

# About FUTURITE



“Education is the passport to the future,  
for tomorrow belongs to those who prepare for it today”

--Malcolm X

Futurite aims to bring high quality STEM (Science, technology, Engineering and Mathematics) education to school students in India, UAE and Africa. Our mission is to use cutting edge technologies such as Robotics and 3D Printing to impart a thorough grounding in STEM subjects and concepts to school students while making their learning experience fun, engaging and hands-on. Futurite has been founded by alumni from IIT, IIM, JU and HEC Paris.



# FUTURITE

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# Preface

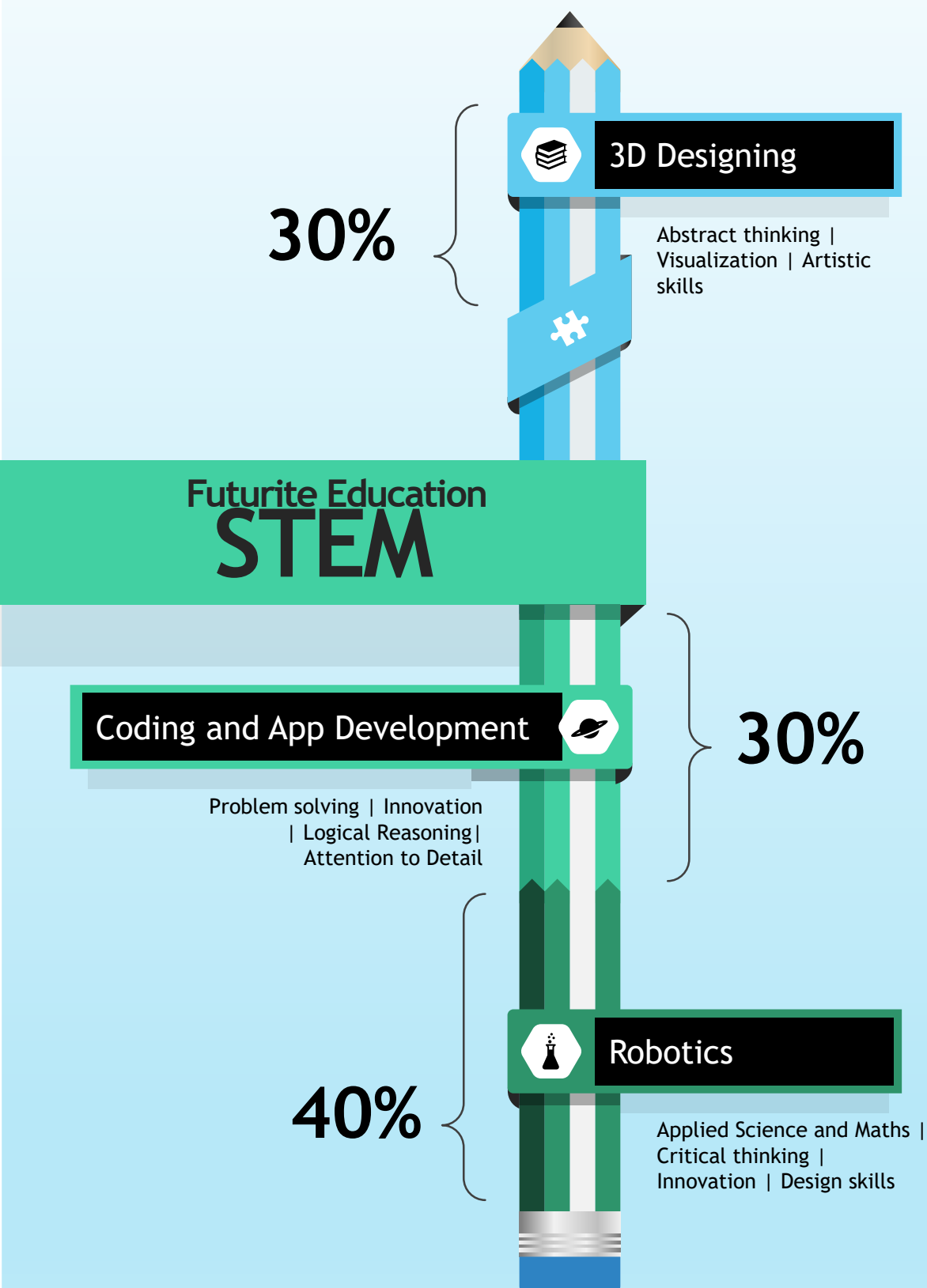
*"STEM develops a set of thinking, reasoning, teamwork, investigative, and creative skills that students can use in all areas of their lives. STEM isn't a standalone class—it's a way to intentionally incorporate different subjects across an existing curriculum."*

In today's technology-driven world, it's important now more than ever to prepare students for the future. Teaching STEM to young students throughout their schooling can increase their ability to be creative and innovative thinkers and more productive members of society. By teaching our students the basics of robotics and STEM, we can open a whole new world to them and exciting opportunities that they wouldn't have access to otherwise.

STEM lessons immerse students in hands-on inquiry and open-ended exploration. STEM learning is open-ended; at the same time, the students' work is collaborative and solutions are student-generated. There is also a sharing of ideas as they work to design their own investigations, resulting in an overall personal development of the kids.

The lessons in the book makes use of technology to teach crucial Science and Maths concepts, involving students in productive teamwork. With STEM learning, students work together as a productive team which is a practice modelled by STEM teachers across the school. They also encourage collaboration with other teachers in these subjects, providing insights into how course objectives can be woven into a lesson.

Following the book ahead gives you a clear idea of how STEM Education can be implemented. The structured course provides a framework for teachers and educators to structuring the course over middle school. The following page gives a course break up of what you can expect to be covered in the book.



# ROBOTICS

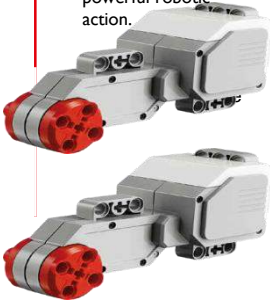


# INTRODUCTION

e

## Large Motor

- + Lets you program precise and powerful robotic action.



## EV3 Brick

- + Serves as the control center and power station for your robot.



## Touch Sensor

- + Recognizes three conditions: touched, bumped, and released.



## Color Sensor

- + Recognizes seven different colors and measures light intensity.



## Medium Motor

- + Maintains precision, while trading some power for compact size and faster response.



## Remote Infrared Beacon

- + Remote controls your robot from a distance.



## Infrared Sensor

- + Detects objects and can track and find the Remote Infrared Beacon.



# Week1

- ▶ With LEGO MINDSTORMS EV3, building and programming your own robot has never been easier. Think of a robot and then build it. Use the motors and sensors to add behavior and movement. The software will guide you in bringing your robot to life.
- ▶ **Create:** Build your robot using the LEGO elements, motors, and intelligent sensors included in the set.
- ▶ **Command:** Program your robot in the intuitive icon-based programming interface. Drag and drop the actions that you want into the programming window and adjust them to suit your robot's behavior.
- ▶ **Go!** Once you have built and programmed your robot, it's time to play!



## Week 2



# CAM MECHANISM

An EV3 medium motor located in the back of Grunt's head (port D) opens and closes the mouth. The motor turns a cam-and-rod mechanism that is attached to the lower jaw. When the cam rotates forward, the rod pushes on the top of the lower jaw and the mouth opens; when the cam rotates in reverse, the rod pulls the mouth



Create a program to run the medium motor with Cam mechanism

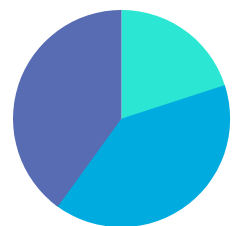


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Students works together in teams to complete the a worksheet

**Sensor 10%**



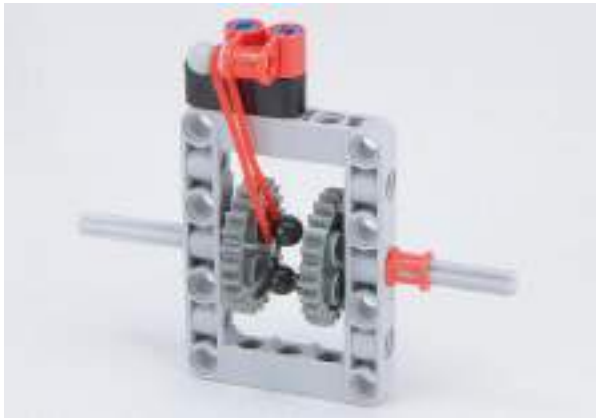
**Program 10%**

**Building  
80%**





## Week 3



# INTERMITTENT MOTION

The Geneva mechanism takes smooth rotary motion and convert it to intermittent rotary motion. One can think of it in electronic terms

As changing the duty cycle of the oscillation. This is a mechanical version



Create a program to run the medium motor with Cam mechanism

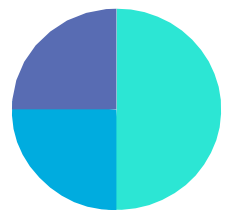


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Students works together in teams to complete the worksheet

**Sensor 25%**



**Program 25%**

**Building  
50%**

## Week 4

# TRANSMITTING ROTATION WITH RUBBER BAND



Use LEGO rubber bands to: -Keep wires out of the way - Like springs

- to hold touch sensor levers in place
- To trigger a trap - Make rubber band motors



Create a program to run the medium motor with Cam mechanism

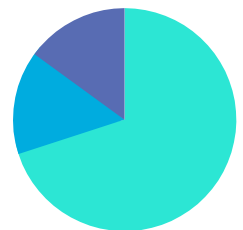


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Students work together in teams to complete the assignment worksheet

**Sensor 15%**



**Program 15%**

**Building**

**70%**

## Week 5

# TRANSMITTING ROTATION WITH CATERPILLAR TREADS



When designing a robot, caterpillar treads helps to rotate the motor over a long distance. It can be used in tank and in stair climber and other models



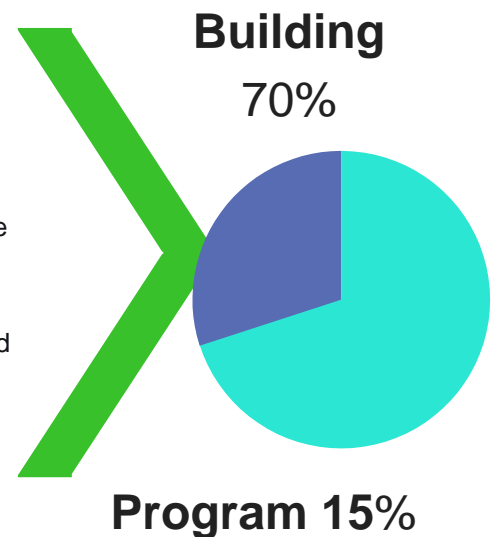
Create a program to run the medium motor with Cam mechanism



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Students work together in teams to complete the assigned worksheet



## Week 6

# Moving without wheels



- Take a moment to reflect on your robot solution.
- Is the robot using something other than wheels to move? Trace the movement from the motor axle to the mechanism(s) that drives the robot forward, backwards or sideways. Wheels can be used to stabilize the robot but not to drive it.
- Does the robot display the distance moved?
- Is it accurate? How do you know?



This program:

Moves the motors using the Move Tank block at 60% power in reverse direction for 9 rotations  
Displays 30 cm at coordinates (2,3) so the text is centred in the middle

Waits for 3 seconds so you have time to see the text

The motors are set for the reverse direction because the motors are mounted upside down in this model

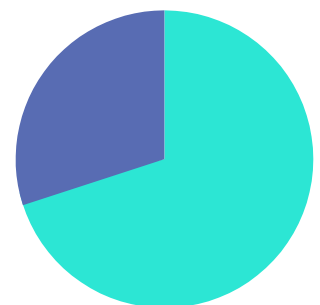


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Students work together in teams to complete the assigned worksheet

**Program 30%**



**Building  
70%**

## Week 7

# Suspended wheel car

Suspension is the system of tires, tire air, springs, shock absorbers and linkages that connects a vehicle to its wheels and allows relative motion between the two. Suspension systems must support both road holding/handling and ride quality, which are at odds with each other.



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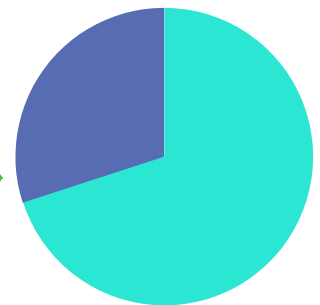


Program: The suspended wheel program helps us to work with different suspensions



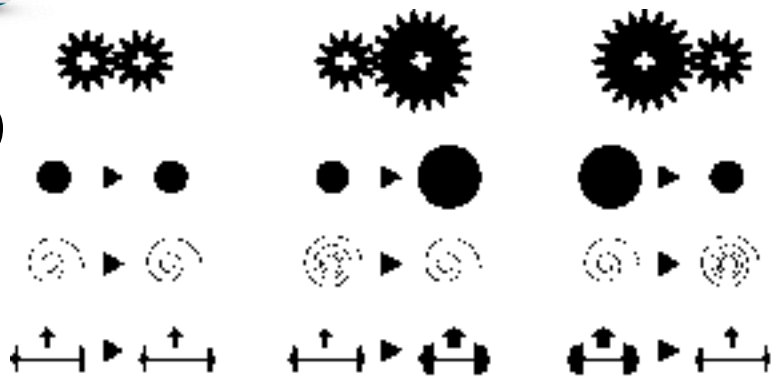
Students work together in teams to complete the assigned worksheet

Program 30%



Building 70%

## Gear Ratio Learning



12:12=1:1



12:20= 3:5

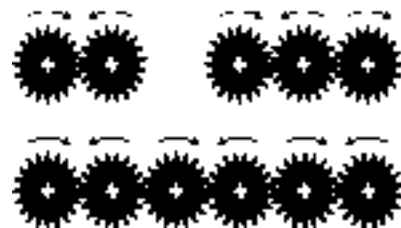


12:36=1:3



12:36=1:3 and 36:12=3:1

To determine the **ratio** of which two meshed **gears** will move relative to each other, divide the number of teeth on the driven **gear** by the number of teeth on the drive **gear**. This is called the **gear ratio**. If a driven **gear** with 24 teeth is meshed with a drive **gear** with 48 teeth, there is a 1:2 **gear ratio**.



Gears are wheels with teeth that mesh with each other. Because the teeth lock together, they can efficiently transfer force and motion. If the drive gear is big and driven gear is small then it will speed up and if the drive gear is small and driven gear is big then it will speed down the gear



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Students works together in teams to complete the assigned worksheet

**Building 62%**

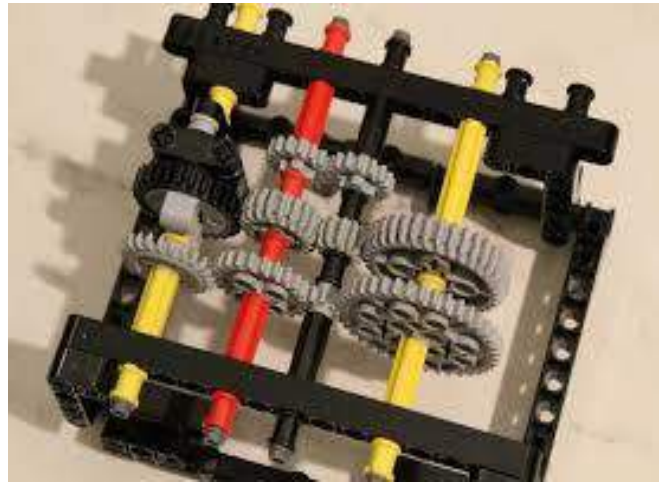
**Sensor 14%**



**Program 24%**



## Compound Gear System



If we attach the bigger gear(Driver gear) with smaller gear it will increase the speed and decrease the torque and if we attach

The smaller gear(Driver gear) with larger gear it will decrease the speed and increase the torque



The program we need to make to rotate the motor with the gears



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Students work together in teams to complete the assigned worksheet

**Building 54%**

**Sensor 32%**



**Program 14%**

## Week 10

# Reciprocal Mechanisms



**Reciprocating** motion, also called **reciprocation**, is a repetitive up-and-down or back-and-forth linear motion. It is found in a wide range of **mechanisms**, including **reciprocating** engines and pumps. The two opposite motions that comprise a single **reciprocation** cycle are called strokes.



Gearings comprising essentially only toothed gears or friction members and not capable of conveying indefinitely-continuing rotary motion for interconverting rotary or oscillating motion and reciprocating motion comprising a rack for converting reciprocating movement in a continuous rotary movement or vice versa, e.g. by opposite racks engaging intermittently for a part of the stroke



The program we need to make to rotate the motor with the gears

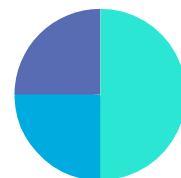


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Students works together in teams to complete the assign worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**



## Week 11

# Walking Machines



**Walking robot allows the bot to move certain distance without using any wheels**



Walking mechanism helps us to make walking movement of the robot without using any wheel

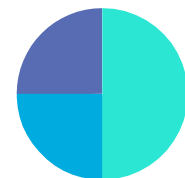


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Students works together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**

## Week 12

# Obstacle Avoiding Robot



We can make a rover bot with an ultrasonic sensor attached in front which will detect any object from a specific distance



Walking mechanism helps us to make the robot avoiding the obstacles

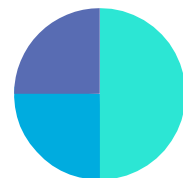


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Students work together in teams to complete the assignment worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**

## Mouse Trap With Touch Sensor



In this mechanism we are gearing it up so that whenever the motor will start moving it will generate maximum vibration to Move the bot forward



Working mechanism helps us to make the robot trap the mouse while touching touch sensor



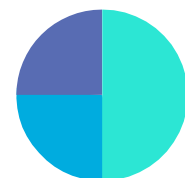
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Students works together in teams to complete the assigned worksheet

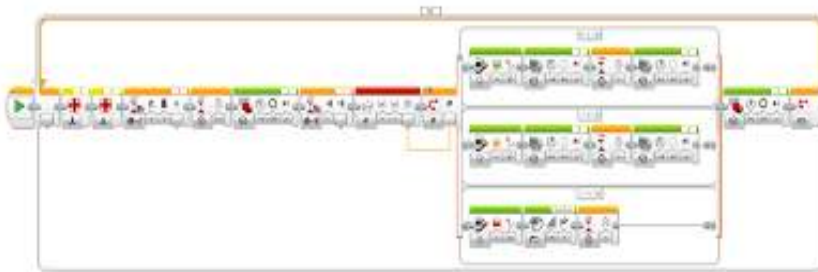
**Building 50%**

**Sensor 25%**



**Program 25%**

## Ball Kicker



This project will help us to kick the ball



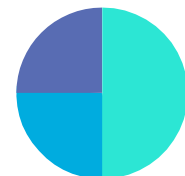
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Students works together in teams to complete the assigned worksheet

**Building 50%**

**Sensor 25%**

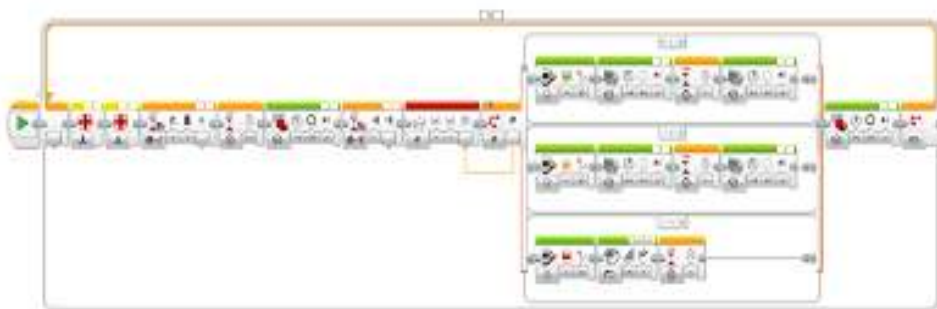


**Program 25%**

## Ball Roller Coaster



In this mechanism we can use one large motor with ultrasonic sensor. The ball will move in the sloop as the ultrasonic sensor detects the ball it will again lift it to the sloop



This project will help us to move the ball on slope

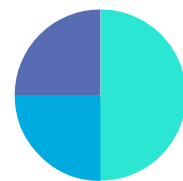


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Students works together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**

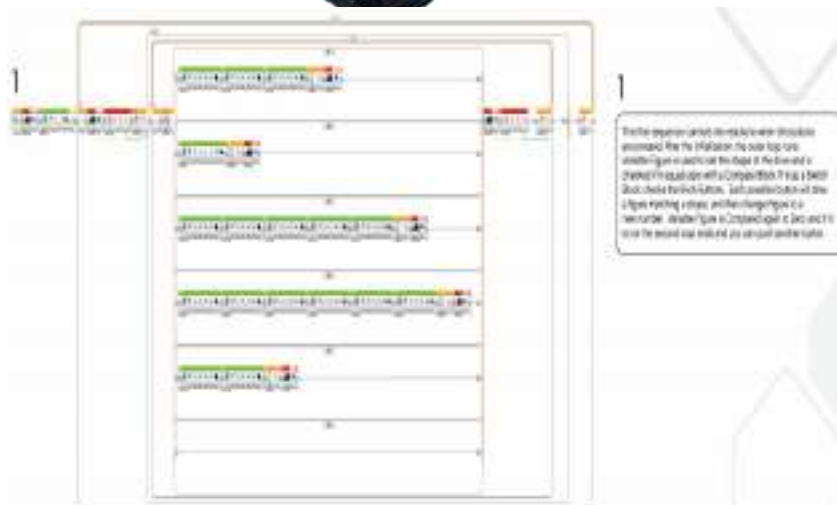


**Program 25%**

## Tank Bot



In this mechanism we can use one large motor with ultrasonic sensor. The ball will move in the sloop as the ultrasonic sensor detects the ball it will again lift it to the sloop



This project will help us to move the tank with help of sensor



Download the building instructions from our Google Drive



Students works together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**



## Electric Guitar



The electric guitar model is playing guitar with the help of the ultrasonic sensor. As the distance of the ultrasonic sensor increases it will lighten the sound and if it decreases sound will be heavier



This project will help us to play guitar

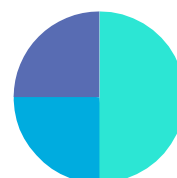


Download the building instructions from our Google Drive



Students works together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**

## Bulldozer

In this mechanism we can use the bulldozer robot which can work like real bulldozer



This project will help us to build and program a bulldozer



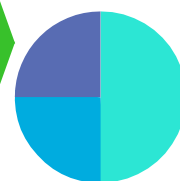
Download the building instructions from our Google Drive



Students works together in teams to complete the assigned worksheet

**Building 50%**

**Sensor 25%**



**Program 25%**



# Color Sorter

The ev3 color sorter model helps us to divide the objects in respect to their colors. One color sensor is used here which is dividing red, blue, yellow, green separately and can put them in respective colored glasses



This project will help us to sort the different color Lego pieces

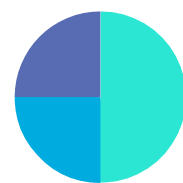


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Students work together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**

# EV3 Game

In ev3 game we have taken three wheels under any one of this wheel there is a ev3 ball now the game will be you have to find out that ev3 ball which can be there under any one of the wheels



This project will help us to make and play a game

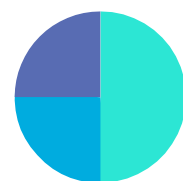


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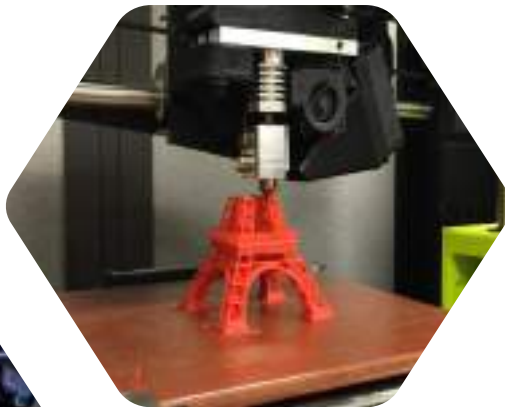
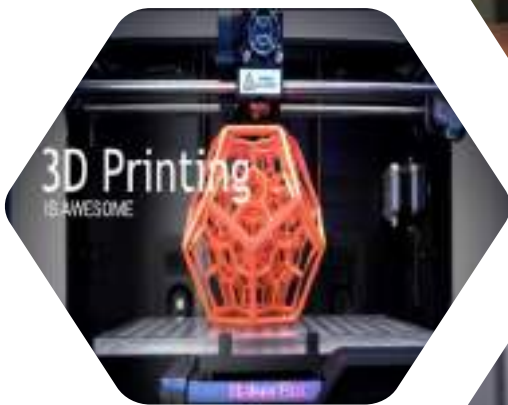
Students works together in teams to complete the assigned worksheet

**Building 50%**  
**Sensor 25%**



**Program 25%**

# 3D PRINTING

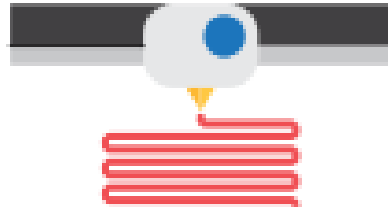


# Introduction to 3D Printing

3D printing is a manufacturing process where successive layers of material are laid down on top of each other in an additive process. Let's take a look at the steps required in the typical 3D printing process:



**3 D Model File (.STL)**



**3 D Printing**



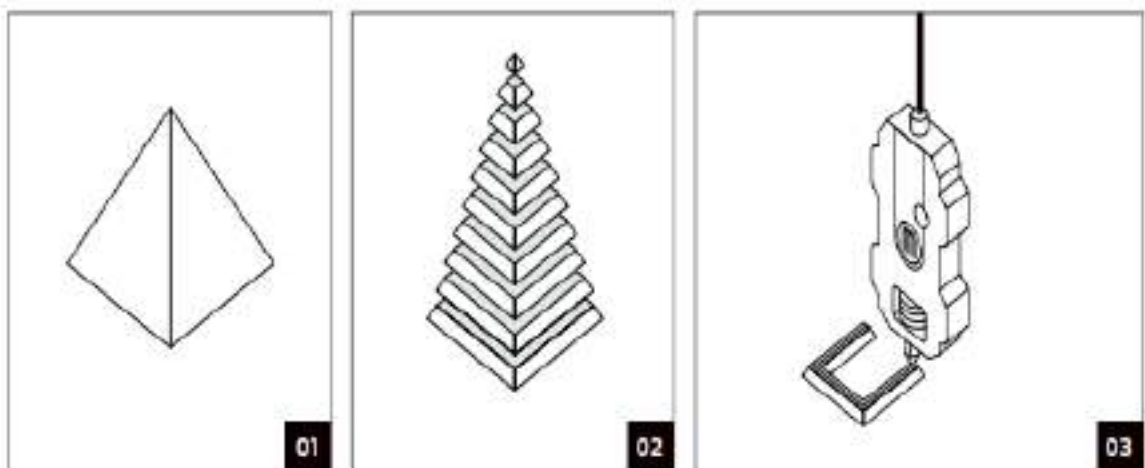
**Slicing**



**Post Processing**

## How Does It Works

There are several types of 3D printing technology in use today. The additive manufacturing technology that MakerBot 3D Printers use is called Fused Deposition Modeling, or FDM for short.



**01:** FDM printing starts with a digital 3D model, most often generated from a 3D modeling program.

**02:** The 3D model is sliced into 2D layers using a slicing software and then sent to the printer.

**03:** On the printer, filament is fed into an extruder that draws out each slice, layer by layer, onto the build plate. Over time, these 2D layers stack on top of each other to build a 3D print.



## Introduction To BlocksCAD



# Coffee Mug

## Learning Outcome:

1. Use of various shapes like cylinder and torus in Blockscad.
2. Learning to use various tools like translate, rotate, union and difference.



## Tools Used :

1. Cylinder
2. Torus
3. Union
4. Translate
5. Rotate
6. Union
7. Difference

# Snow Man

## Learning Outcome:

1. Understanding the 3D Co-Ordinate System
2. Understanding the use of shapes like Sphere and Cylinder
3. Clarifying translation in 3D space



## Tools Used :

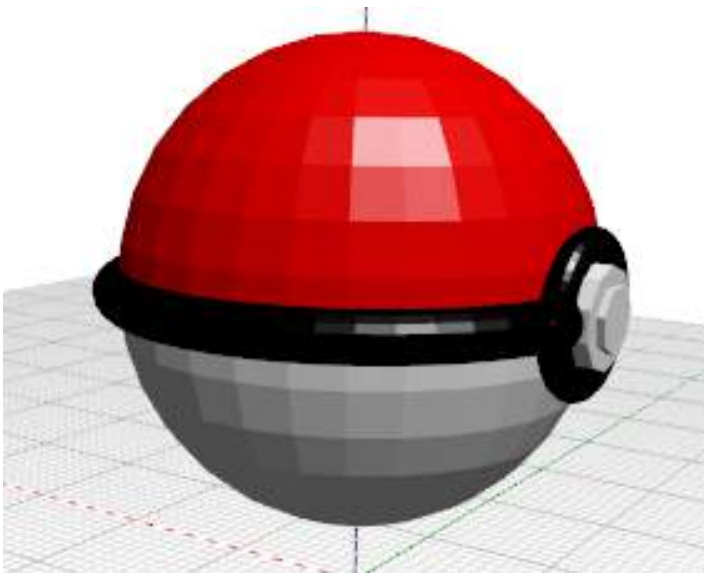
1. Cylinder
2. Sphere
3. Translate
4. Rotate
5. Union



# Poke Ball

## Learning Outcome:

1. Deeper understanding of translation in 3D space
2. Proper use of Union and difference operator



## Tools Used :

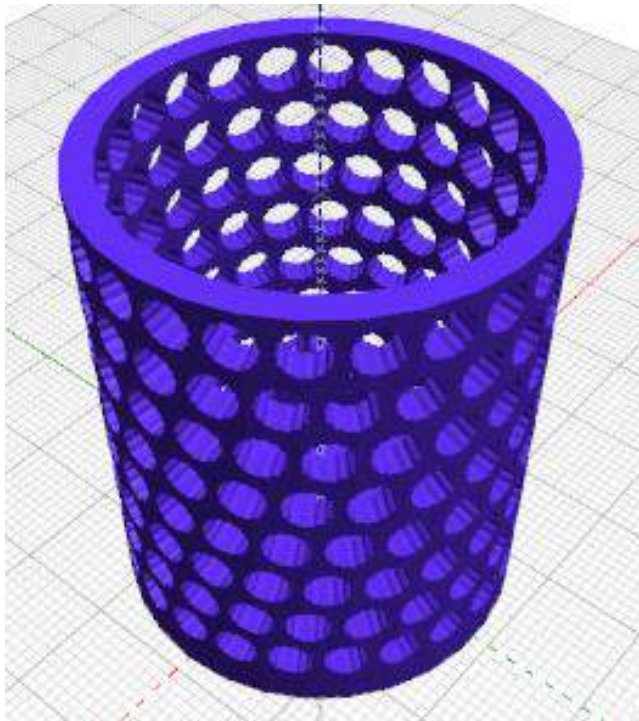
1. Sphere
2. Cylinder
3. Torus
4. Difference
5. Union
6. Translate



# Tea Light

## Learning Outcome:

1. Understanding the concept of loop using count with
2. Visualizing in 3d space



## Tools Used :

1. Count With
2. Cylinder
3. Extrude
4. Difference
5. Union
6. Translate
7. Rotate

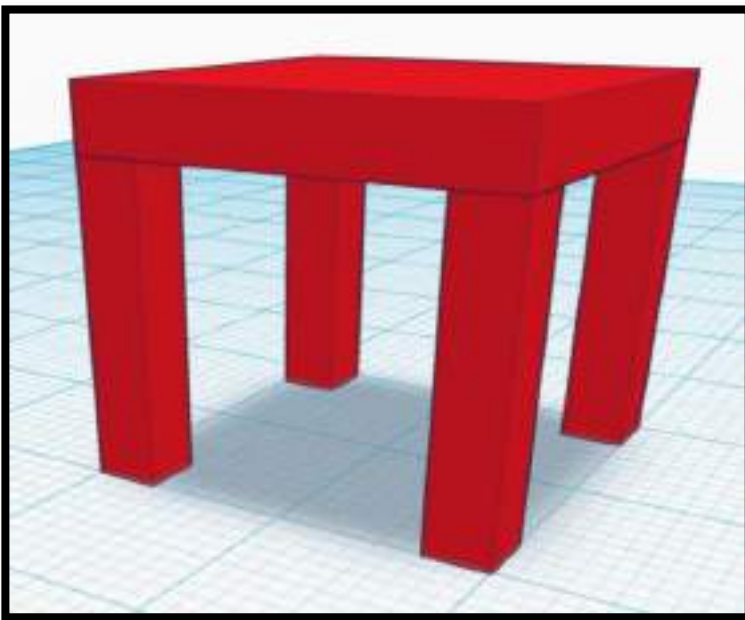
# Introduction To Codeblocks



# Table Design

## Learning Outcome:

1. Getting to know various 3D shapes
2. Familiar variables and their use in codeblocks



### Tools Used :

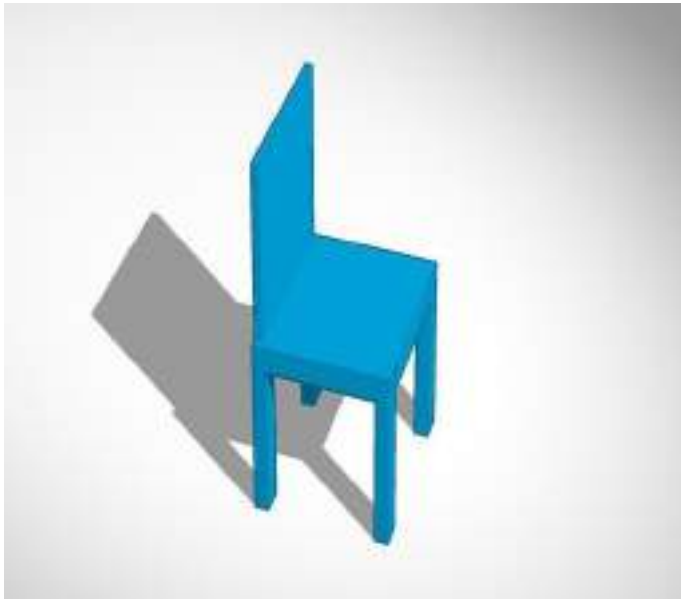
1. Different 3D shapes
2. Add
3. Move Object
4. Set Variable



# Chair Design

## Learning Outcome:

1. Understanding of 3D shapes, i.e. box, cylinder etc.
2. Understanding of proper measurement.
3. Understanding Rotation and Translation in 3D space in Blockcad



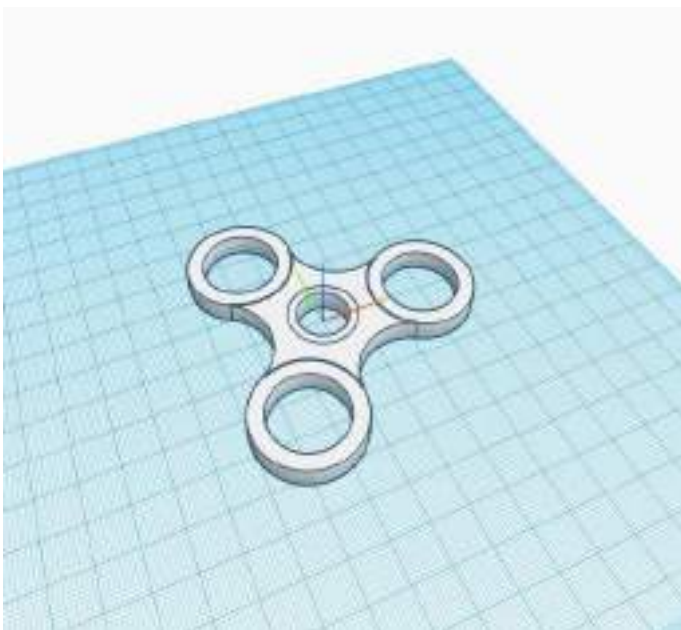
## Tools Used :

1. Different 3D shapes
2. Add
3. Move Object
4. Set Variable

# Fidget Spinner

## Learning Outcome:

1. Overview of basic code for writing program. Here the program is defined by combining the code blocks in the same way we would combine building blocks.
2. Learning of creating a Pattern by making the structure of Fidget Spinner



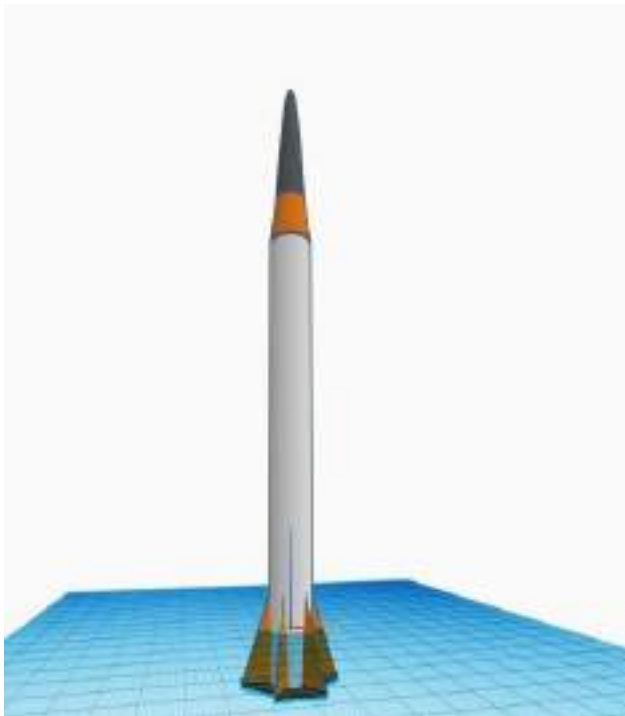
## Tools Used :

1. Create Variable
2. Move
3. Add
4. Loop
5. Repeat

# Rocket Design

## Learning Outcome:

1. Overview of basic code for writing program. Here the program is defined by combining the code blocks in the same way we would combine building blocks.
2. Learning about various parts of a rocket



## Tools Used :

1. Create Variable
2. Move
3. Add
4. Loop
5. Repeat

# Penguin



## Tools Used :

1. Create Variable
2. Move
3. Add
4. Loop
5. Repeat



# CODING AND APP DEVELOPMENT

SCRATCH

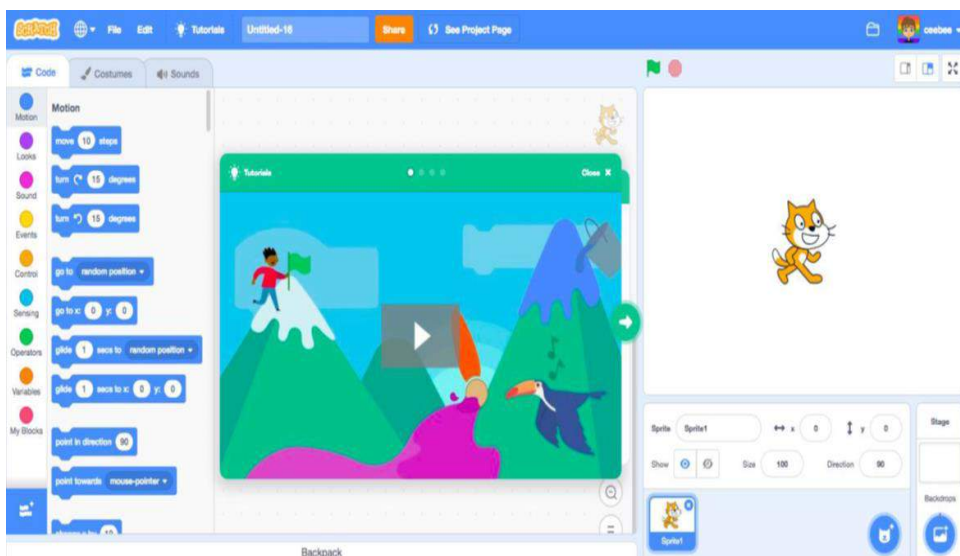


## Week 31

# Scratch



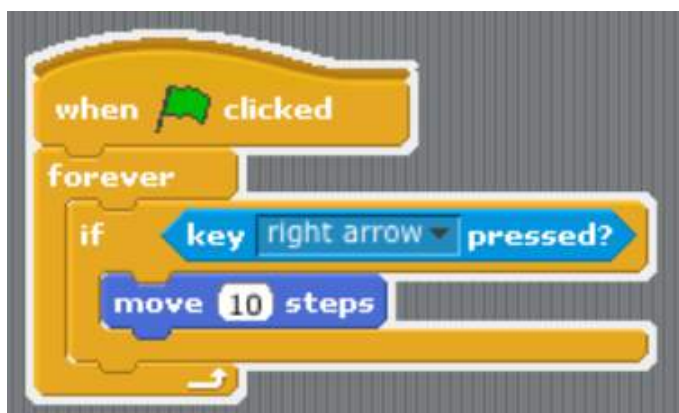
- Scratch is a block-based visual programming language and online community targeted primarily at children. Users of the site can create online projects using a block-like interface. The service is developed by the MIT Media Lab, has been translated into 70+ languages, and is used in most parts of the world.
- With Scratch, you can program your own interactive stories, games, and animations — and share your creations with others in the online community.
- Scratch helps people learn to think creatively, reason systematically, and work collaboratively — essential skills for success in anything you want to do.
- Scratch is a project of the Lifelong Kindergarten Group at the MIT Media Lab. It is provided free of charge, and you can access your projects from any computer connected to the Internet.



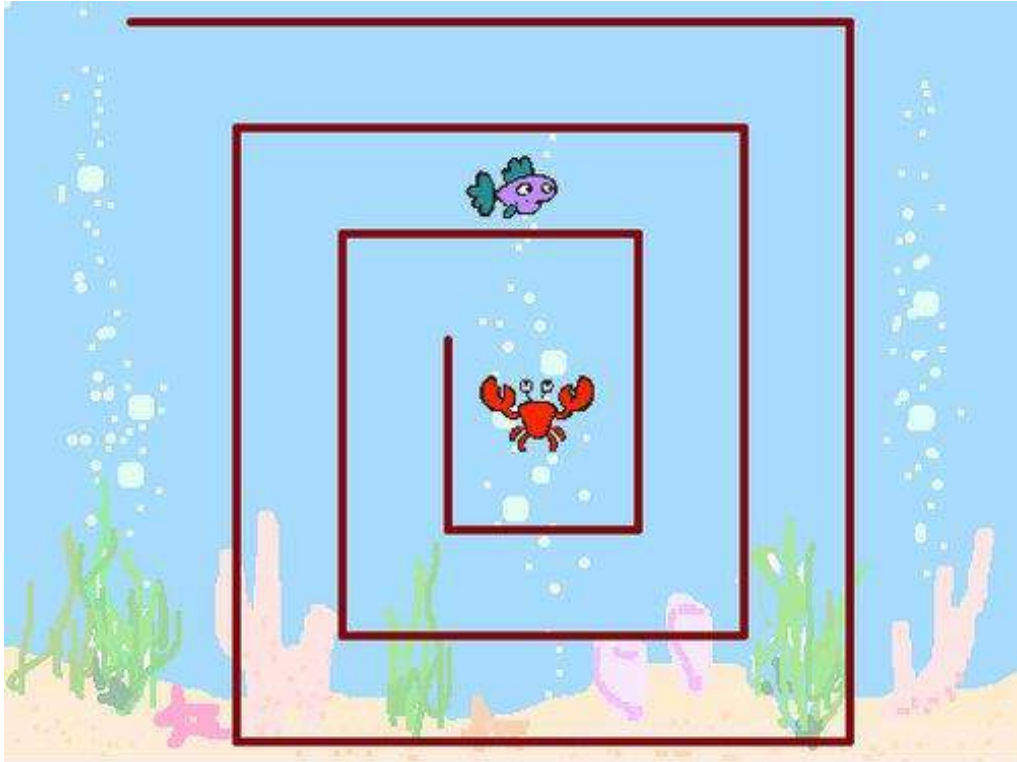
# Basic Movement



In this class students will learn how to move sprite up, down, right and left.



# Hungry Crab



## LEARNING OUTCOME-

- Controlled movement of a sprite.
- To hide and show a sprite.
- To program the game over condition

# Quiz Game



## LEARNING OUTCOME-

- Taking user input
- IF Then condition
- Loop concept.
- How to use a variable as score and thereby changing it.

# Save From Lightning

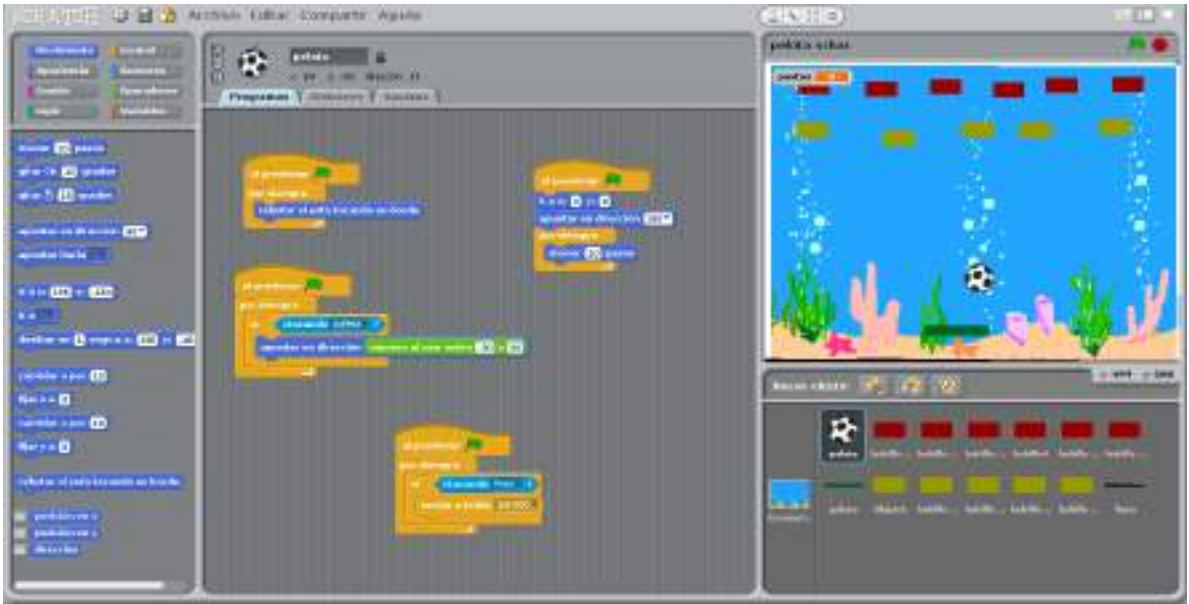


**In this game we need to save the sprite from touching lightning.**

## LEARNING OUTCOME-

- Controlled movement of a sprite
- IF Then condition.
- Condition to exit game.

# Hit the Brick



**In this game the bricks will disappear when ball touches it. The ball hits the paddle at the bottom and move in different direction with a different angle.**

## LEARNING OUTCOME-

- Show and Hide of a sprite.
- IF Then condition
- Concept of variable as score.



## Cross The River



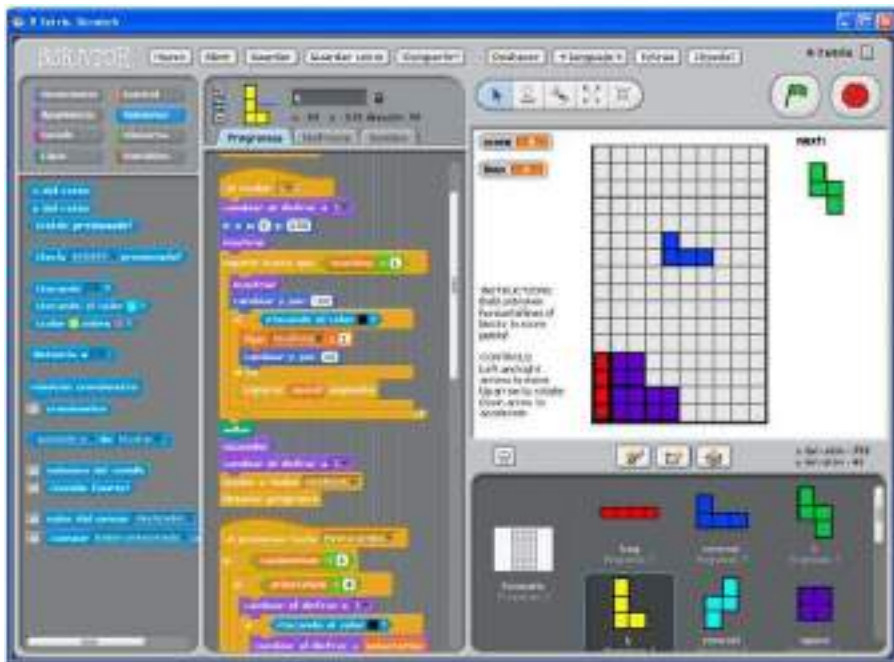
In this game we need to make the sprite cross the river as per predefined set of rules.

### LEARNING OUTCOME-

- Show and Hide a sprite
- IF Then condition.
- Game exit condition.



# Puzzle



In this game we need to make customized sprite and to solve the puzzle.

## LEARNING OUTCOME-

- Designing sprites
- IF Then condition
- Concept of variable as score.

# Flappy Bird



In this game we need to make the bird keep on flying and also saving it from any other sprite in its way.

## LEARNING OUTCOME

- Designing sprites
- IF Then condition
- Concept of chances a player has to play the game.

# Mario



In this game we need to make the sprite walk on the bricks at bottom. Also to avoid hindrance n between.

## LEARNING OUTCOME

- Designing sprites
- IF Then condition
- Concept of chances a player has to play the game.

# Python

## Python Indentation

- Indentation refers to the spaces at the beginning of a code line.
- Python uses indentation to indicate a block of code

if 5 > 2:

```
    print("Five is greater than two!")
```

### Data types:

In programming, data type is an important concept. Python has the following data types built-in by default, in these categories:

|                        |                              |
|------------------------|------------------------------|
| <b>Text Type:</b>      | str                          |
| <b>Numeric Types:</b>  | int, float, complex          |
| <b>Sequence Types:</b> | list, tuple, range           |
| <b>Mapping Type:</b>   | dict                         |
| <b>Set Types:</b>      | set, frozenset               |
| <b>Boolean Type:</b>   | bool                         |
| <b>Binary Types:</b>   | bytes, bytearray, memoryview |

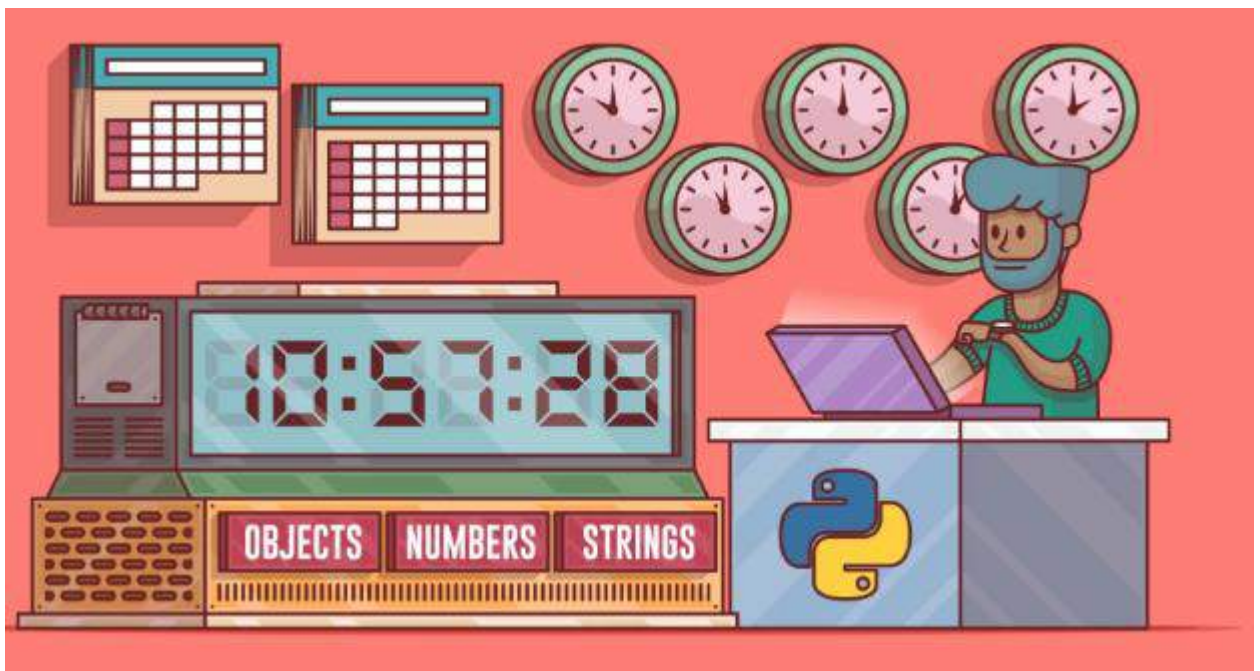
## Week 41

# Strings

### String Literals

String literals in python are surrounded by either single quotation marks, or double quotation marks.

'hello' is the same as "hello".



# Operators

Operators are used to perform operations on variables and values. Python divides the operators in the following groups:

- Arithmetic operators
- Assignment operators
- Comparison operators
- Logical operators
- Identity operators
- Membership operators
- Bitwise operators

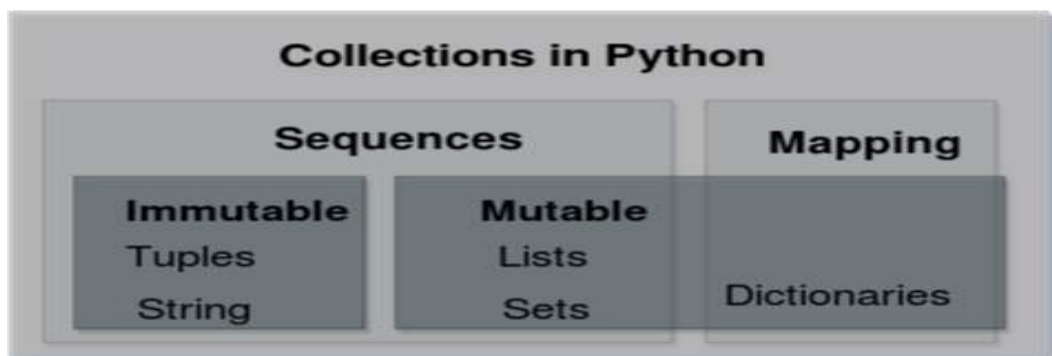






# COLLECTIONS

## (Arrays)



- There are four collection data types in the Python programming language:
- List is a collection which is ordered and changeable. Allows duplicate members.
- Tuple is a collection which is ordered and unchangeable. Allows duplicate members.
- Set is a collection which is unordered and unindexed. No duplicate members.
- Dictionary is a collection which is unordered, changeable and indexed. No duplicate members.
- When choosing a collection type, it is useful to understand the properties of that type. Choosing the right type for a particular data set could mean retention of meaning, and, it could mean an increase in efficiency or security.

# CONDITIONS AND IF STATEMENTS



Python supports the usual logical conditions from mathematics:

**Equals:**  $a == b$

**Not Equals:**  $a != b$

**Less than:**  $a < b$

**Less than or equal to:**  $a \leq b$

**Greater than:**  $a > b$

**Greater than or equal to:**  $a \geq b$

These conditions can be used in several ways, most commonly in "if statements" and loops.

An "if statement" is written by using the if keyword.

