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.

Table of Contents

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.

30%

3D Designing

Abstract thinking |
Visualization | Artistic
skills

Futurite Education
STEM

60%

Lorem ipsum dolor
sit amet.

65%

Lorem ipsum dolor
sit amet.

24%

Lorem ipsum dolor
sit amet.

Coding and App Development

30%

Problem solving | Innovation |
Logical Reasoning| Attention to
Detail

Robotics

40%

Applied Science and Maths |
Critical thinking | Innovation |
Design skills
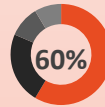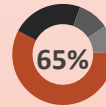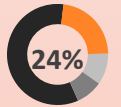
ROBOTICS

INTRODUCTION TO EV3

▶ 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!
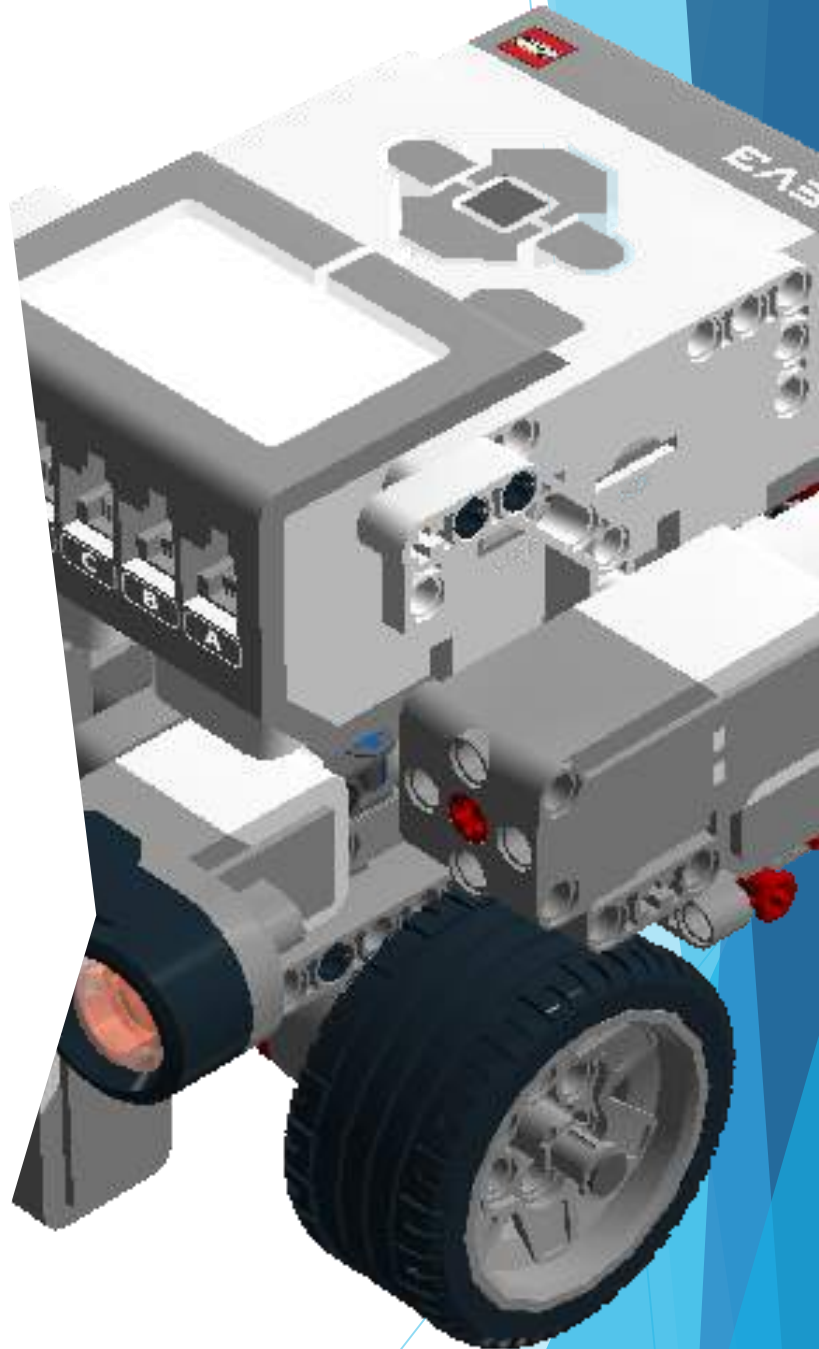
EV3 COMPONENTS

Large Motor
+ Lets you program precise and powerful robotic action.
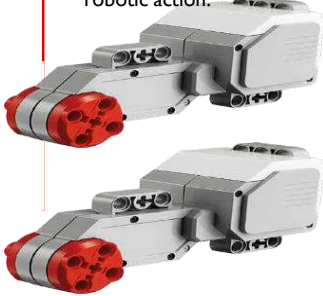
EV3 Brick
+ Serves as the control center and power station for your robot.

Touch Sensor
+ Recognizes three conditions: touched, bumped, and released.

Color Sensor
+ Recognizes seven different colors and measures light intensity.

Medium Motor
+ Maintains precision, whil 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.
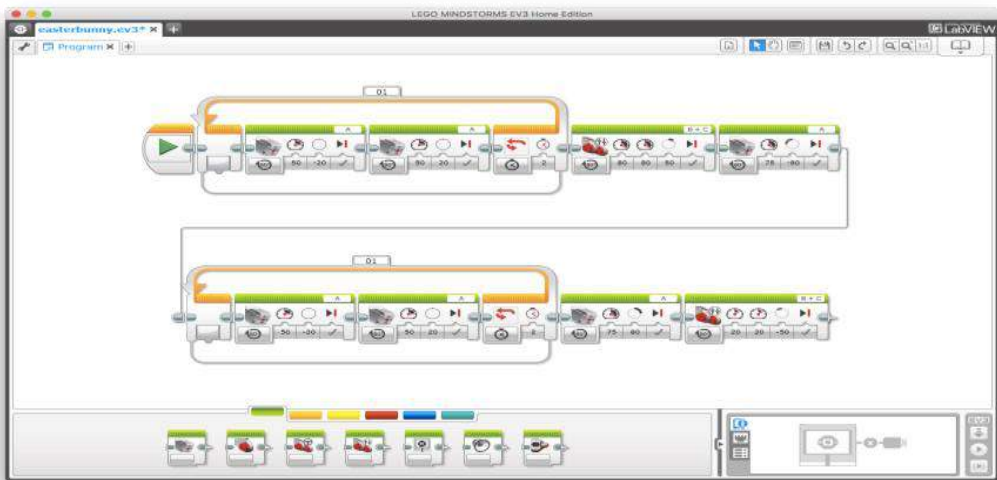
Brick Name

USB

Wireless Connection Status Icons
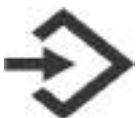
Speed Race Car

This is the racer car which is made by a single medium motor and we can use the different gear combinations to speed up or speed down the car
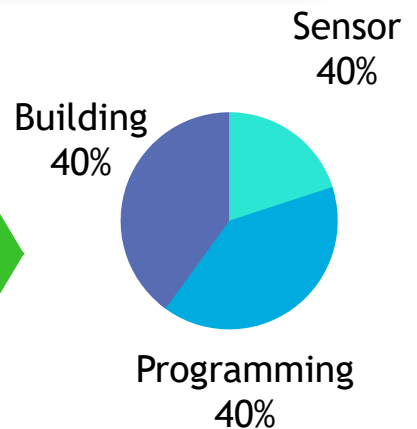

 Download the building instructions from our Google Drive

 Create a program to run the medium motor with the different combination of gears. We can use ultrasonic sensor

 Students works together in teams to complete the   assigned worksheet

Sensor 40%

Building 40%

Programming 40%

Riley Rover

This is the basic bot which is made with two large motors and can be associated with different sensors. We can make the program to move it straight or to make a turn in specific direction.
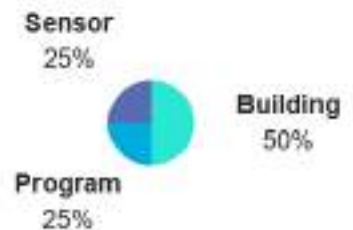

 Download the building instructions from our Google Drive

 Create a program to move the rover bot in forward and backward direction. We can use different sensors like ultrasonic and color with this bot

 Students works together in teams to complete the   assigned worksheet

Sensor
25%

Building
50%

Program
25%

Precise Movements

All turns are actually circles, that is obvious. Different types of turns have different centres of turn.

For a spin turn? The centre of the turn is the centre between the two tires.

For a pivot turn? The centre is on top of the tire that is not moving.

For an arc turn? The centre is outside of the robot, somewhere in the distance. The further the centre, the smoother the turn.
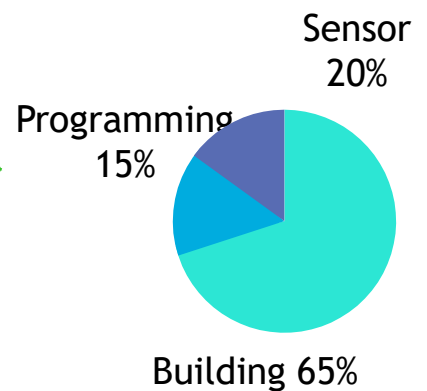
Download the building instructions from our Google Drive

Create a program to make the bot moving in a specific direction

Students works together in teams to complete the assigned worksheet

Sensor 20%

Programming 15%

Building 65%

Walking Bot by a Simple Lever

 When designing a robot, sometimes we may want to build a fast robot that needs to get to its objective quickly. At other times, we may want a powerful robot. For instance, maybe the robot needs to push a heavy object, push another robot, or climb a steep hill. When it comes to a robotic arm, we might be trying to lift a heavy object slowly or lift a small object quickly.

However, we cannot have both speed and power. There is a trade-off here—if you increase one, you decrease the other. This trade-off is called the law of conservation of energy.
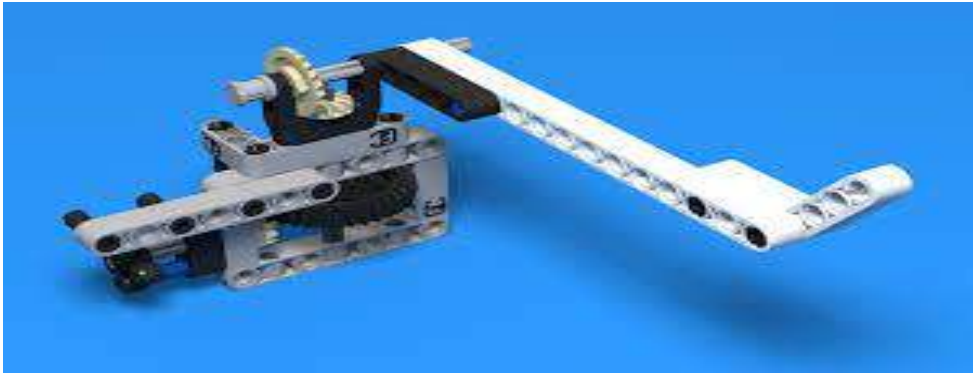
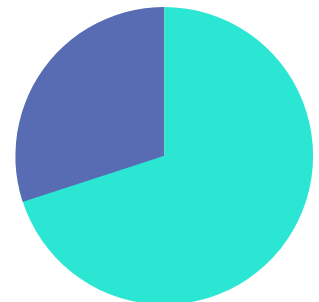Download the building instructions from our Google Drive

Create a program to rotate the cams suing the motor which helps move the arms of the monkey in a drumming pattern

Students works together in teams to complete the   assigned worksheet

Program 30%

Building 70%

Move 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?

Download the building instructions from our Google Drive

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 centered 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 actually mounted upside down in this model.

Building 30%
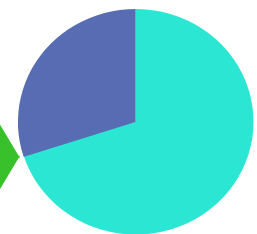
Program 70%

Students works together in teams to complete the assigned worksheet

Suspended Wheels 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.
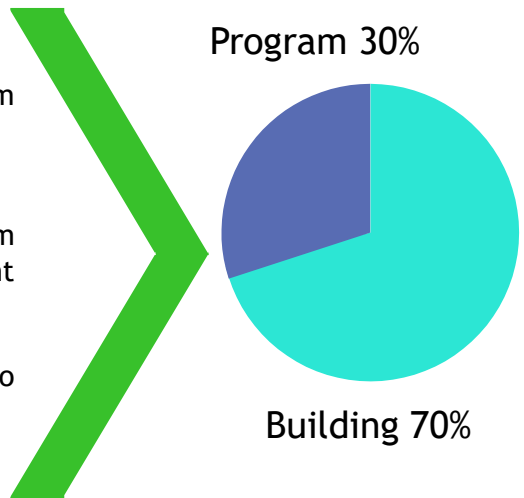
Download the building instructions from our Google Drive

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

Students works together in teams to complete the   assigned worksheet

Program 30%

Building 70%

Gear Ratios

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 dive gear is small and drive gear is small and driven gear is big then it will speed down the gear
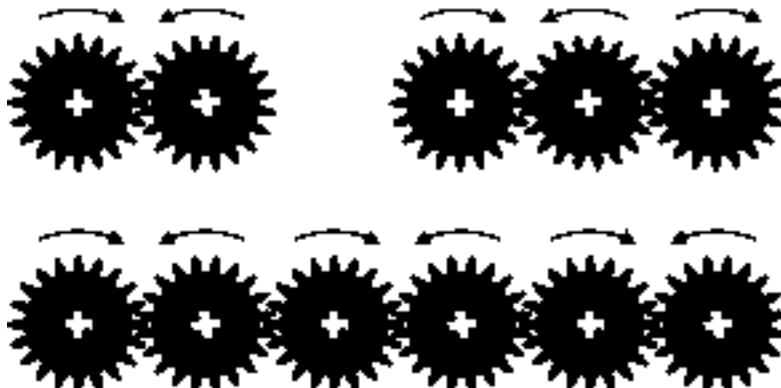
12:12=1:1	12:20= 3:5	12:36=1:3	12:36=1:3 and 36:12=3:1

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.

The direction of the gears changes as in the picture above.

Swinging Mechanisms

In a **Swing Turn** ONLY ONE wheel actually turns. The other wheel is stopped completely. In this case, the wheel that turns will trace a circular path in which the diameter is equal to twice the distance between the wheels.

What if you wanted the robot to make a 90 degree turn? How many times does each wheel have to rotate? What if you wanted the robot to make a 180 degree turn? How many times does each wheel have to rotate?

Download the building instructions from our Google Drive

The method comprising: the motor rotates clockwise, the first sensor is determined whether the operation, if the first sensor is operated, the counterclockwise rotation of the motor, a second sensor determines whether the operation, and if the second sensor is operated, the clockwise rotation of the motor.

Students works together in teams to complete the   assigned worksheet

Programming 15%

Sensor 20%
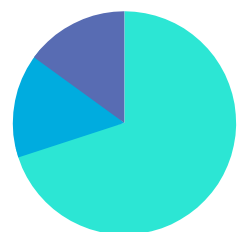
Building 65%

Reciprocating 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.


Download the building instructions from our Google Drive

Reciprocating mechanism comprises a crank mechanism and a cam mechanism. Only the internal combustion engine crank mechanism, to the vertical linear motion of the piston in the piston cylinder into sliding rotation of the output shaft
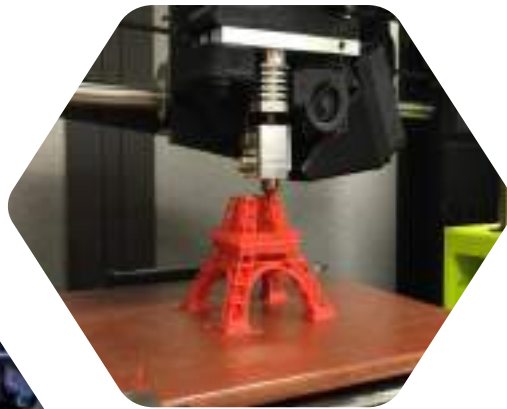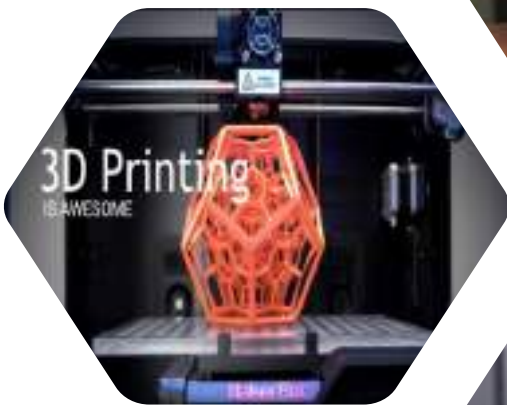
Students works together in teams to complete the   assigned worksheet

Programming 25%

Sensor 25%

Building 50%
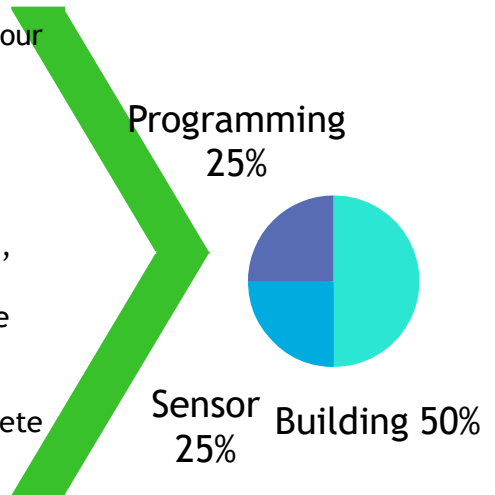
3D PRINTING

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:

1. 3D Model File (.STL)

3. 3D Printing

2. Slicing

4. Post-processing
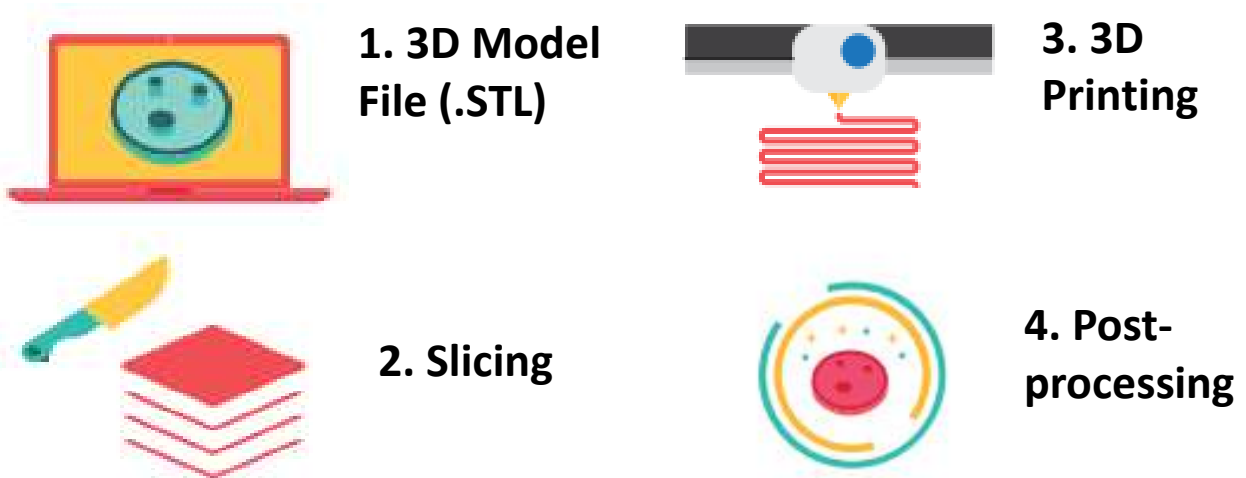
How it works!

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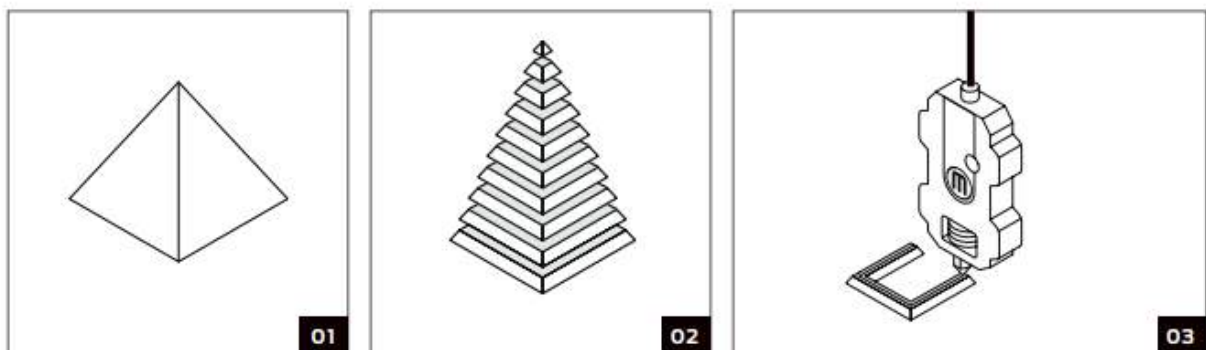
01: FDM printing starts with a digital 3D model, most often generated from a 3D modeling program.

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.

3D SLASH

3D Slash is used for design thinking, prototyping, scale modelling and digital entertainment. It is a very easy tool where any design can be created just by slashing a 3D cube.

BIG BEN DESIGN

Lesson Overview

• Using 3DSlash for the first time? Let's get exploring then. Create a 3D design of the Big Ben Tower using the tools mentioned below. Research about the architecture of Big Ben Tower if needed.

Learning Objectives

• Overview of Big Ben Tower.
• Working of hammer, chisel.
• Proper understanding of the 3D shapes, i.e. box, stair case, and clock.

Tools Used

• Hammer
• Trowel
• Chisel
• Wall
• Colour
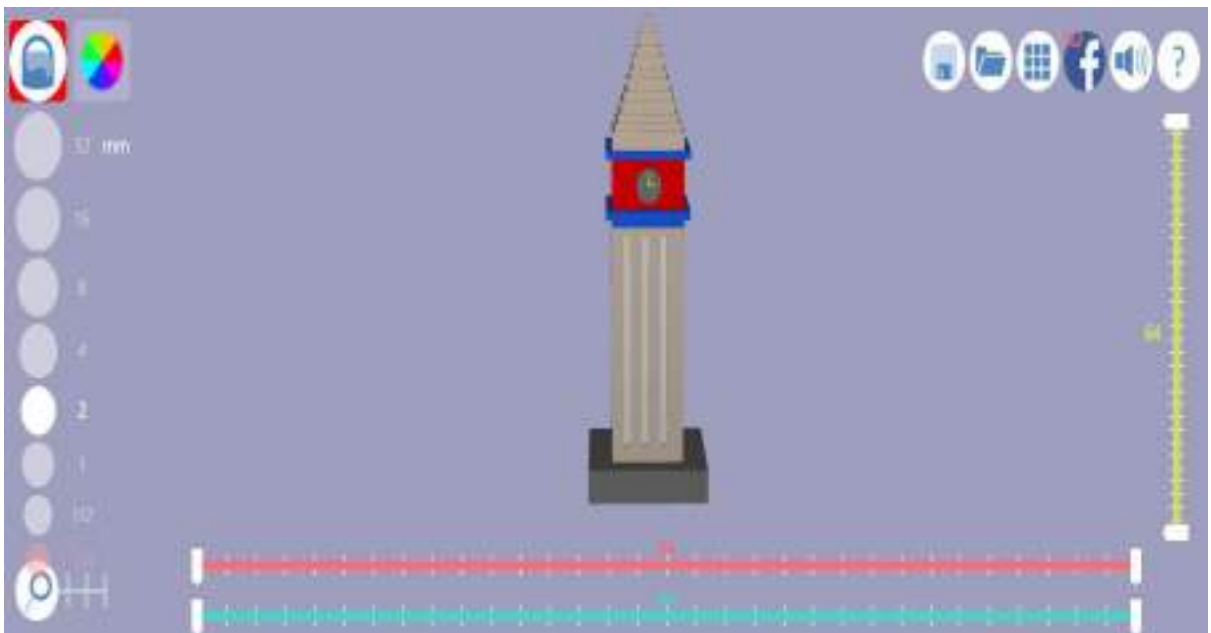
ROCKET DESIGN

Lesson Overview

There are multiple factors to take into consideration when designing a rocket. Aerodynamics, thrust, shapes for different parts etc. Find out what the best design for a rocket is and then, design it on 3DSlash.

Learning Objectives

• Understanding the function of Rocket
• Working knowledge of hammer, trowel, and chisel.
• Proper understanding of the 3D shapes, i.e. cone, cylinder.

Tools Used

• Hammer
• Trowel
• Chisel
• Wall
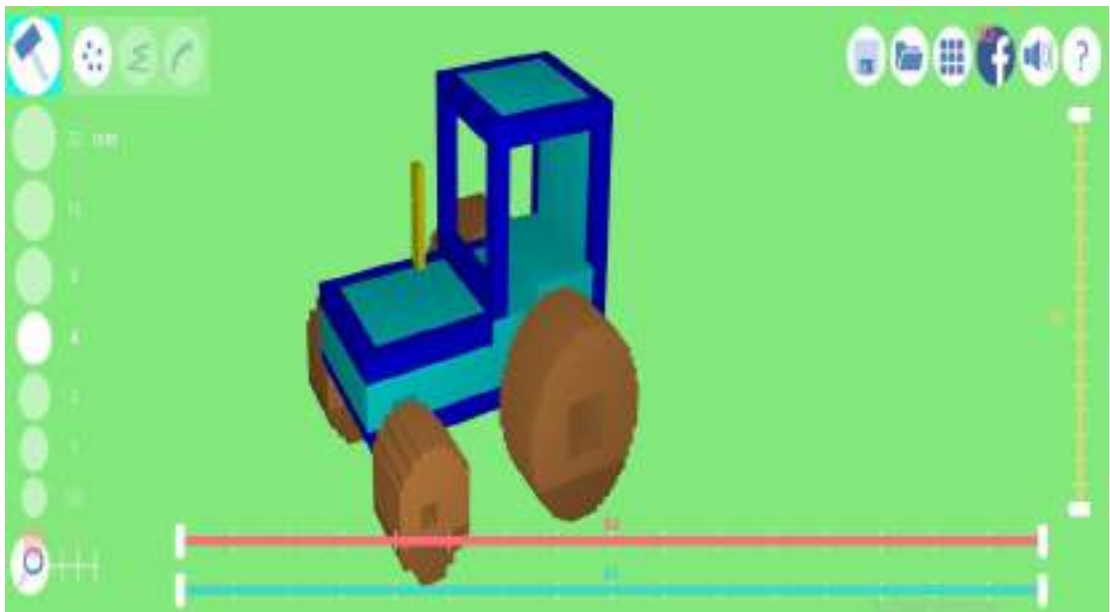• Colour
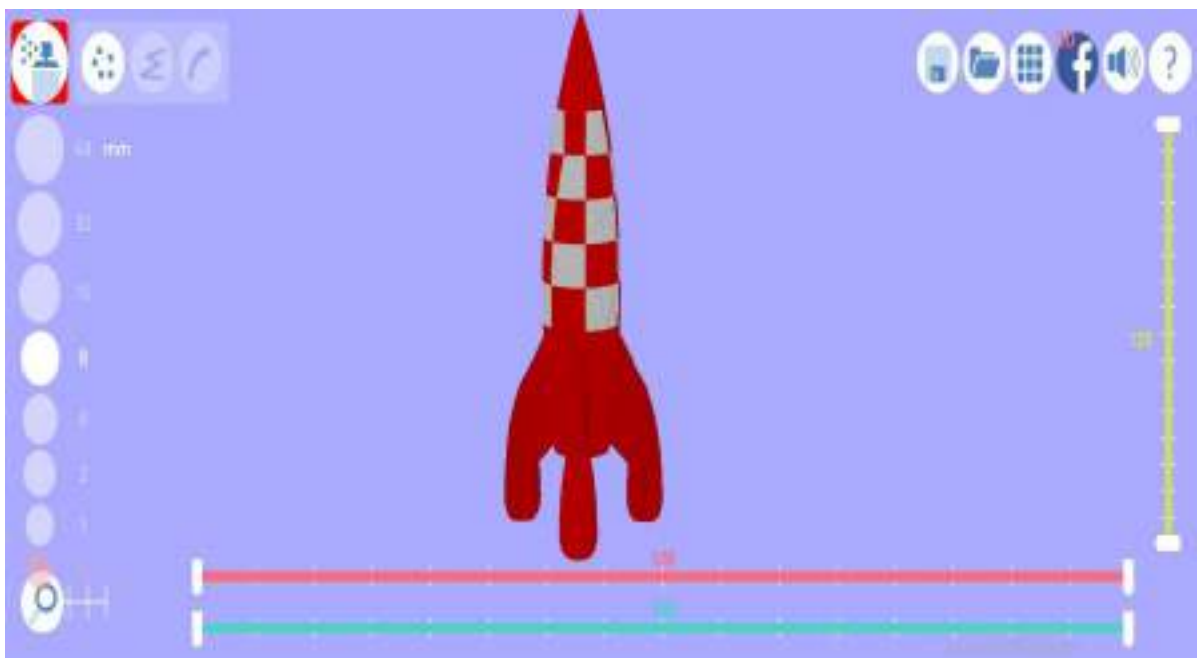
PLOUGH DESIGN

Lesson Overview

We have worked on some designs with limited number of shapes involved. Let's try creating a plough, putting together so many different little shapes.

Learning Objectives

• Overview of Tractor.
• Working of hammer, chisel.
• Properly understanding of the 3D shapes, i.e. box, wheels.

Tools Used

• Hammer
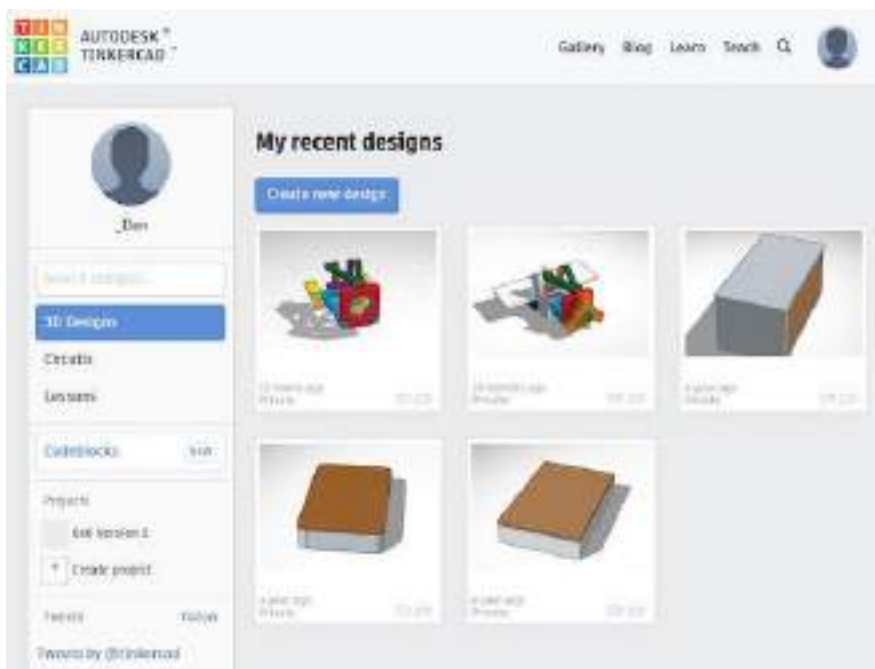• Trowel
• Chisel
• Wall
• Colour

Introduction to TinkerCAD

Tinkercad is a browser-based 3D design and modeling program created to provide a way for a variety of users (beginners to experts) to create projects.

Visit www.tinkercad.com You'll need to create a free account to access the service. After logging in, you'll be greeted with a screen similar to this one:

Click on "Create new design" right below "My recent designs" next to your profile picture. A new design will open up. Explore the application.

Note:

Before you start designing your case in Tinkercad, make sure to get a rough idea of what you want your case to look like by creating a hand-drawn sketch.
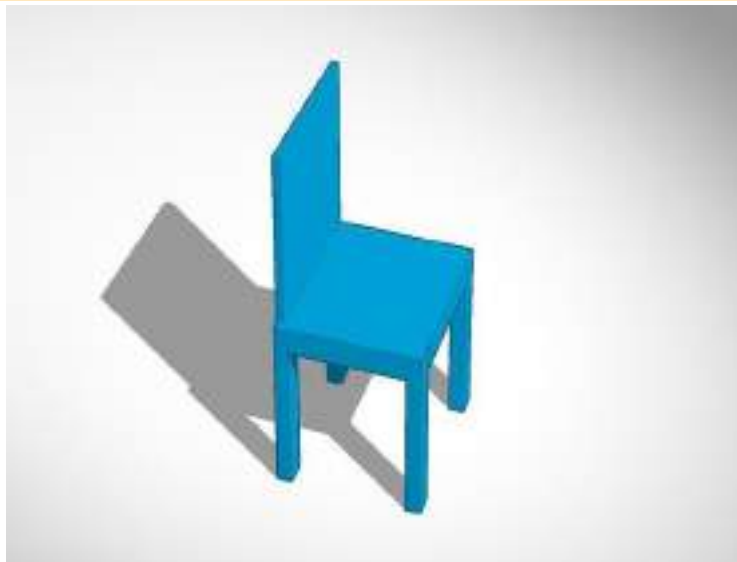
CHAIR DESIGN

Lesson Overview

Put the different shapes together on tinkercad to create your design of a 3D chair.

Learning Objectives

- Understanding of 3D shapes, i.e. box, cylinder etc.
- Understanding of proper measurement.

Tools Used

- Different 3D shapes
- Three Dimensional Rotation
- Move Object

ALARM CLOCK DESIGN

Lesson Overview

We have a great design for the wall clock. The manufacturing company wants to create different types of clocks. Upgrade the design you currently have to make it look like an alarm clock.

Learning Objectives

• Measuring the time or duration of an event or action
• Adding features to a basic design.
• Understanding the Three Dimensional figures i.e. Box, cylinder, sphere etc.

Tools Used

• Different 3D shapes
• Three Dimensional Rotation
• Move Object
• Rotate
• Text

# PENDULUM CLOCK DESIGN

Lesson Overview

Having learnt how to work with the different shapes and how to put them together, let's practice on creating a complete project. Create a complete pendulum clock with as much detail as possible.

Learning Objectives

- Measuring the time or duration of an event or action
- Adding features to a basic design.
- Detailing

Tools Used

- Different 3D shapes
- Three Dimensional Rotation
- Move Object
- Rotate
- Text
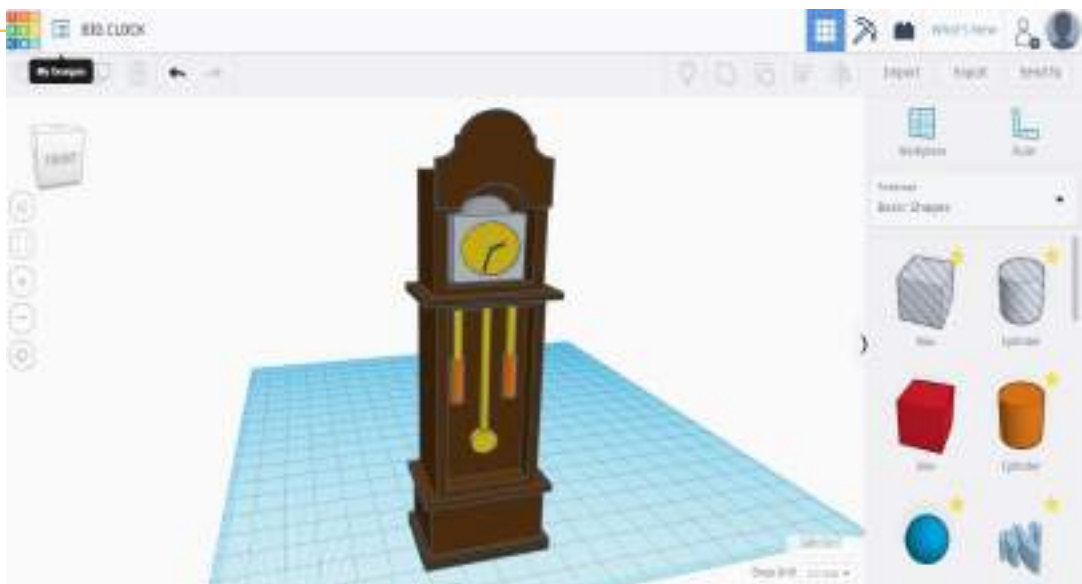
CODING AND APP DEVELOPMENT

INTRODUCTION

- 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.
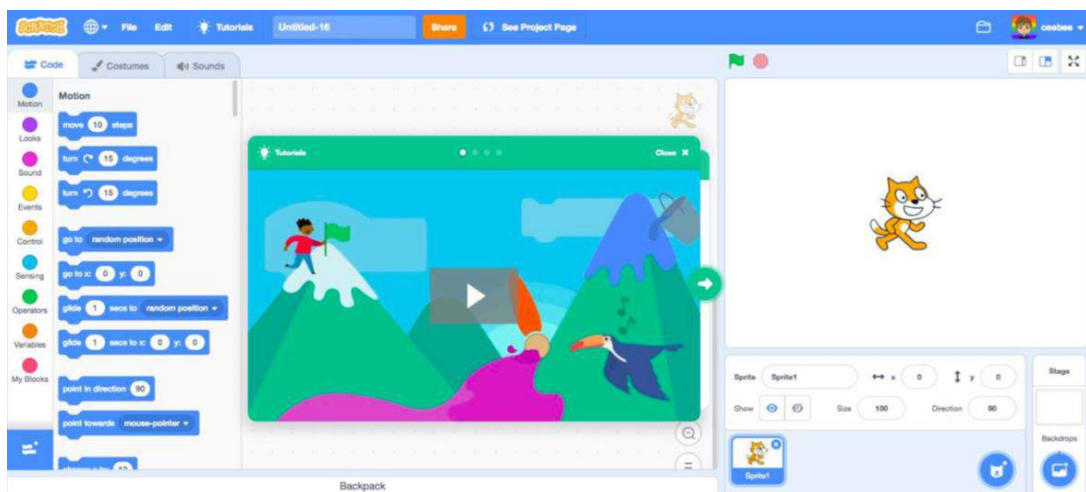
In this class student will be introduced to scratch. They will come to know about from where to select sprite and backdrop and function of each block.

BASIC MOVEMENT-1

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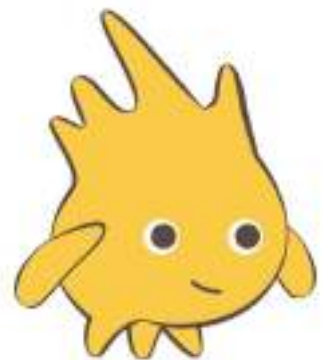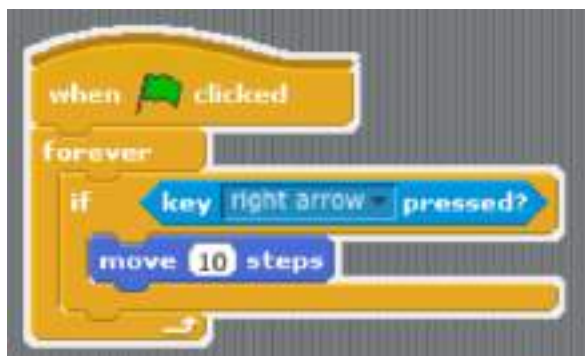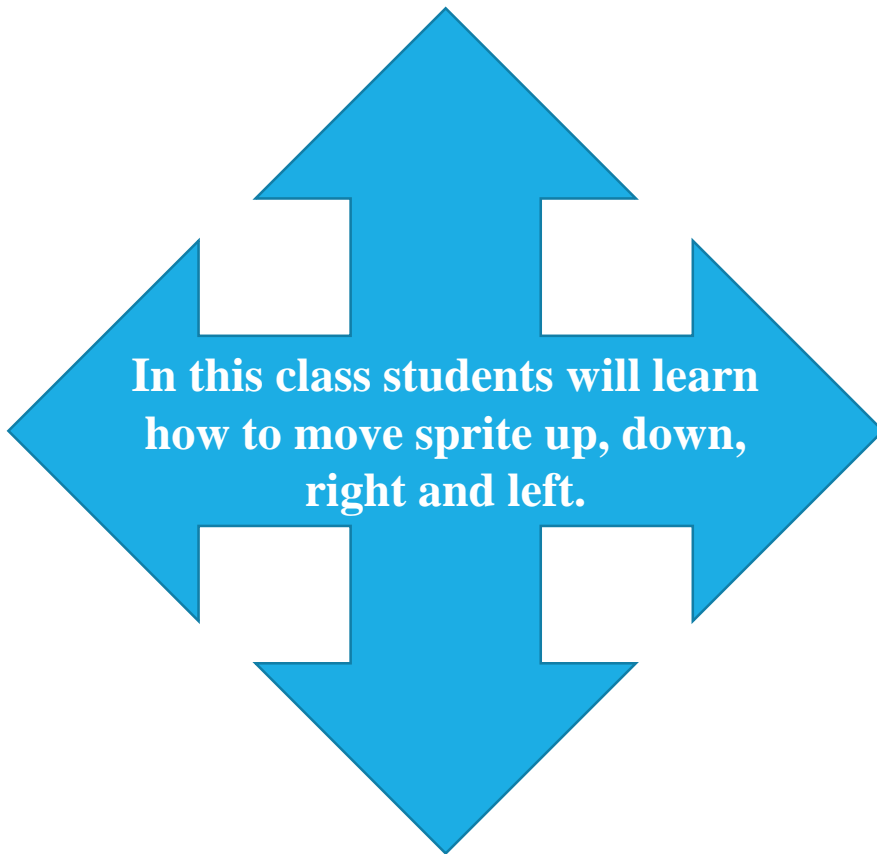
FLYING BIRD

Learning Outcomes:

- Basic function of a loop.
- How sound and looks code of block works.

Task:

- Create an animation of the bird moving from one end of the stage to another.

Notes:

WALKING AVERY

Learning Outcomes:

- Conditional statements
- IF condition

Task:

- Change the backdrop when the sprite hits the edge.

Notes:

FLYING PLANE

LEARNING OUTCOME-
- How to make a sprite move.
- To control the motion using keys on the keyboard.
- To change the backdrop on "IF Then" condition.

CASTLE STORY

LEARNING OUTCOME-
-How take input from user.
-How to make an user interactive animation.
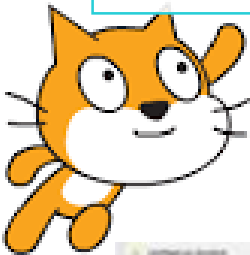-How to change backdrop in a program.

BASKETBALL GAME

Learning Outcomes:

- Conditional statements
- IF then else
- For loops

Task:

- Program the ball to get to the basket when the space bar is clicked.

Notes:

BIRTHDAY CARD

Learning Outcomes:

- Conditional statements
- Loops
- Changing costumes and looks

Task:

- Create an animation for a happy birthday greeting for your friend
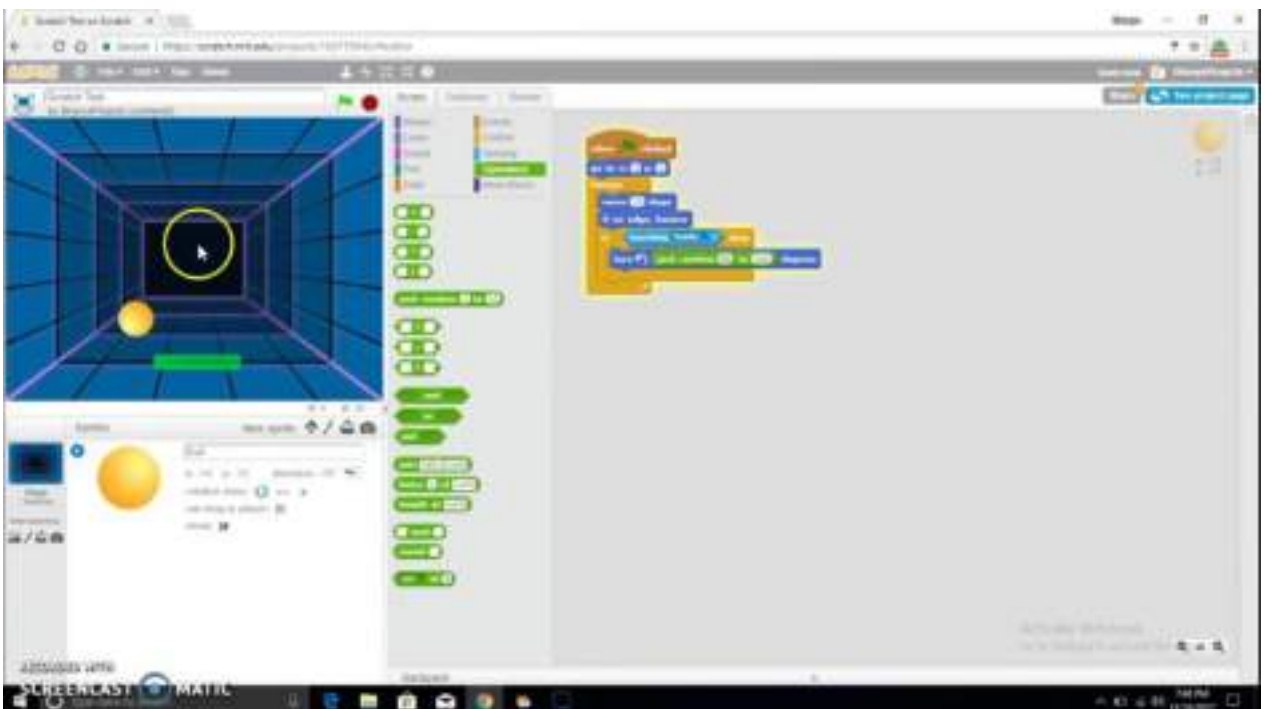
Notes:

PING PONG GAME

Learning Outcomes:

• Multiple behaviour traits for sprites.
• Conditional statements
• Loops

Task:

• Create an animation for a happy birthday greeting for your friend
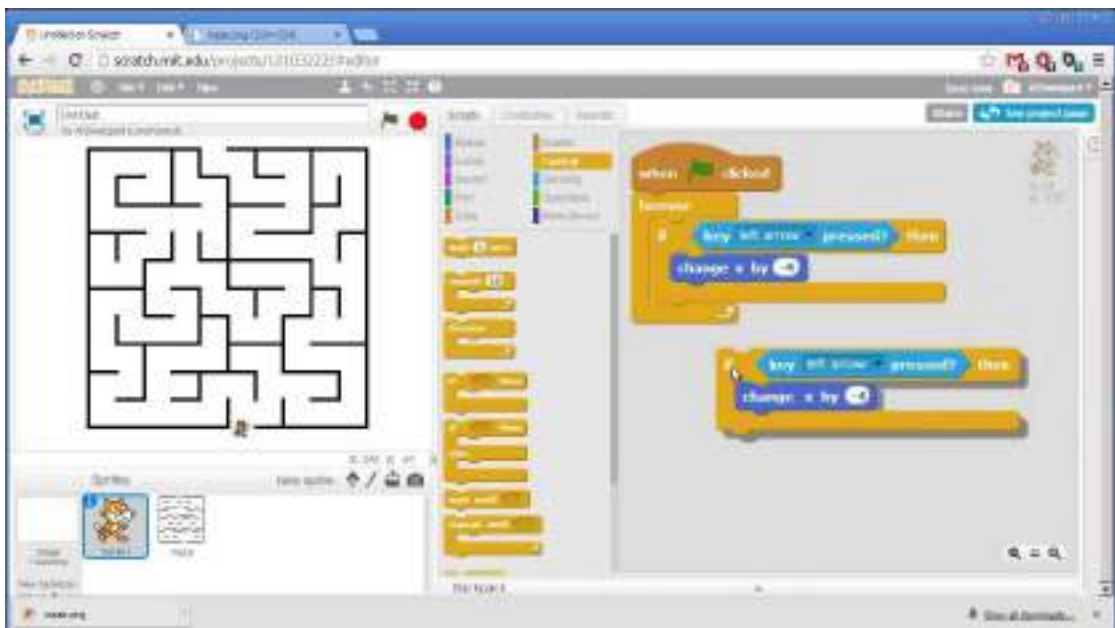
Notes:

MAZE GAME

Learning Outcomes:

- Multiple behaviour traits for sprites.
- Design your own backdrop
- Loops
- Multiple forever loops

Task:

- Create a maze game using Scratch.

Notes:

Education is the most powerful weapon which you can use to change the world.

-- Nelson Mandela

Teachers need to integrate technology seamlessly into the curriculum instead of viewing it as an add-on, an afterthought or an event.

---Heidi Hayes Jacobs

Happy Learning!