REFERENCE GUIDE

1. INTRODUCTION

Scratch is a new programming language that makes it easy to create interactive stories, games, and animations – and share your creations with others on the web.

This Reference Guide provides an overview of the Scratch software. If you are just getting started with Scratch, we encourage you to try the Getting Started Guide first (*http://scratch.mit.edu/files/ScratchGettingStarted.pdf*). Then, if you want more detailed information, come back to the Reference Guide.

The Scratch website has many other resources to help you learn Scratch: Video Tutorials, Scratch Cards, and Frequently Asked Questions (FAQs). See *http://scratch.mit.edu/howto*

For the latest version of the Reference Guide, see *http://scratch.mit.edu/files/ScratchReferenceGuide.pdf*

BASIC INGREDIENTS OF A SCRATCH PROJECT

Scratch projects are made up of objects called **sprites**. You can change how a sprite looks by giving it a different **costume**. You can make a sprite look like a person or a train or a butterfly or anything else. You can use any image as a costume: you can draw an image in the paint editor, import an image from your hard disk, or drag in an image from a website.

You can give instructions to a sprite, telling it to move or play music or react to other sprites. To tell a sprite what to do, you snap together graphic **blocks** into stacks, called **scripts**. When you double-click on a script, Scratch runs the blocks from the top of the script to the bottom.

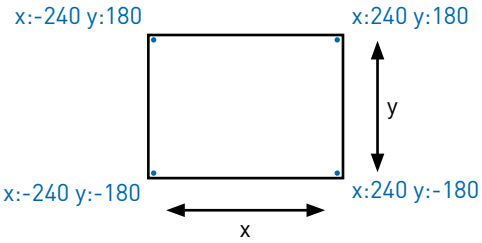
Scratch is developed by the Lifelong Kindergarten Group at the MIT Media Lab, with financial support from the National Science Foundation, Intel Foundation, and the MIT Media Lab research consortia.

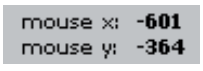
2. SCRATCH INTERFACE

STAGE

The **Stage** is where you see your stories, games, and animations come to life. Sprites move and interact with one another on the stage.

The stage is 480 units wide and 360 units tall. It is divided into an x-y grid. The middle of the stage has an x-coordinate of 0 and a y-coordinate of 0.





To find out x-y positions on the stage, move the mouse around and look at the **mouse x-y display** just below the stage, on the right.

Click the **Presentation Mode** button to see projects at full-screen size. To exit Presentation Mode, press the Esc key.

NEW SPRITE BUTTONS

When you start a new Scratch project, it begins with a single cat sprite. To create new sprites, click on these buttons:


Paint your own sprite

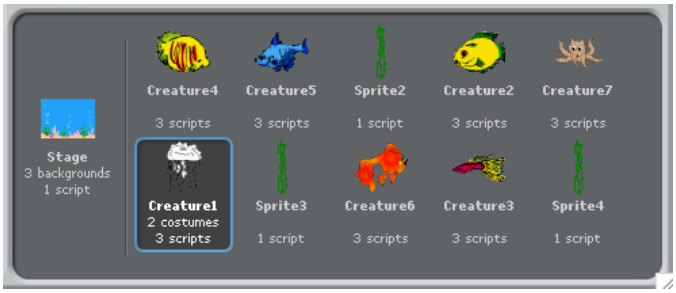

Select a costume for a new sprite – or import an entire sprite


Get a surprise sprite

If you want to delete a sprite, select the scissors from the Toolbar and click on the sprite. Or right-click on the sprite and select "delete" from the pop-up menu.

SPRITE LIST

The **Sprite List** displays thumbnails of all of the sprites in the project. For each sprite, it shows the sprite's name, how many scripts it has, and how many costumes it has.



To see and edit a sprite's scripts, costumes, and sounds, click on the sprite's thumbnail in the Sprite List – or double-click on the sprite itself on the Stage. (The selected sprite is highlighted and outlined in blue in the Sprite List.)

You can rearrange the sprites in the Sprite List by dragging the thumbnails.

Just as a sprite can change its appearance by switching costumes, the Stage can change its appearance by switching **backgrounds**. To see and edit the scripts, backgrounds, and sounds associated with the Stage, click on the Stage icon at the left of the Sprite List.

BLOCKS PALETTE and SCRIPTS AREA

To program a sprite, drag out blocks from the **Blocks Palette** to the **Scripts Area**. To run a block, double-click on it.

Create scripts (programs) by snapping blocks together into stacks. Double-click anywhere on the stack to run the whole script, from top to bottom.
To find out what a block does, right click on it, then select Help from the pop-up menu.

When you drag a block around the Scripts Area, a white highlight indicates where you can drop the block and form a valid connection with another block.

To move a stack, pick it up from the top block. If you drag out a block from the middle of a stack, all of the blocks beneath it will come along with it.

Some blocks have white editable text fields inside, such as move 10 steps. To change the value, click inside the white area, delete the existing number, and type a new number. You can also drop rounded blocks, like x position, inside these areas.

Some blocks have pull-down menus, such as set instrument to 1. Just click on the to see the menu, then click again to make a selection.

COSTUMES

Click the **Costumes** Tab to see and edit the sprite's costumes.

This Sprite has two costumes. The sprite's current costume (girl1-walking) is highlighted.
To switch to a different costume, simply click on the thumbnail of the costume you want.

There are three ways to create new costumes:

- Click Paint to paint a new costume in the Paint Editor
- Click Import to import an image file from your hard disk
- Drag in an image from the web or your desktop

Scratch can recognize many different image formats: JPG, GIF, BMP, and PNG

You can rearrange the order of the costumes by dragging the thumbnails.

Right-click on a costume thumbnail to convert the costume into a new sprite, or to export a copy of the costume as a separate file.

SOUNDS

Click the Sounds Tab to see the sprite's sounds.

You can record new sounds and import sound files. Scratch can read MP3 files and uncompressed WAV, AIF, and AU files (encoded with 8-bits or 16-bits per sample, but not 24-bits per sample).

CURRENT SPRITE INFO

Current Sprite Info shows a sprite's name, x-y position, and direction.

You can type in a new name for the sprite.

The sprite's direction indicates which direction the sprite will move when it runs a move block (0=up, 90=right, 180=down, -90=left). The blue line on the thumbnail shows the sprite's direction. You can drag this line to change the sprite's direction. Double-click on the sprite to set the direction back to its original state (direction=90).

Click **Export Sprite** to save the sprite as a separate file, for use in another project.

ROTATION STYLE

Click the **Rotation Style** buttons to control how the costume rotates as the sprite changes its direction.

- Rotate: The costume rotates as the sprite changes direction.
- Left-right flip: The costume faces either left or right.
- No-rotate: The costume never rotates (even as the sprite changes direction)

TOOLBAR

Click on the **Toolbar** to select a tool, then click on other objects to perform an action.

- **Arrow:** Normal mode. Pick up and move sprites and blocks.
- **Copy:** Duplicate sprites, costumes, sounds, blocks, and scripts.
- **Delete:** Delete sprites, costumes, sounds, blocks, and scripts.
- **Grow:** Make sprites bigger.
- **Shrink:** Make sprites smaller.

MENU

New, **Open**, **Save**, and **Save As** do what you would expect them to do.

Share! uploads your project to the Scratch website (http://scratch.mit.edu)

Undo allows you to retrieve the last block, script, or sprite you deleted (but does not allow you to undo most other actions).

Language allows you to select the language used on the Scratch blocks. (For now, the menu items and tabs are available only in English.)

Extras gives a pop-up menu with special features:

> **Import Project:** Bring all of the sprites and backgrounds from another project into this project. This feature is useful for combining sprites from multiple projects.
> **Start Single Stepping:** The Scratch program runs one step at a time, highlighting each block as it runs. This feature can be useful for finding bugs in programs, and for helping new programmers understand the flow of a program.
> **Compress Sounds:** Compress sounds used in the project, to reduce the overall file size of the project.
> **Compress Images:** Compress images used in the project, to reduce the overall file size of the project.

Want Help? brings up a page with links to reference materials, tutorials, and frequently-asked questions. To get help on an individual block, right click on the block and select Help from the pop-up menu.

GREEN FLAG 

Click the Green Flag to start all scripts with 

at the top.

The Green Flag provides a convenient way to start many scripts at the same time.

In Presentation Mode, the Green Flag appears as a tiny icon  at the top-right corner of the screen.
Shortcut: Pressing the Enter key has the same effect as clicking the Green Flag.

3. SCRATCH BLOCKS

TYPES OF BLOCKS

There are three main types of blocks in the Blocks Palette:

Stack Blocks: These blocks have bumps on the bottom and/or notches on the top, such as 

. You can snap these blocks together into stacks. Some stack blocks have an input area inside them, where you can type a number (such as 10 in the 

block) or choose an item from a pull-down menu (such as "pop" in the 

block). Some stack blocks, such as 

, have a C-shaped "mouth" where you can insert other stack blocks.

Hats: These blocks have rounded tops, such as 

. These blocks are placed at the tops of stacks. They wait for an event to happen, such as a key being pressed, then run the blocks underneath them.

Reporters: These blocks, such as 

and 

, are designed to fit in the input area of other blocks. Reporters come in two shapes, and fit only into "holes" of the same shape. Reporters with rounded ends (such as 

) report numbers and fit inside blocks with rounded holes (such as 

). Reporters with pointed ends (such as 

) report "boolean" values (true or false) and fit inside blocks with pointed holes (such as 

).

Some reporter blocks have a check box next to them, such as 

. If you click in the check box, a monitor appears on the stage, displaying the current value of the reporter. As the value of the reporter changes, the **monitor** updates automatically. A monitor can display the value of the reporter in several different formats:

a small readout with the name of the reporter

a large readout without any name

a slider that allows you to manipulate the value of the reporter (available only for variables)

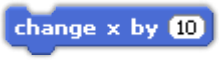
Double-click or right-click on the monitor to change from one format to another.

The slider format is available only for user-created variables. Right-click on the slider to adjust its minimum and maximum values.

BLOCK DESCRIPTIONS

The Scratch blocks are organized into eight color-coded categories.

Motion

	Moves sprite forwards or backwards
	Rotates sprite clockwise
	Rotates sprite counterclockwise
	Points sprite in the specified direction 0=up, 90=right, 180=down, -90=left
	Points sprite towards mouse-pointer or another sprite
	Moves sprite to specified x and y position on Stage
	Moves sprite to the location of the mouse-pointer or another sprite
	Moves sprite smoothly to a specified position over specified length of time
	Changes sprite's x-position by specified amount
	Sets sprite's x-position to specified value
	Changes sprite's y-position by specified amount
	Sets sprite's y-position to specified value
	Turns the sprite in the opposite direction when it touches the edge of the stage
	Reports sprite's x-position (ranges from -240 to 240)
	Reports sprite's y-position (ranges from -180 to 180)
	Reports sprite's direction 0=up, 90=right, 180=down, -90=left

Looks

switch to costume costume1	Changes sprite's appearance by switching to different costume
next costume	Changes sprite's costume to next costume in the costume list (If at end of the costume list, jumps back to first costume)
say Hello! for 2 secs	Displays sprite's speech bubble for specified amount of time
say Hello!	Displays sprite's speech bubble (You can remove speech bubble by running this block without any text)
think Hmm... for 2 secs	Display sprite's thought bubble for specified amount of time
think Hmm...	Displays sprite's thought bubble
change color effect by 25	Changes a visual effect on a sprite by specified amount (Use pull-down menu to choose effect)
set color effect to 0	Sets a visual effect to a given number Most visual effects range from 0 to 100
clear graphic effects	Clears all graphic effects for a sprite
change size by 10	Changes sprite's size by specified amount
set size to 100 %	Sets sprite's size to specified percentage of original size
size	Reports sprite's size, as % of original size
show	Makes sprite appear on the Stage
hide	Makes sprite disappear from the Stage When sprite is hidden, other sprites can not detect it with touching? block
go to front	Moves sprite in front of all other sprites
go back 1 layers	Moves sprite back a specified number of layers, so that it can be hidden behind other sprites

Sound

play sound pop	Starts playing a sound (selected from pull-down menu), and immediately goes on to the next block (even as the sound is still playing)
play sound pop and wait	Plays a sound and waits until the sound is finished playing before continuing with next block
play drum 48 for 0.25 secs	Plays a drum sound (selected from pull-down menu) for specified number of seconds
play note 60 for 0.5 secs	Plays a musical note (higher numbers for higher pitches) for specified number of seconds
set instrument to 1	Sets the type of instrument that the sprite uses for **play note** blocks. (Each sprite has its own instrument.)

Pen

clear	Clears all pen marks and stamps from the Stage
pen down	Puts down sprite's pen, so it will draw as it moves
pen up	Pulls up sprite's pen, so it won't draw as it moves
set pen color to	Sets the pen's color, based on choice from color picker
change pen color by 10	Changes the pen's color by specified amount
set pen color to 0	Sets the pen's color to a specified value (pen-color = 0 is at red end of rainbow, pen-color = 100 is at blue end of rainbow)
change pen shade by 10	Changes the pen's shade by specified amount
set pen shade to 50	Sets the pen's shade to a specified amount (pen-shade = 0 is very dark, pen-shade = 100 is very light)
change pen size by 1	Changes the thickness of the pen
set pen size to 1	Sets the thickness of the pen
stamp	Stamps the sprite's image onto the Stage

Control

	Runs script below when green flag is clicked
	Runs script below when specified key is pressed
	Runs script below when sprite is clicked
	Waits specified number of seconds, then continues with next block
	Runs the blocks inside over and over
	Runs the blocks inside a specified number of times
	Sends a message to all sprites, triggering them to do something, and waits until they all finish before continuing with next block
	Sends a message to all sprites, then continues with the next block (without waiting for the triggered scripts to finish)
	Runs script below when it receives specified broadcast message
	Continually checks to see if condition is true; whenever it is, runs the blocks inside
	If condition is true, runs the blocks inside
	If condition is true, runs the blocks inside the **if** portion; if not, runs the blocks inside the **else** portion
	Waits until condition is true, then runs the blocks that follow

	Checks to see if condition is true; if so, runs blocks inside and checks condition again. If condition is not true, goes on to the blocks that follow.
	Stops the script
	Stops all scripts in all sprites

Sensing

	Reports the x-position of the mouse-pointer
	Reports the y-position of the mouse-pointer
	Reports true if the mouse button is being pressed down
	Reports true if the specified key is pressed
	Reports true if sprite is touching specified sprite, edge, or mouse-pointer (selected from pull-down menu)
	Reports true if sprite is touching specified color Click on color patch, then use eyedropper to select color
	Reports true if first color (within sprite) is touching the second color (in background or another sprite) Click on color patch, then use eyedropper to select color
	Reports distance from the specified sprite or mouse-pointer
	Sets the timer to zero
	Reports the value of the timer (in seconds) Note: The timer is always running
	Reports the volume (from 1-100) of sounds detected by the computer microphone
	Reports true if computer microphone detects a sound volume greater than 30 (on scale of 1-100)
	Reports the value of specified sensor To use this block, you need to have a "ScratchBoard" connected to your computer. See http://scratch.mit.edu/scratchboard
	Reports true if specified sensor is pressed To use this block, you need to have a "ScratchBoard" connected to your computer. See http://scratch.mit.edu/scratchboard

Numbers

	Adds two numbers
	Subtracts one number from another
	Multiplies two numbers
	Divides one number by another
	Picks a random integer within the specified range
	Reports true if first number is less than second number
	Reports true if the two numbers are equal
	Reports true if first number is greater than second number
	Reports true if both conditions are true
	Reports true if either condition is true
	Reports true if condition is false; reports false if condition is true
	Reports the absolute value of a number
	Reports the remainder of dividing the first number by the second number
	Reports the closest integer to a number

Variables

	Allows you to create and name a new variable When you create a variable, three blocks are created automatically (see below). You can choose whether the variable is for all sprites (global) or just for one sprite (local).
	Deletes all three blocks associated with the variable
	Changes variable by specified amount
	Sets variable to specified number
	Reports value of variable