



# SCRATCH 2

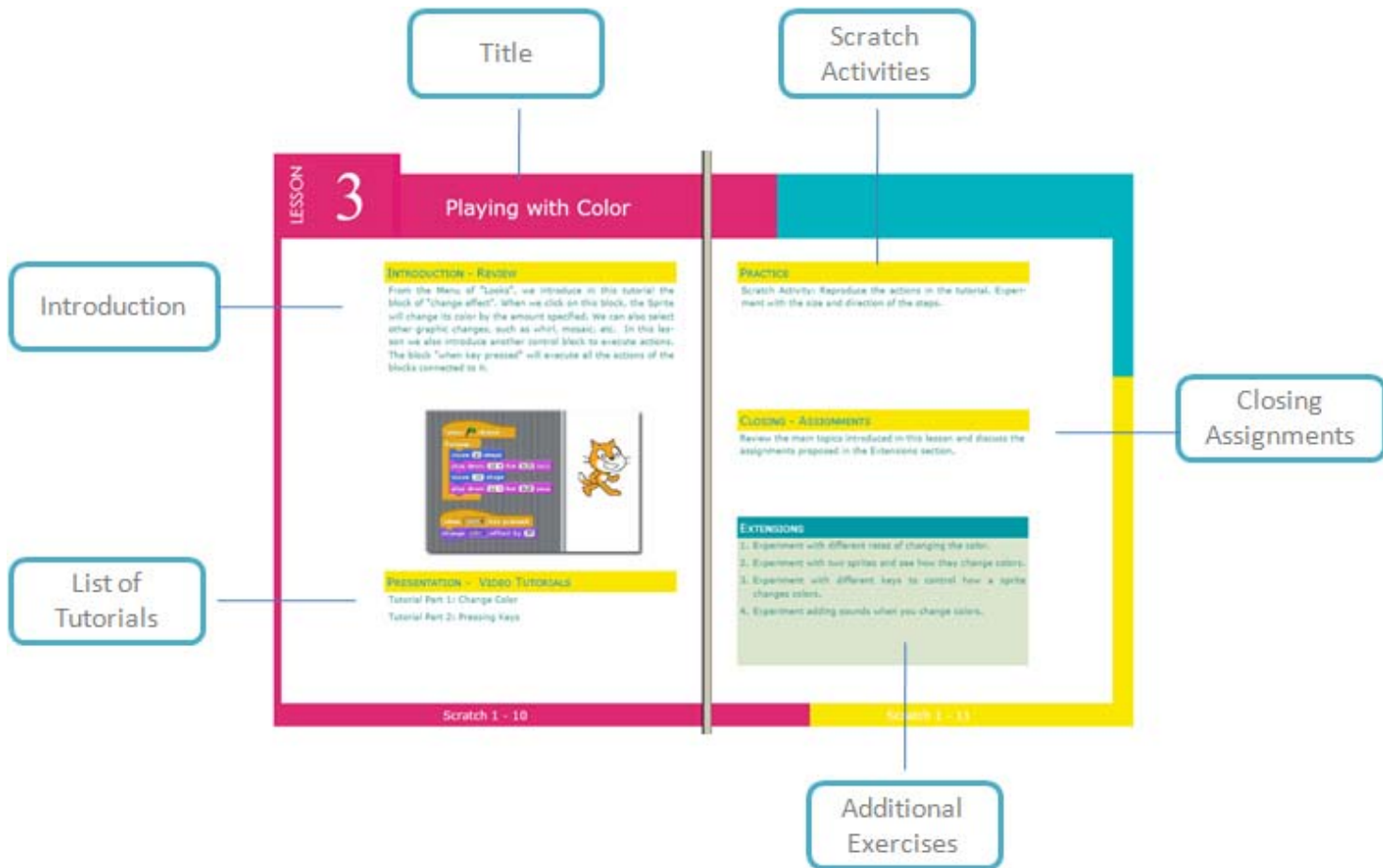
STEP BY STEP:  
A COURSE IN SCRATCH  
PROGRAMMING

LESSON PLANS



[learnscratch.org](https://learnscratch.org)

# Lesson Layout



# List of Lessons

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# Class Management

## TIME SCHEDULE

This course has been designed so that each lesson will occupy one meeting session with the students.

Once the tutorial has been reviewed, the activity of the student will concentrate on mastering the new concepts presented.

Practicing with Scratch and exploring all the possibilities of the new concepts learned is essential for a robust learning process.

The exercises proposed in the Extensions section are designed to reinforce the learn-by-doing approach.

## SCRATCH ACTIVITIES

After studying the tutorials the students will replicate on their own Scratch environment the activities presented during the lesson.

The students are encouraged to explore, beginning with the environment presented in the tutorials, all the possibilities open by the newly learned concepts.

## EXTENSIONS

The exercises presented in the Extensions section provide suggestions to develop and reinforce the knowledge and techniques learned in the tutorials.

They also provide a schedule support by allocation a variety of work assignments for each lesson.

# Class Management

## DVD WITH COURSE MATERIALS

Schools and institutions can reduce their internet demands for using these materials by installing them locally in their labs and computers.

To receive DVDs with these materials, send the institutions mailing address via the "Contact Us" link at [learnscratch.org](http://learnscratch.org).

## SOLUTIONS TO EXTENSIONS EXERCISES

Scratch programs with solutions to the Extension exercises can also be obtained sending a request via the "Contact Us" link at [learnscratch.org](http://learnscratch.org).

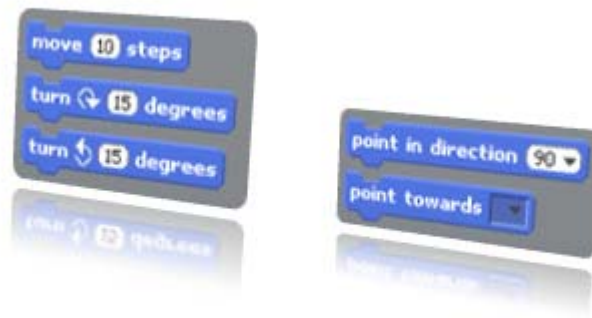
## ADDITIONAL COURSES

New courses using Scratch are being developed to be incorporated into the K-12 curriculum. Information on these courses will be available at [learnscratch.org](http://learnscratch.org).

# Move, Turn and Point

## INTRODUCTION - REVIEW

This lesson introduces the building blocks that allow the Sprites to move forwards and backwards and to rotate clock and counter clockwise, and to make our Sprites face or point in a particular direction. The direction may be determined by an angle in degrees, or by the position of the mouse pointer or other Sprites.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Move and Turn

Tutorial Part 2: Pointing

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment with the size and direction of the steps and turns.

Scratch Activity: Reproduce the actions in the tutorial. Experiment with other directions and sprites.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

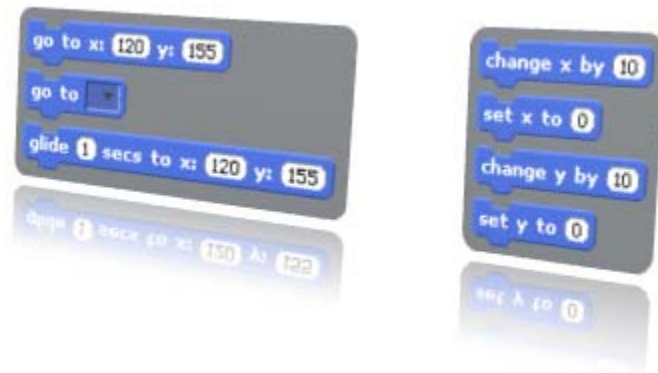
## EXTENSIONS

1. Experiment with step sizes: very small, small, larger, very large.
2. Experiment with all ranges of turns.
3. Experiment by combining move and turn actions simultaneously.
4. Experiment pointing into all range of directions and to other sprites.
5. Experiment combining all actions in this lesson.

# Go-&-Glide, Changing Positions

## INTRODUCTION - REVIEW

This lesson presents the blocks that allow us to position immediately or smoothly our Sprite in a particular position within the X-Y grid of Scratch. The position may be determined by a set of x-y coordinates, the position of the mouse pointer or another Sprite,. It also presents how to modify relatively or absolutely the X and Y coordinates of the Sprite within the Scratch grid.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Go and Glide

Tutorial Part 2: Changing Positions



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment with the controls of the glide movements.

Scratch Activity: Reproduce the actions in the tutorial. Experiment by exploring the range of vertical and horizontal coordinates

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by exploring the range of vertical and horizontal coordinates.
2. Experiment with the controls of the Go and Glide and Change and Set controls.
3. Experiment by performing equivalent movements of the sprite with alternative controls.
4. Experiment by moving the sprite around the edge of the stage.
5. Experiment by moving the sprite over the vertical and horizontal axes ( $x=0$ , and  $y=0$ )

# Bouncing, Locating the Sprite

## INTRODUCTION - REVIEW

This lesson presents the programming block that allows us to force a Sprite in motion to remain within the limits of the Scratch grid by requiring it to bounce when it reaches one of the edges of the Stage. It also introduces the programming blocks that provide us with the three characteristics of the Motion of the Sprite: the x position, the y position, and its direction.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Bouncing

Tutorial Part 2: Locating the Sprite

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment by modifying the settings and parameters used in the tutorial.

Scratch Activity: Reproduce the actions in the tutorial. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by having two sprites bouncing off the edges of the stage.
2. Experiment by having two sprites reporting their location and direction.
3. Experiment by adding sounds when the sprite moves or bounces.
4. Experiment by adding sounds when the sprite crosses some thresholds.

# Changing Costumes

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to select the next costume of the sprite or any of its pre-defined costumes. It also introduces the programming block to change the backgrounds.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Change of Costumes

Tutorial Part 2: Change of Backgrounds

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment by exploring the sprites and their costumes in the different Scratch libraries.

Scratch Activity: Reproduce the actions in the tutorial. Experiment by exploring the backgrounds and their costumes in the different Scratch libraries.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

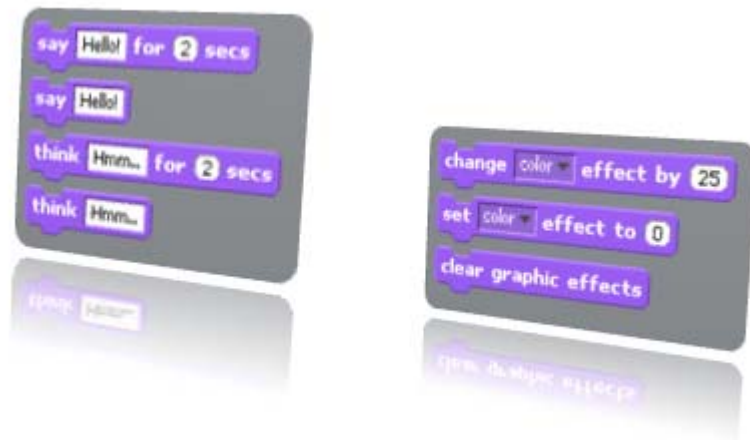
## EXTENSIONS

1. Experiment by applying the techniques of the tutorial to other sprites.
2. Experiment by synchronizing changes of costumes and backgrounds.
3. Experiment by adding sounds when the sprite changes costumes.
4. Experiment by adding sounds when the background changes costumes.

# Speaking, Thinking and Graphic Effects

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to display a speech or a thought bubble with its corresponding message. The message is presented permanently or for a fix duration of time. It also introduces the programming blocks that allow us to set or change graphic effects applied to the sprite. These effects include: color, fisheye, whirl, pixelate, mosaic, brightness and ghost.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Speaking and Thinking

Tutorial Part 2: Graphic Effects

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by having two sprites communicate in words and thoughts.
2. Experiment by adding sounds when a sprite speaks or thinks.
3. Experiment by applying multiple graphic effects to a sprite.
4. Experiment by adding sounds when graphic effects are applied.

# Size, Presence and Layers

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to set or change the size of the sprite, making it larger or smaller than its initial size. It also introduces the programming blocks that allow us to show the sprite on the Stage or to make it disappear from it, and how to move the sprite in front of the other sprites, or to move it back one or several layers.



## PRESENTATION - VIDEO TUTORIALS

- Tutorial Part 1: Changing Size
- Tutorial Part 2: Show and Hide
- Tutorial Part 3: Controlling Layers



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by changing the size of two or more sprites at the same time.
2. Experiment by making appear and disappear several sprites.
3. Experiment by controlling the layer relative position of several sprites.
4. Experiment by adding sounds as the sprite change sizes, show or hide, or change layers.

# Playing Sounds

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to play one of the predefined sounds associated with the sprite, and either continue with other actions or wait until the end of the sound. It also introduces the control to stop all sounds.



## PRESENTATION - VIDEO TUTORIALS

Tutorial: Playing Sounds

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment by exploring the sounds in the libraries of Scratch and by recording your own sounds.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by recording multiple sounds.
2. Experiment by having multiple sprites play multiple sounds.
3. Experiment by adding text and sounds to a simple story.
4. Experiment by having several sprites sing and play instruments together.

# Playing Drums

## INTRODUCTION - REVIEW

This Tutorial introduces the programming block that allows us to select one among many drum sounds and to play it for a pre-defined duration.



## PRESENTATION - VIDEO TUTORIALS

[Tutorial Part 1: Playing Drums](#)

[Tutorial Part 2: Playing Drums](#)

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorial. Experiment by exploring the sounds in the libraries of Scratch and by recording your own sounds.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by playing multiple drums.
2. Experiment by playing sequences of drums.
3. Experiment by adding text when drum sounds are played.
4. Experiment by exploring the drum sounds in the Scratch libraries.

# Playing Instruments

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to select one among many instruments and to play a selected note for a predefined duration.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Playing Instruments

Tutorial Part 2: Playing Instruments

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by exploring the sounds in the libraries of Scratch and by recording your own sounds.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by playing multiple instruments.
2. Experiment by playing sequences of instruments.
3. Experiment by adding text when instrument sounds are played.
4. Experiment by exploring the instrument sounds in the Scratch libraries.

# Pen and Color Control

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to put the pen down, and therefore draw as it moves, or to move the pen up, disabling the pen from marking as it moves. The clear block removes all the pen marks from the Stage. It also introduces the programming blocks that allow us to set or change the pen color. We can set the pen color graphically or numerically.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Pen Up and Down

Tutorial Part 2: Changing Colors



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by drawing circles (use move and turn: Unit 1.)
2. Experiment by drawing rectangle (use move and set direction: Unit 1.)
3. Experiment by adding sounds as the pen draws.
4. Experiment by having two or more pens draw together.

# Pen Size, Shade, Stamp

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to set or change the shade of the pen. The shade scale ranges from 0, very dark or black, to 100, very light. It also introduces the programming blocks that allow us to set or change the pen size. The scale of the size goes from 1 pixel to sizes larger than the complete Stage. Finally it introduces how to stamp on the Stage images of the sprite.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Changing Shades

Tutorial Part 2: Changing Pen Size

Tutorial Part 3: Stamping Effects

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by changing the size of the pen as it draws circles and rectangles.
2. Experiment by changing the shade of the color of the pen as it draws circles and rectangles.
3. Experiment by performing stamping effects as those seen in the tutorials.
4. Experiment by adding sound effects to the previous programs.

# Beginning and Waiting

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to activate scripts by clicking on the green flag, clicking on the corresponding sprite, or by pressing a key on the keyboard. It also introduces the programming blocks that allow us to stop the execution of the script and wait for a predefined time or until a condition becomes true.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Beginning Actions

Tutorial Part 2: Waiting

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

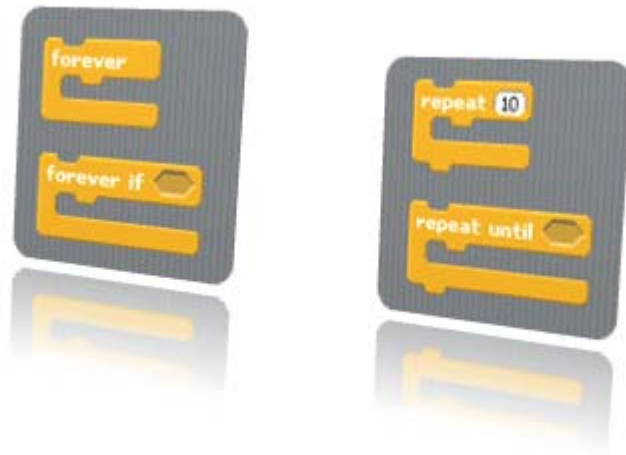
## EXTENSIONS

1. Experiment by controlling actions using three different techniques.
2. Experiment by applying simultaneous controls to multiple sprites.
3. Experiment by starting some actions and stopping others with the same controls.
4. Experiment by adding sound effects to the previous programs.

# Repeating Actions

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to repeat indefinitely a group of actions unconditionally or when a condition, which is constantly checked, becomes true. It also introduces the programming blocks that allow us to repeat a group of actions a predetermined number of times, or until a condition becomes true.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Doing Forever

Tutorial Part 2: Repeating Actions

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by applying the techniques seen in the tutorials to: two, three or more sprites.
2. Experiment by applying image effects to the previous programs.
3. Experiment by adding sound effects to the previous programs.

### INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allows communication between sprites through messages which are broadcast by one sprite and received by all sprites.



### PRESENTATION - VIDEO TUTORIALS

Tutorial: Broadcasting



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by creating two sprites (to draw circles and rectangles) controlled by the broadcast signal of a third sprite.
2. Experiment by creating a dialog between two sprites coordinated with broadcast signals.
3. Experiment by adding sound effects when the broadcast signals are sent and received.

# Conditional Actions

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to implement a group of actions when a condition is true, or to select between two groups of actions depending on the state, true or false, of a condition.



## PRESENTATION - VIDEO TUTORIALS

Tutorial: Conditional Actions

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by drawing circles when a condition is true (e.g.: the sprite is touching the edge.)
2. Experiment by drawing rectangles or circles depending on whether a condition is true or not (e.g.: the sprite is on the right side of the stage - x is positive.)
3. Experiment by adding sound to the previous programs.

### INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to stop the execution of a particular script or to stop the execution of all scripts in all sprites of the project.



### PRESENTATION - VIDEO TUTORIALS

Tutorial: Stopping

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by stopping the movement of the sprite when it reaches the edge.
2. Experiment by drawing circles of different colors until the color turns to white.
3. Experiment by moving two sprites and stopping them when they collide.
4. Experiment by adding sound effects to the previous programs.

# Mouse and Keyboard Control

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to receive information on the location of the mouse, coordinates  $x$  and  $y$ , and whether the mouse button is pressed down or not. It also introduces the programming block that allows to receive information on whether a particular key of keyboard is being pressed down.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Mouse Report

Tutorial Part 2: Pressing Keys

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by drawing shapes defined by the mouse cursor.
2. Experiment by playing sounds using the keyboard keys (e.g.: asdf.)
3. Experiment by moving one sprite with the mouse and another with the arrow keys.
4. Experiment by changing the color of the background by pressing keys.

# Touching, Over Distance Reporting

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to know whether the sprite is touching another sprite, the mouse pointer or an edge of the Stage, a particular color, or if a color of the sprite is touching another color. It also introduces the programming block that allow us to know the current distance from the sprite to another sprite or to the mouse pointer.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Touching and Over

Tutorial Part 2: Reporting Distance



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by drawing circles when the sprite touches a green path of color.
2. Experiment by playing sounds when the sprite touches another sprite.
3. Experiment by playing a warning sound when the sprite gets to close to the edge.
4. Experiment by adding graphic or sound effects to the previous programs.

# Using the Timer and Volume

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to know the current value of the timer in seconds, and to reset the timer. The timer starts running the moment we open or create a new project. It also introduces the programming blocks that allow us to determine the current volume of the sounds detected in the microphone, and whether this value is greater than 30 on a scale from 1 to 100.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Using the Timer

Tutorial Part 2: Checking the Volume

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by resetting the timer each time a moving sprite bounces off the edge.
2. Experiment by microphone to move forward a sprite.
3. Experiment by using the timer to measure the time it takes a sprite to move around the edges of the stage.
4. Experiment by using the microphone to change the color of the sprite.

### INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to know the current value of the timer in seconds, and to reset the timer. The timer starts running the moment we open or create a new project. It also introduces the programming blocks that allow us to determine the current volume of the sounds detected in the microphone, and whether this value is greater than 30 on a scale from 1 to 100.



### PRESENTATION - VIDEO TUTORIALS

Tutorial: Variables

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by setting the color of the sprite using variables.
2. Experiment by drawing squares using variables.
3. Experiment by controlling the speed of a moving sprite using variables.
4. Experiment by playing different sounds using variables.

# Arithmetic, Random Numbers

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to implement the arithmetic operations addition, subtraction, multiplication and division, both with integer and real numbers. It also introduces the programming block that allows us to generate randomly a number in a range determined by its minimum and maximum limits.



## PRESENTATION - VIDEO TUTORIALS

Tutorial Part 1: Arithmetic Operations

Tutorial Part 2: Random Numbers

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by using variables and arithmetic operators to draw circles of different sizes and colors.
2. Experiment by using variables and arithmetic operators to move a sprite at different speeds.
3. Experiment by using random numbers to play computer generated melodies.
4. Experiment by adding image and sound effects to the previous programs.

# Comparing Numbers

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to determine whether a number is less than, equal to, or greater than a second number.



## PRESENTATION - VIDEO TUTORIALS

Tutorial: Comparing Numbers



## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by using variables and comparison of numbers to change the background when the sprite moves close to the edges (for example: distance = 40.)
2. Experiment by using variables and comparison of numbers to play a sound when two moving sprites have the same vertical coordinate.
3. Experiment by using variables and comparison of numbers to change the size of a sprite if it is smaller than a certain reference.

# Logic Operations

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to implement the logic functions AND and OR between two boolean values, and the NOT function of a boolean value.



## PRESENTATION - VIDEO TUTORIALS

Tutorial: Logic Operations

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by play a sound when two moving sprites touch the edge of the stage.
2. Experiment by changing the background when one of two sprites (or both) touch a read square in the middle of the stage.
3. Experiment by adding graphic effects when the sprite is not over a red color square in the middle of the stage.

# Extra Operations

## INTRODUCTION - REVIEW

This lesson introduces the programming blocks that allow us to obtain the remainder of the division of two numbers, the absolute value of a number, or the closest integer to a number.



## PRESENTATION - VIDEO TUTORIALS

Tutorial: Extra Operations

## PRACTICE

Scratch Activity: Reproduce the actions in the tutorials. Experiment by modifying the settings and parameters used in the tutorial.

## CLOSING - ASSIGNMENTS

Review the main topics introduced in this lesson and discuss the assignments proposed in the Extensions section.

## EXTENSIONS

1. Experiment by using variables and the modulo operator to play different sounds according with the result of a division.
2. Experiment by using the absolute operator to have two sprites jump the same height but move in opposite directions.
3. Experiment by using a variable and the round operator to have the sprite move in discrete jumps.

# Scratch Courses



This guide and materials were prepared by Juan Carlos Olabe and other members of the LearnScratch Team.

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