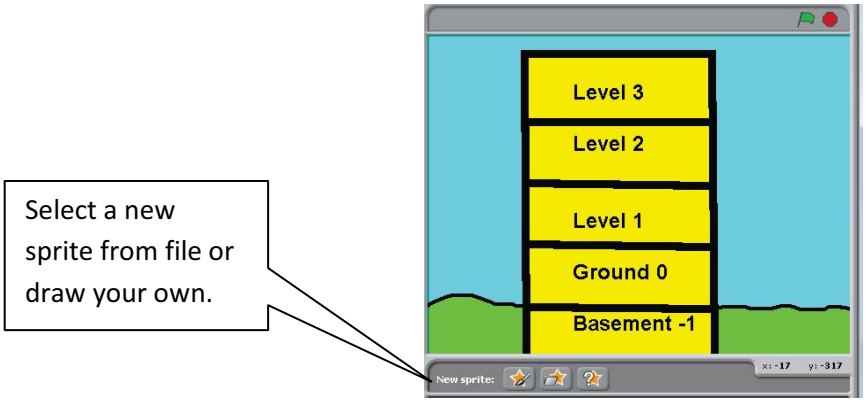
Discuss how you could use these features in your Maths lesson. Remember that the children should be actively working with Scratch.

Task 1. Write up a list of coordinates on the board. Pupils must create a script which moves a sprite to these coordinates. Using a map background this could integrate with a geography lesson. Remind children that when writing any coordinates we use the following format (x,y), i.e. the x coordinate is written first, followed by the y coordinate. Therefore in the example (90, 25) x=90, y=25.

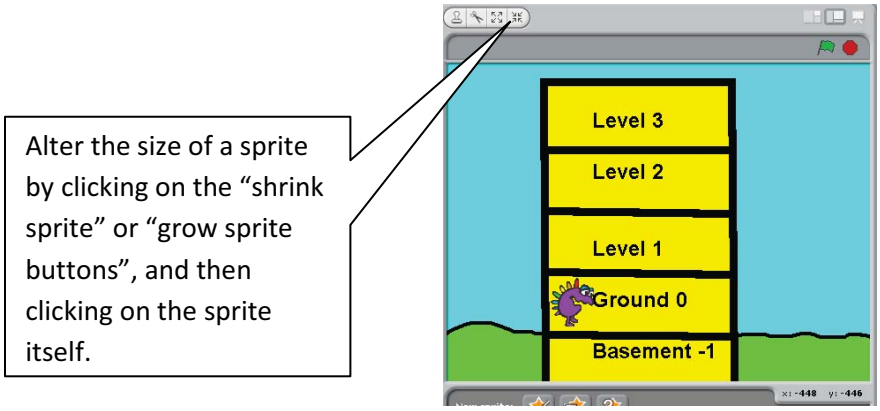
Task 2. Use the pen blocks. Add the block pen down to the start of your script. Ask the children to draw different shapes.



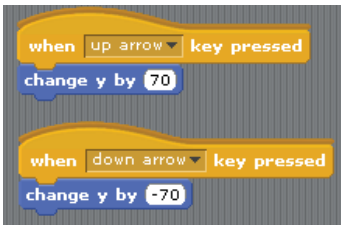
Task 3. Click on the stage in the Sprite List.
Click on backgrounds.
Click Paint.
Ask children to draw a building with several floors.



Ask the children to choose a sprite. The can delete the cat sprite by right clicking on it in the sprite list and choosing delete.



Ask the children to create scripts which allow the sprite to move up and down the building.



5.6 Saving Project, Project notes

To save any completed work:

Click on File, and then Save as.

Give the project a title.

In the "About this Project" section fill in details about the project such as what it does, what buttons activate the controls, and any other information you wish to include.

6. The use of Scratch to explore variables

6.1 Curriculum Requirements

The child should be enabled to:

- Explore the concept of a variable in the context of simple patterns, tables and simple formulae and substitute values for variables

While variables are only mentioned explicitly in the sixth class curriculum, they can be seen at different levels too:

Area = Length * width (a = l*w)

Diameter = 2*radius (d = 2*r)

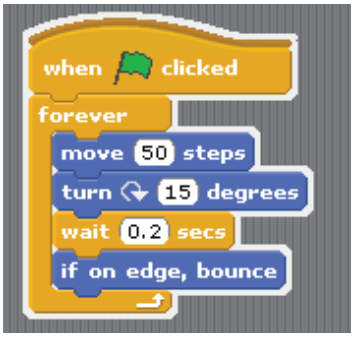
Speed = Distance/Time (S= D/T)

In Scratch, the children can use simple variables to enhance their games.

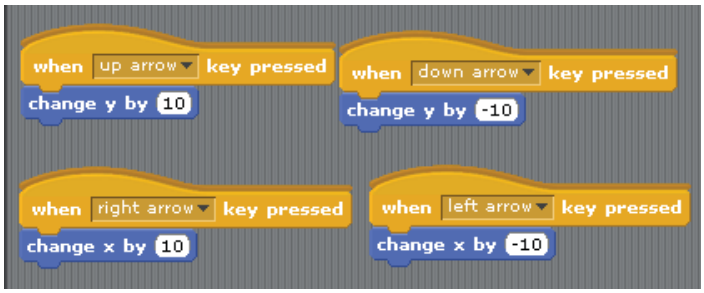
6.2 Activity

This is a simple chase game. One sprite will move randomly around the screen. A second sprite, controlled by the user, will move around the screen trying to avoid the first sprite. If they touch, your sprite will lose a life.

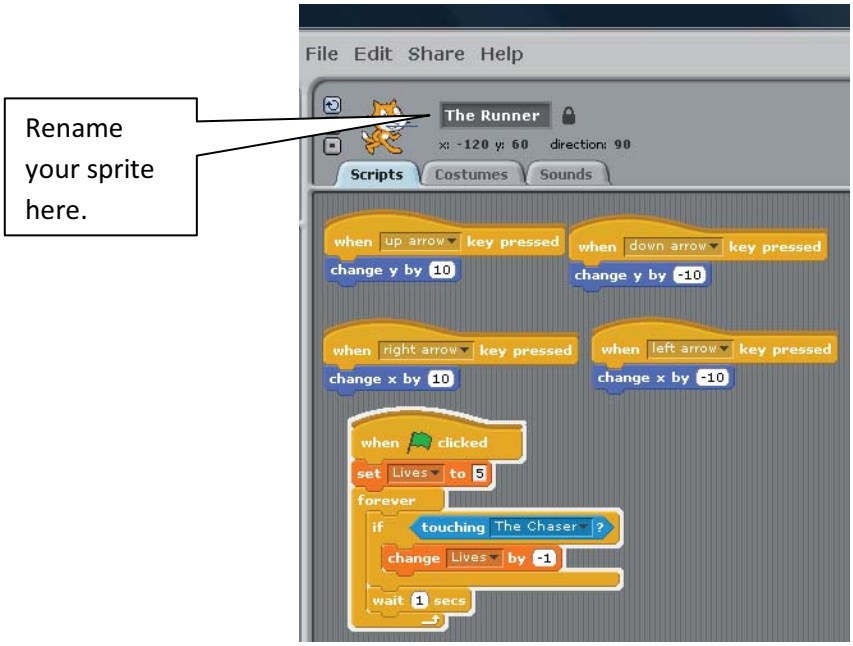
Choose a sprite. We will call it The Chaser. Create a script which allows it to move randomly around the screen.



Choose a second sprite. We will call it The Runner. Create scripts that allow it to move up, down, left and right.

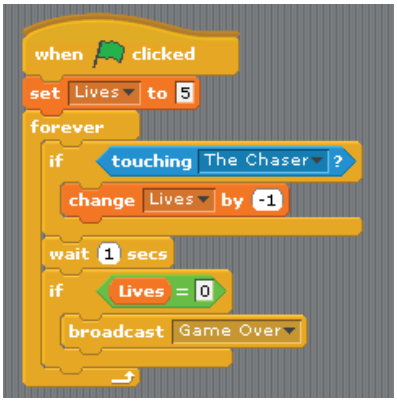


Click on the Variables Palette.
Create a variable called Lives.
We want The Runner to start with five lives. Each time it touches The Chaser sprite it will lose a life.



What happens when the lives reach 0? We need to create a program to tell the sprites what to do. This will require a broadcast.

7. The use of Operators block, sensing and broadcast



A broadcast sends out a message to all scripts. We must program what the scripts will do once they receive the broadcast.

In this case we want the background to change to say Game Over. We also want The Chaser to stop moving.

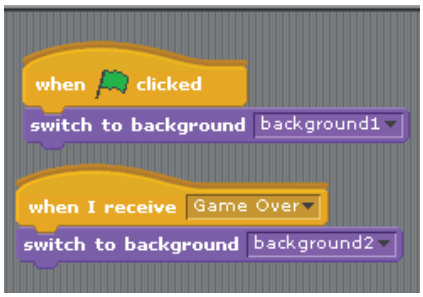
Click on stage in the Sprite List.

Click Backgrounds.

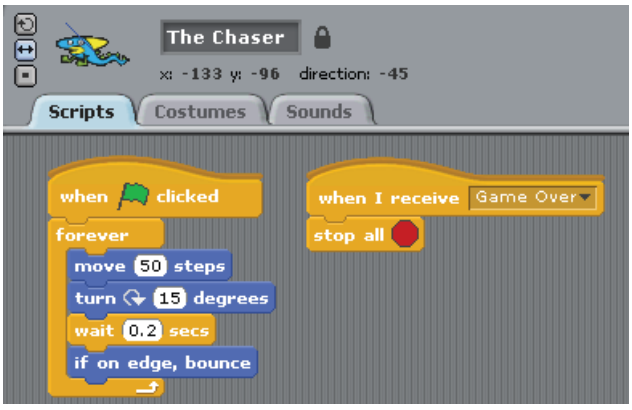
Click Paint.

Create a background that shows that the game is over.

Click on Scripts and create a script that will change the background.



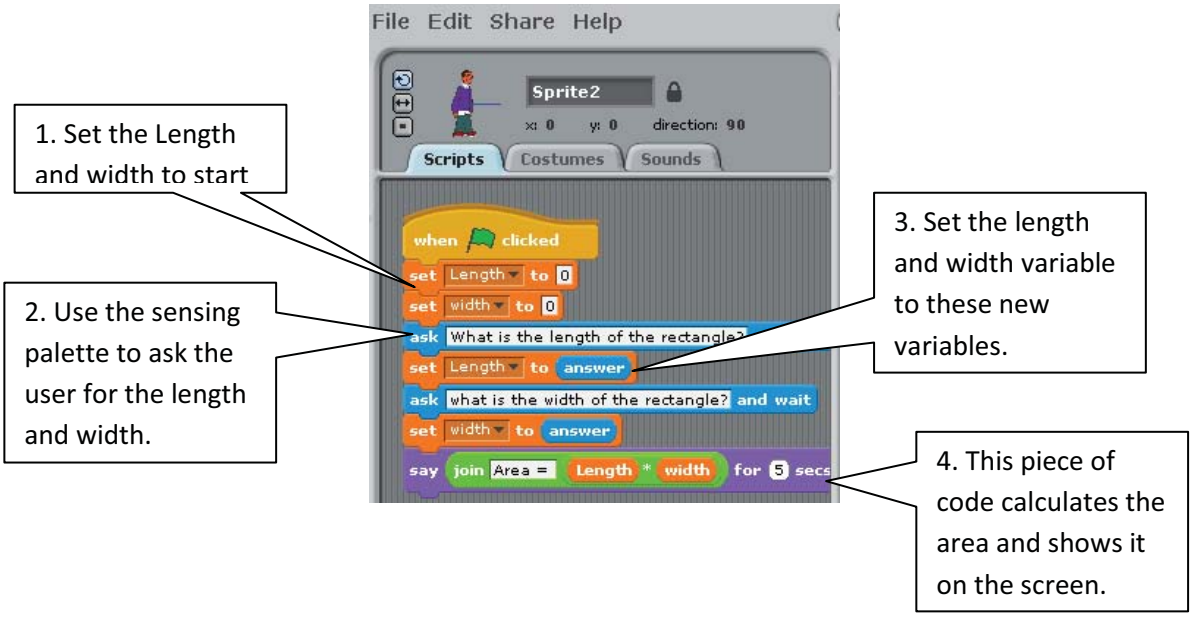
When The Chaser receives the broadcast it will stop moving.



7.1 Participant Activity

Discuss how you could use these features in your Maths lesson. Remember that the children should be actively working with Scratch.

Task 1. This lesson uses Scratch to calculate the area of a square or rectangle. Create 2 variables, one called Length, the other Width. The user can enter the length and width values and the program will calculate the area.



Task 2. The children can create a quiz based on class work e.g. http://scratch.mit.edu/projects/ballns/1905085

8. Discussion on how Scratch can support Numeracy in the classroom

8.1 Today's objective was to cover:

1. Introduction to the Scratch Interface and Scratch projects
2. Introduction to some resources available online for Scratch
3. Installing Scratch
4. Review of the Mathematical Skills from the Mathematics Curriculum
5. The use of Scratch to explore x y coordinates and directed numbers
6. The use of Scratch to explore variables
7. The use of Operators block, sensing and broadcast

8. Discussion on how Scratch can support Numeracy in the classroom

8.2 Discuss:

In what way could you extend or adapt today's activities for your own classroom? What would work well? What might be difficult to implement or use?