



DEMHA TECHNOLOGY INSTITUTE
Invest in the Future

DTL TINKERTANK CURRICULUM

LEVEL III





Our future generation will be the drivers of innovation and discovery and will set Tanzania's pace as a global powerhouse. Demha Tinkertank Lab is Demha Innovation Mission (DIM), DTI's flagship initiative to promote innovation and creativity. DTLs are open innovation makerspaces where young minds give shape to their ideas through hands-on do-it-yourself mode. The program has become a national movement that is revolutionising the Education Ecosystem of Tanzania. When I meet students from different quarters of the country who come up with innovations regardless of how remote and resource-constrained they may be, I am filled with much hope for the future of our country.

I am thrilled to introduce the DTL Tinkertank Curriculum, a hands-on learning program that empowers young people to build the skills and attributes required for success in the 21st century. This innovative curriculum provides students with the opportunity to understand the basics of emerging technologies and apply their learning to solve real-world problems.

The curriculum focuses on a wide variety of concepts, ranging from basic electronics, mechanics, data visualization, and woodworking, to more advanced technologies such as 3D printing, the Internet of Things, and design thinking. Through hands-on, experiential learning, students will be encouraged to identify and design creative solutions to everyday problems.

The aim of this curriculum is to provide stage-wise learning to meet the needs of students at different stages of their tinkertank journey. This will help cultivate the next generation of entrepreneurs, engineers, and innovators, who will be equipped with the knowledge and skills to navigate the rapidly changing technological landscape of the 21st century. I am confident that the DTL Tinkertank Curriculum will be a valuable resource for educators and students alike. This new initiative will help in achieving the goal of the National Education Policy of developing 21st century skills in students and preparing them for the fourth Industrial Revolution.



Under the aegis of Demha Innovation Mission, Demha Tinkertank Labs were set up with the goal of inspiring a generation of neoteric innovators and entrepreneurs in Tanzania. The underlying philosophy of our DTLs has been to equip the young minds of Tanzania with all the knowledge and skills necessary to thrive in the twenty-first century. The idea is to allow children to explore the world of research and innovation, and contribute towards nation development, by developing innovative and disruptive solutions to Tanzania's biggest community problems.

In 2030, the Demha Tinkertank Labs are expected to achieve a milestone of setting up 10,000 labs across Tanzania. Over seven million students in Tanzania will learn in these DTLs. With this accomplishment in the next stage of development, our goal is to ensure that the DTL students have the best tools and resources to learn from.

I am honoured to introduce the DTL Tinkertank Curriculum, which is designed to equip young people with the skills and attributes they need to thrive in the 21st century. This hands-on learning curriculum is built around the latest technologies and focuses on a wide range of concepts, from basic electronics and mechanics to advanced topics such as 3D printing, the Internet of Things, and design thinking.

This curriculum starts with basic concepts and hands-on activities in the early stages to introduce students to the subject matter and build their foundation in tinkertank. As students progress, the curriculum introduces more advanced topics and projects that challenge them to apply their knowledge and skills in new and creative ways.

I look forward to seeing the impact this curriculum will have on the learning journey of the students in DemhaTinkertank Labs. I strongly recommend this DTL Curriculum be used by all DTL schools across the country to learn tinkertank.



With the pace of technological innovation, our youth of today face an uncertain future. On one hand, technological progress has led to tools that promise healthier and more comfortable lives. On the other, youth face a future with widespread automation, and have to learn to use emerging technologies and adapt to meet the needs of a changing job market. No longer is it enough to be able to recall information and learn routine tasks that can be performed by a machine. Critical thinking, problem solving, collaboration, and communication skills, along with the ability to self-learn, are essential to stay relevant in the workplace, and to drive innovation and social change in the country over the next few decades.

These goals are laid out clearly in our National Education Policy (NEP) 2024, which aims to develop ‘higher order’ cognitive capacities, such as critical thinking and problem solving, alongside social, ethical, and emotional capacities and dispositions. NEP also lays out a focus on experiential learning, and conceptual clarity over rote learning. The making or tinkertank philosophy exemplifies such an approach, by centering learning through exploration, experimentation, and play. It also creates room for failure, encouraging youth to take risks and exercise their creativity without fear. The collaborative environment of a makerspace or tinkertank lab also creates an opportunity to exercise socioemotional skills and learn to communicate one’s ideas effectively.

MakerGhat’s collaboration with the Demha Innovation Mission at DTI is an exciting opportunity to realize the goals of NEP 2024 and put the tinkertank philosophy into practice. The curriculum that we have developed emerged as a result of countless conversations with teachers across the country who expressed an interest in making, but lacked resources that could help them get started. The DTL Curriculum manual aims to fill that gap. It has been designed to support not just schools with access to an DTL, but any educator who is excited about tinkertank and making. Many of our activities, particularly at Level I and II, can be performed with space and tools available at hand.

The development of this manual is only the beginning. MakerGhat is excited to support teachers in many other ways, through mentorship, training, and assessment resources. Over the next decade, we are committed to building a network and movement of makers—educators and youth—who can usher in change at a local, national, and global level. The pressing problems of our time need creative solutions from diverse communities. Our educators are the country’s best resource to inspire and prepare youth to lead us into a better future, and we invite them to join hands with us to realize this vision.



Overview

The DTL Curriculum helps young people build skills and attributes required for success in the 21st Century. It provides students with the experience to understand the basics of all the emerging technologies and apply the learnings to solve the real-world problems. This is designed to be a hands-on learning program that empowers children to analyse the facts, connect the dots and apply what they learn in school rather than memorizing them which will lead to the creation of next generation of entrepreneurs, engineers and innovators.

This curriculum will enable the young learners to develop interest in Science, Technology, Engineering & Math through a hands-on experiential learning. It focuses on wide variety of concepts ranging from Basic electronics, Mechanics, Data visualisation and Wood working to other emerging technologies such as 3D Printing, Internet of Things and Design Thinking that culminates in building prototypes of their ideas. The aim of this curriculum is to lead the students to identify and design creative solutions to everyday problems.

Curriculum Objectives

- Students will be able to turn ideas into reality by brainstorming, modelling and prototyping.
- Inculcate innovative and entrepreneurial mind-set through Design thinking and Hands-on Learning.
- Identify and research problems in their community and beyond, generate relevant and creative solutions, and develop sustainability plans for their solutions.
- Identify and self-learn for dignified career opportunities based on their skills and interests, particularly in STEM or entrepreneurship.
- Develop basic knowledge in electrical and mechanical engineering principles.
- Develop skills of using hand tools to construct a prototype of an engineering design.

Curriculum Structure

The DTL Curriculum engages students actively in the development of hands-on activities through a sequence of 3 Levels with incremental difficulty. Each level comprises of different modules, which are further subdivided into sessions. It is highly recommended to start the course with Level 1 and end the course with Level 3. The detail of each level is as follows:

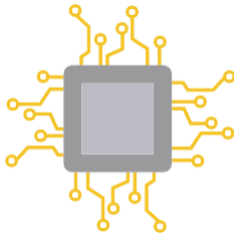
Level 1 comprises of 5 modules namely, Basic Electronics, Mechanics, 3D Design & Printing, Data Visualisation and Design & Entrepreneurial Thinking. All the 5 modules are further divided into 14 sessions. The duration of each session is 60 min.

Level 2 comprises of 4 modules namely, Electronics, Mechanics, 3D Design & Printing and Design & Entrepreneurial Thinking. All the 4 modules are further divided into 13 sessions. The duration of each session is 60 min.

Level 3 comprises of 5 modules namely, Electronics, IoT, 3D Design & Printing, Wood Working and Design & Entrepreneurial Thinking. All the 5 modules are further divided into 17 sessions. The duration of each session is 60 min.

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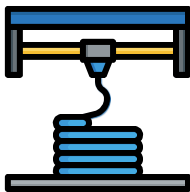
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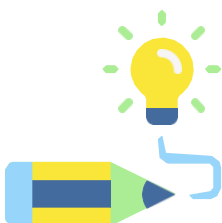
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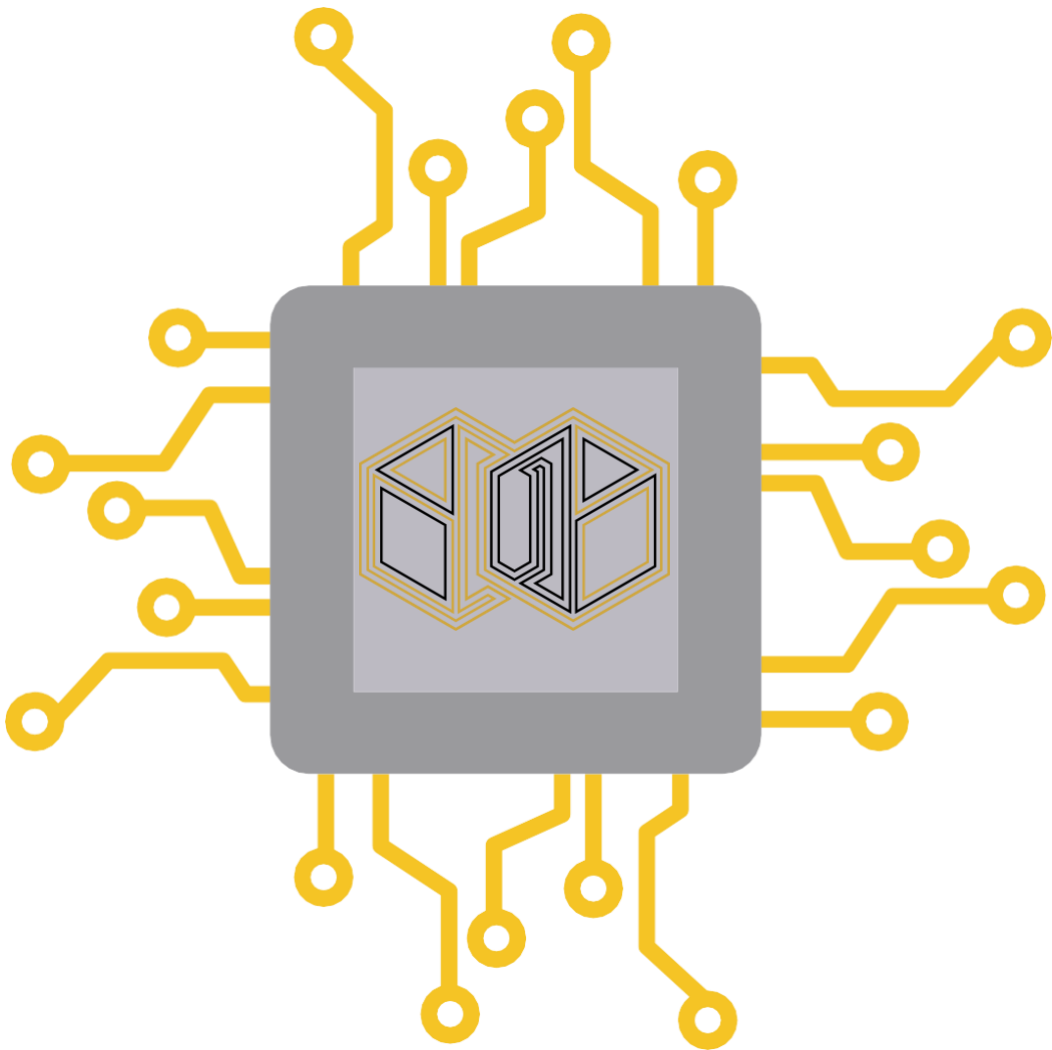
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BASIC ELECTRONICS





Introduction to Multimeter and Ohm's Law (10 mins):

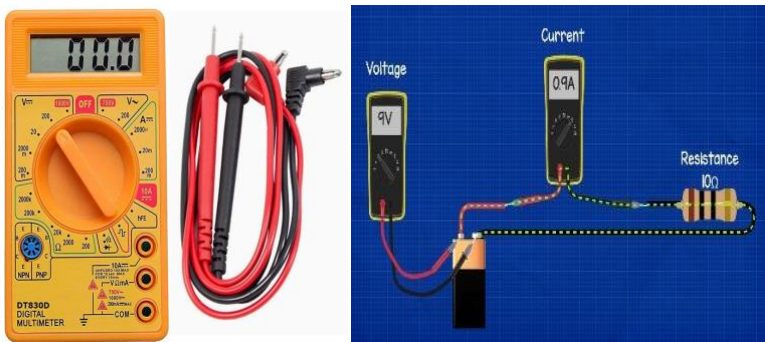


Is it possible to measure the current, voltage and resistance?

Yes it is possible, to measure the current, voltage and resistance. The device used to measure them is called as multimeter. A multimeter or a multimeter, also known as a volt/ohm meter or VOM, is an electronic measuring instrument that combines several measurement functions in one unit. A typical multimeter may include features such as the ability to measure voltage, current and resistance.

What Is Ohm's Law?

Ohm's law is the relationship between voltage, current and resistance and how they relate to each other. Ohm's law was developed by a German physicist named Georg Ohm who undertook many experiments to develop his theory including measuring current by touching electrical circuits to see how much it hurt. The higher the current, the more it hurt, which is also represented as $V=IR$ (Voltage = Current * Resistance)



source:tomshardware.com

Materials Required :



1. Breadboard
2. Multimeter
3. Resistor(3 ohm)
4. 9v battery
5. 6v battery
6. Lamp

🕒 : 60 minutes

Module: Basic Electronics

Grade: 6th to 9th

Importance/ Value:

The aim of this session is to make the learners aware about the ohm's law and uses of multimeter. Multimeter is a very essential tool for professionals which is used to check voltage, resistance, and electrical current levels by connecting two leads to various electrical system components.

Learning Goals:

1. Learners will be able to understand the basics of Electronics and its components
2. Learners will be able to use the multimeter and identify the relationship between the current, voltage and resistance

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker- Who's in your circle?
15 Min	Introduction to ohm's law and multimeter
20 Min	Activity- multimeter and ohm's law
10 Min	Try it yourself- Measure the current in the circuit
09 Min	Reflection and Learnings

Icebreaker (5 mins): Who's in your circle?

Ask your students to draw three concentric circles on a piece of paper. Give them a topic (food, seasons, sports...) and ask them to write it in the center circle. In the second circle students write "love", in the third "like", and outside the circles "don't like". Under the topic, students individually choose a specific example to focus on (e.g., bananas, spring, tennis). Students then mingle and ask their classmates how they feel about the item they have chosen, writing the students' names in the circles that correspond to their opinions. Repeat with another topic.

Safety Measures:



1. Do not connect power to a circuit until the circuit is completed..
2. Never work on a circuit while power is switched on.
3. Never touch any electrical equipment with wet hands.
4. Your work area must always be kept dry.

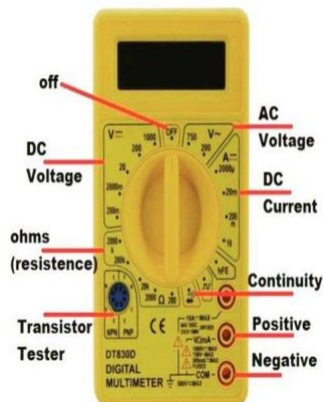


5. If you smell anything burning, immediately disconnect the power and examine your circuit to find out what went wrong.
6. Always use appropriate insulated rubber gloves and goggles while working on any branch circuit or other electrical circuit.

Activity: Measure the voltage of the battery using a Multimeter (20 mins)



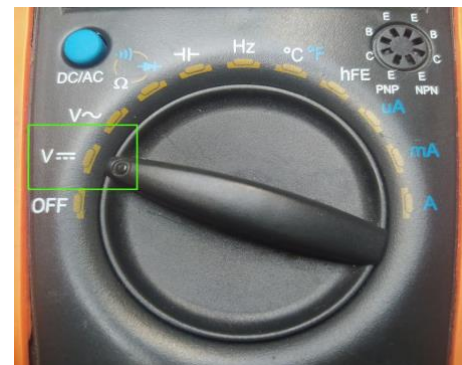
In this Activity, We are going to measure the voltage of the battery, before measuring we need to know the different symbols of Multimeter. Observe the image given below, look at the symbol and the corresponding function.



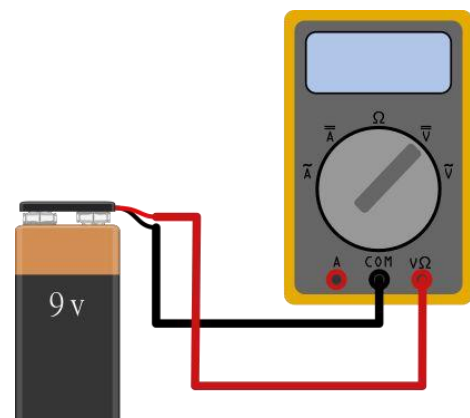
Switch Position Or Symbols	Measurement Functions
\tilde{V}	AC Voltage
\overline{V}	DC Voltage
$A \overline{=}$	DC Current
Ω	Resistance (Ohms)
$\ \cdot \ $	Continuity Beeper
$\rightarrow \leftarrow$	Diode Test
OFF	ON/OFF Switch

Source: tomshardware.com

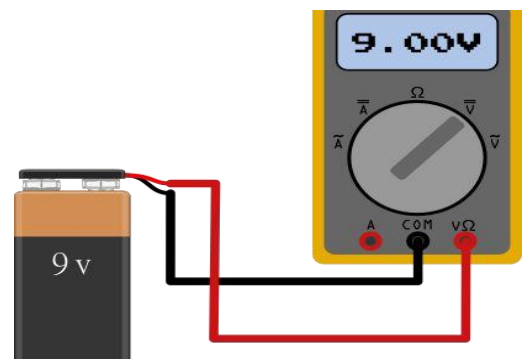
Step 1: Turn the dial on the multimeter to read a DC voltage.



Step 2: Touch the black probe, connected to COM on the multimeter to the negative (-) terminal of the battery and touch the red probe, connected to the DC terminal of the multimeter to the positive (+) terminal of the battery.



Step 3: A reading will appear on the screen. This is the voltage of the 9V battery. This voltage could be higher or lower depending on the age and state of the battery.



Activity: Identifying the relationship between current, voltage and resistance using Ohm's law



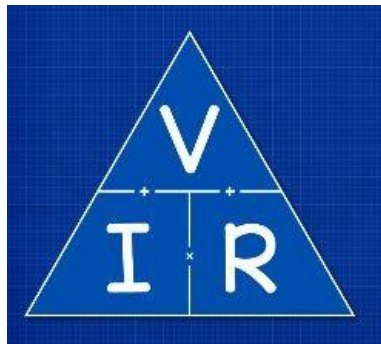
Three formulas used for Ohms Law

$$\text{Voltage (V)} = \text{Current (I)} \times \text{Resistance (R)}$$

$$\text{Current (I)} = \text{Voltage (V)} \div \text{Resistance (R)}$$

$$\text{Resistance (R)} = \text{Voltage (V)} \div \text{Current (I)}$$

If the above formulae seems like a lot to remember then don't worry because you don't need to remember all of them. All you need to remember is Ohm's triangle as shown in the image given below.

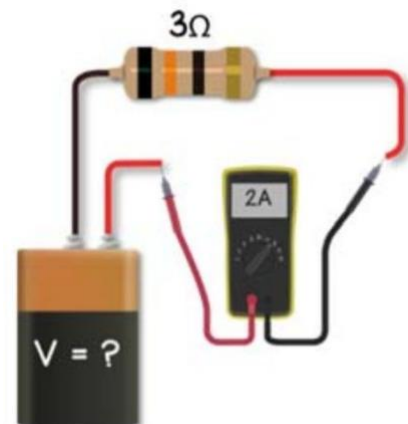


1) Find the voltage of battery

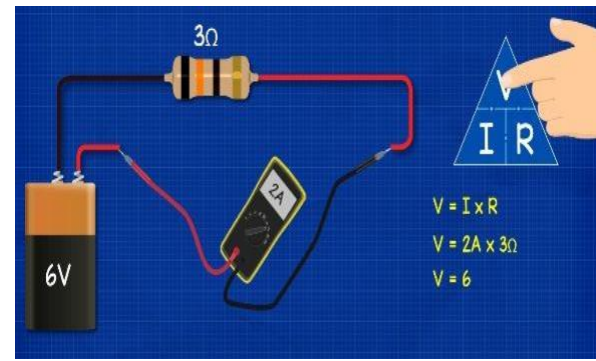


Let's build a simple electrical circuit with a battery and a resistor. We don't know what voltage the battery is though

Step 1: Take the 3Ω resistor and connect one end to the negative side of the battery. Connect another end to the multimeter (Black wire). Then, connect the battery positive to the red probe of multimeter as show in the image.



Step 2: Observe the current reading on the Multimeter. In the image we see the reading of the Current (I) as 2 Amps. Using the Ohms Law formula $V=IR$, Let's find out the Voltage.



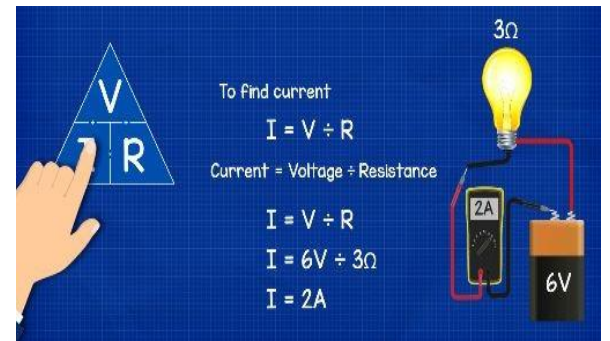
2) Find the current in the circuit



Step 1: Take 3Ω lamp and connect it to a 6V power supply. To find the current we write down $I =$ and cover up the I in the triangle. That gives us $V \div R$ so Current equals Voltage divided by resistance.



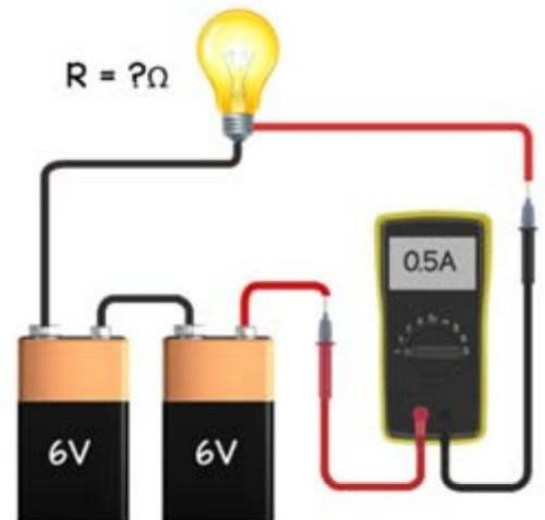
Step 2: We know the voltage is 6V and the resistance is 3 ohm so the current is therefore $6/3 = 2A$ and that's what we see with the multimeter.



3) Find the resistance in the circuit

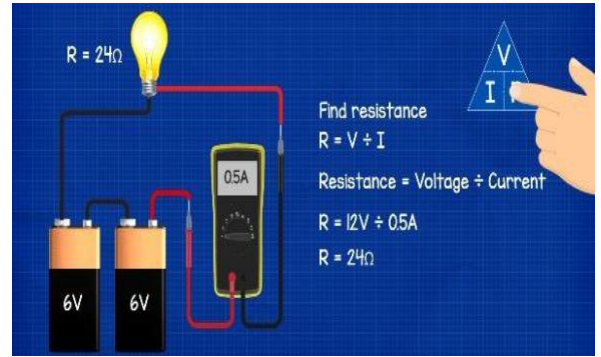


Step 1: Take a resistive lamp and connect it to a 12V power supply as shown in the image. Now, pick up a multimeter and check the current value. We can see the current measured as 0.5A.



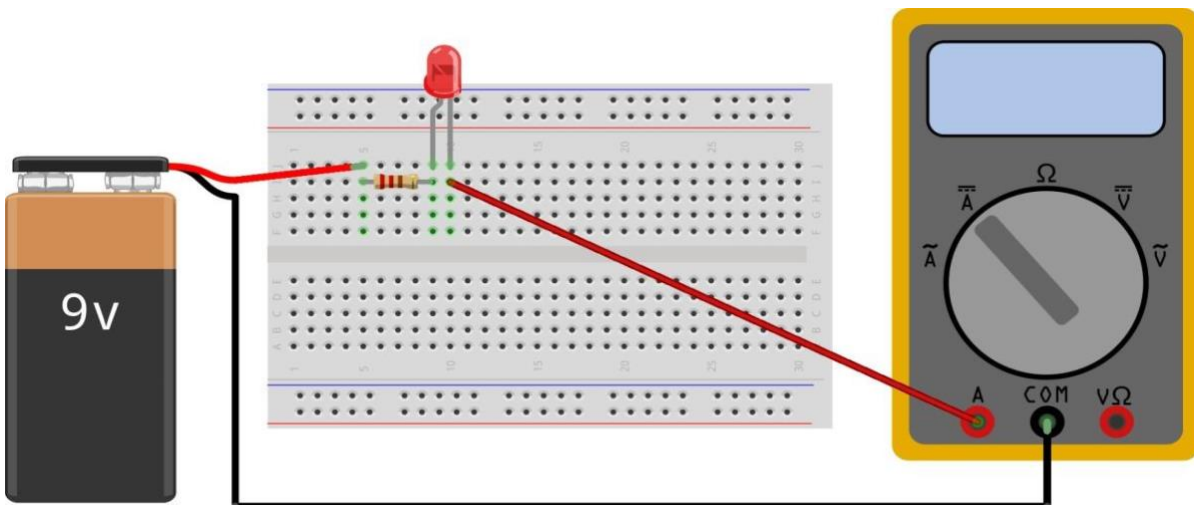
source: theengineeringmindset.com/ohms-law

Step 2: Now, Try this for yourself! Using the ohm's law identify the resistance value. Look at the image for solution.



Try it yourself: Look at the image given below, build the circuit as shown in image and Measure the current in the circuit using multimeter

Materials required: LED, Multimeter, 9v battery, Breadboard



Source: theengineeringmindset.com/ohms-law

Reflection and Learnings (9 mins):

1. Share at least 3 skills or lessons that you learned today.
2. How will you apply these skills outside class?
3. Recall and write down the Ohm's Law. What values do you think you can measure using Ohm's Law.
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings.



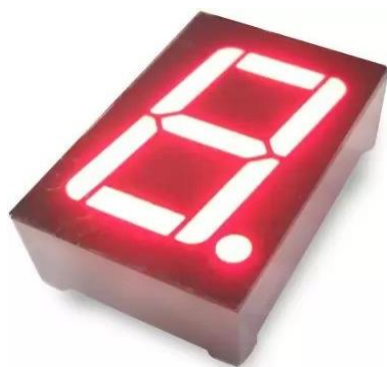
Introduction to 7 Segment display(10min):



A seven-segment LED is a digital display module specialized to display numerical information. Light-emitting diodes (LEDs) arranged in the shape of numbers offer an easily visible display. They are sometimes called "seven-segment displays" or "seven-segment indicators."

Seven segment displays are the output display device that provides a way to display information in the form of images or text or decimal numbers which is an alternative to the more complex dot matrix displays. It is widely used in digital clocks, basic calculators, electronic meters, and other electronic devices that display numerical information. It consists of seven segments of light-emitting diodes (LEDs) which are assembled like numerical 8.

Can you think of anywhere 7 segment displays are used? For today's activity we are going to create a 7 segment display



Source: Flipkart.com

Materials Required :

1. Pencils
2. A4 Size sheet
3. LED
4. Coin Cell/Rechargeable 9 V batteries
5. Breadboard
6. 7 segment display



🕒 : 60 minutes

Module: Electronics

Grade: 6th to 9th

Importance/ Value:

The aim of this session is to provide some basic understanding of how to create a 7 segment display for electronic devices using the material available in the ATL Lab.

Learning Goals:

1. Learners understand the basics of Electronics and its components
2. Learners will gain understanding about the 7 segment display and other essential electronic components and safety measures.
3. Learners will be equipped to create a simple circuit on a breadboard

Time	Description
01 Min	Check-in-Experience (CIE)
10 Min	Icebreaker
10 Min	Introduction to 7 segment display
30 Min	Activity- 7 segment display
09 Min	Reflection and Learnings

Icebreaker (10 mins):

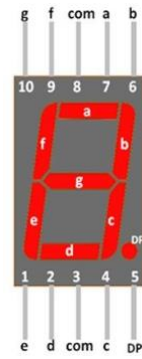
Stand in a circle. The first player must ask the person on their left, "What are you doing?" The other player should only tell the answer while enacting it. The other kids must all copy them before moving on to the next player.

For instance, if the first player asks the second player, "What are you doing?" and the second player replies, "I am running in circles," while also running in circles, then all the kids have to run in circles. The second player will then ask the third player, and so forth.

Working of a 7 Segment Display:

When we connect the 7 segment display to all the segments, The number 8 is displayed and if you disconnect the power for 'g', then it displays the number 0. In a seven-segment display, power (or voltage) at different pins can be applied at the same time, so we can form combinations of display numerical from 0 to 9. Since seven-segment displays can not form alphabets like X and Z, they can be used only for displaying decimal numerical magnitudes.

However, seven-segment displays can form alphabets A, B, C, D, E, and F, so they can also be used for representing.

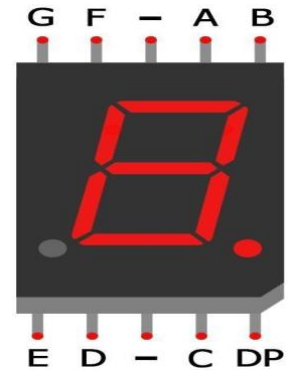


Source: Microcontrollerlab.com

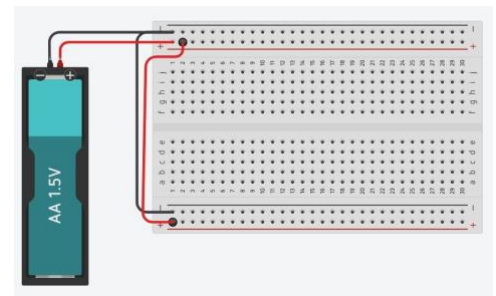
Activity (30min):

Steps to make a 7 Segment Display:

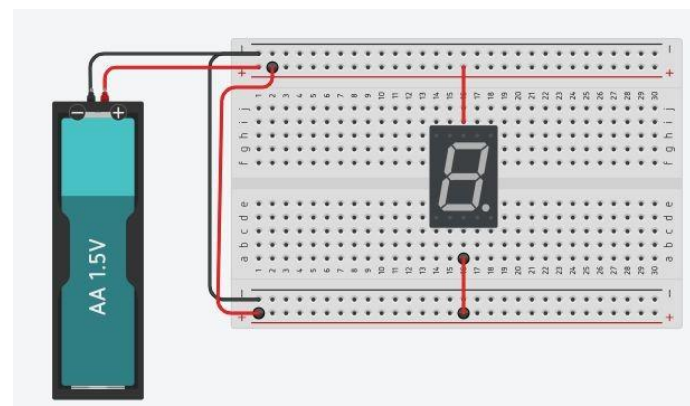
Step 1: Identifying the legs of 7 segment display. Observe the image and identify different legs of a 7 segment display.



Step 2: Connect +ve and -ve terminals of the battery in the breadboard as shown in the image.

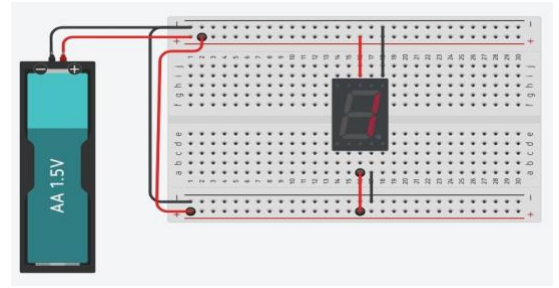


Step 3: Place the seven segment display and connect two common pins of the display to the +ve terminal.

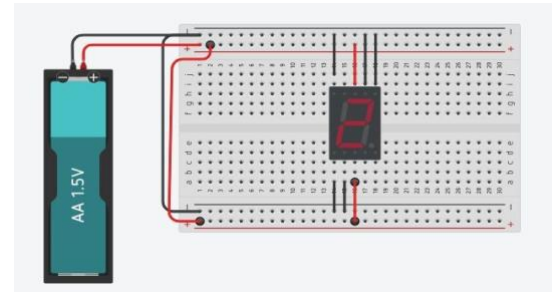


Source: Tinkercad.com

Step 4: To show the number 1 in the display, Connect the pins B & C to the terminals as shown in the image



Step 5: To show the number 2 in the display, Connect the pins A, B, G, E, D to the terminals as shown in the image.



Try it yourself: Repeat the step for digits 3-9 based on the following table.

1 - ON 0 -OFF

Decimal Digit	Individual Segments Illuminated						
	<i>a</i>	<i>b</i>	<i>c</i>	<i>d</i>	<i>e</i>	<i>f</i>	<i>g</i>
0	1	1	1	1	1	1	0
1	0	1	1	0	0	0	0
2	1	1	0	1	1	0	1
3	1	1	1	1	0	0	1
4	0	1	1	0	0	1	1
5	1	0	1	1	0	1	1
6	1	0	1	1	1	1	1
7	1	1	1	0	0	0	0
8	1	1	1	1	1	1	1
9	1	1	1	1	0	1	1

Reflection and Learnings (9 mins):

1. What is a 7 segment display? Have you ever seen such a display before?
2. What are the real-world applications of a 7 segment display?
3. What did you or your team struggle with while doing this activity and why? How can you improve next time?
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What communication challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings





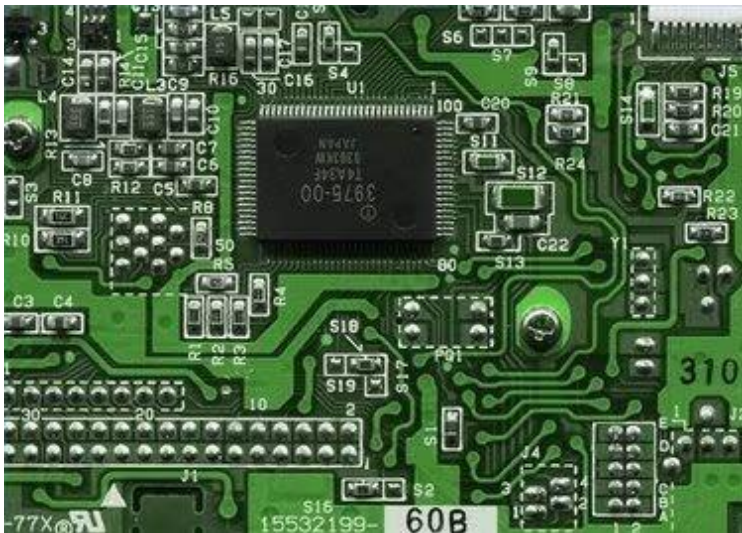
Introduction to Printed Circuit Boards (15 mins):



Printed circuits boards, also known as PCBs, are the circuit boards used in most electronic devices. It is an electronic assembly that uses copper conductors to create electrical connections between components. Printed circuit boards provide mechanical support for electronic components so that a device can be mounted in an enclosure.

Today we are going to make a small PCB of an emergency light circuit using chemical etching process.

Chemical etching is a process of making electronics circuit board from a copper sheet using Ferric Chloride Solution (FeCl_3)



Source: <https://www.techwalla.com/>

🕒 : 60 min

Module: Frugal Science

Grade: 6th to 9th

Importance/ Value:

The aim of this session is to provide some basic understanding of electronic circuit board making and chemical etching process using copper sheet & FeCl_3 solution.

Learning Goals

1. Learners understand the basics of PCB making process.
2. Learners will gain understanding about circuit of an emergency light.

Time	Description
01 Min	Check-in-Experience (CIE)
15 Min	Introduction to Printed Circuit Boards
10 Min	Types of PCB
25 Min	Activity- PCB Etching
09 Min	Reflection and Learnings

Materials Required :

1. Copper Sheet
2. Ferric Chloride Solution
3. Permanent Marker
4. Plastic Tray
5. PCB Drill



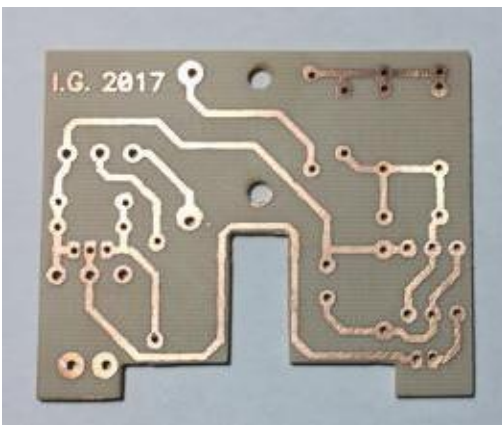
Why we are using PCBs?

A Printed Circuit Board, or "PCB," has several major advantages compared to older ways of building electronics. In the past, every component inside of an electronic device was connected with large wires and placed anywhere they could fit. As you can see in this picture of a 1948 television, this method was very "messy," and used a large amount of space. PCBs use a different approach. Components are mounted on a non-conductive board and connected with small pathways, called "traces." Because they are usually designed on a computer, printed circuit boards fit many components in a minimum amount of space.

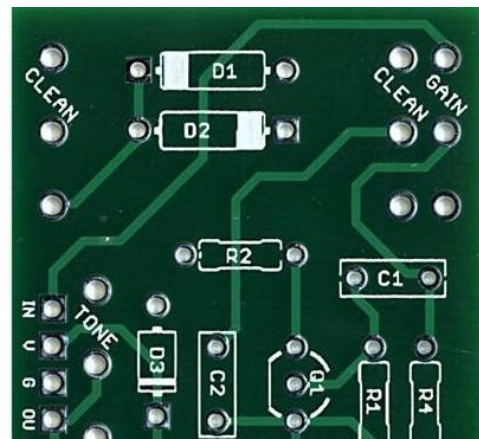


Source: Stockadobe.com

Types of PCBs (10 mins):



Home Made PCB



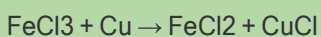
Industrial PCB

Home made PCBs can be made using copper sheet, permanent marker and ferric chloride solution. However to manufacture the industrial PCB we need special machines and other resources.

Any PCB has copper lines, these copper lines are called the trace lines, It acts as a connecting wire within the circuit.

Materials and Tools Required for PCB Etching

1. Ferric Chloride (FeCl₃) Solution- Ferric chloride will react with copper



3. Permanent Marker- We need to mark traces lines with permanent marker and this lines will not react with ferric chloride at the time of etching

2. Copper Sheet

A plastic sheet is coated with copper layer, we can cut this sheet in required shape.



4. PCB Drill

We are using this hand drill for making holes in PCB

Safety Measures:



1. Be careful while handling ferric chloride solution, use latex gloves to avoid contact with the chemical.

2. Wash the containers properly after the etching process.

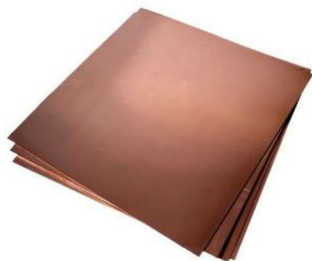
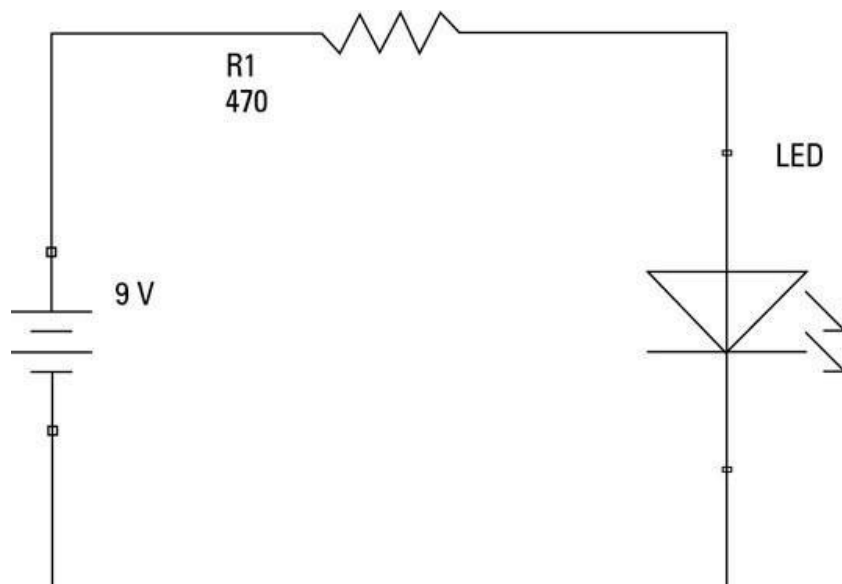


3. Soldering irons can reach temperatures of 400 Degree Celsius, so it's very important to know where your iron is at all times. We always recommend you use a soldering iron stand to help prevent accidental burns or damage.

Activity 1 (25 mins) : PCB Etching



In this activity, we are going to make a PCB design of an emergency light, so before making PCB we need to know circuit diagram and the list of material required to build the emergency light. Look at the image given below to learn more about it.



1. Copper Sheet



2. LED Light



3. Push Button



4. Battery Snap



5. 9V Battery

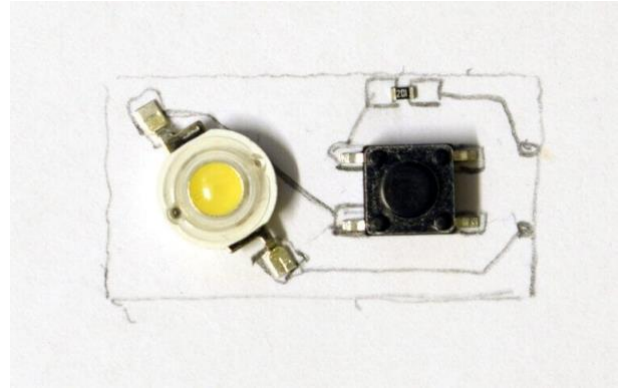


6. Resistor(SMD)

Steps to make a PCB

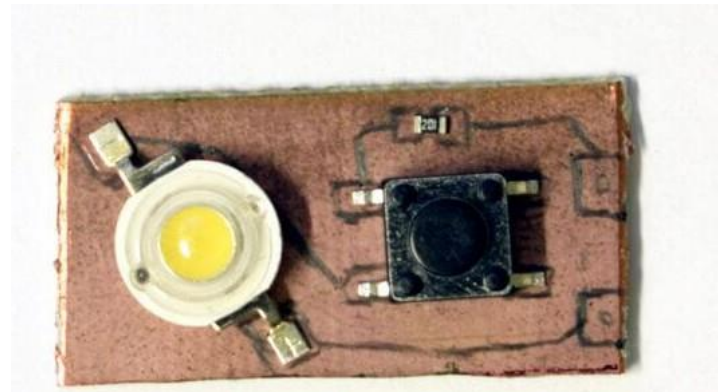
Step 1: Draw Circuit on a Paper

First of all, you need to have PCB traces to be drawn on a piece of paper. You can do it by hand by placing the electronic components on the paper and drawing the lines connecting their pads as you need.



Step 2: Redraw Traces on the PCB

When you have your PCB view, you will have to redraw it on the actual PCB. Use a simple graphite pencil and mark where the parts pads should be and then draw freehand the traces connecting the needed pads.



Step 3: Etch Proofing the Traces

The pencil graphite won't protect the traces from being etched while reacting with FeCl_3 solution, so you need to cover the board with some thicker covering. For this purpose, nail polish or permanent marker can be used.



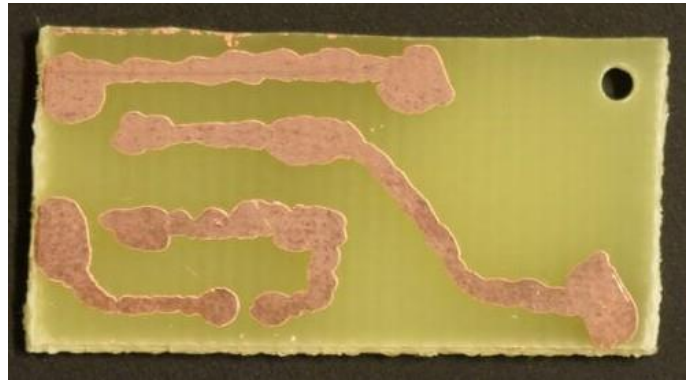
Step 4: Etching Process

Once the marker is completely dry it is time to give the board a bath in ferric chloride. Ferric chloride is a corrosive, acidic chemical compound that will eat away all copper on the board that is not protected by the marker's ink. Pour a modest amount of ferric chloride solution into a plastic container with a lid; just enough to cover the board completely. Let the board soak for 10 minutes, make sure the lid is properly secured and agitate it every few minutes by rocking the container back and forth. After 10 minutes of inspecting the board and if no copper is visible, remove the board while wearing a latex glove.



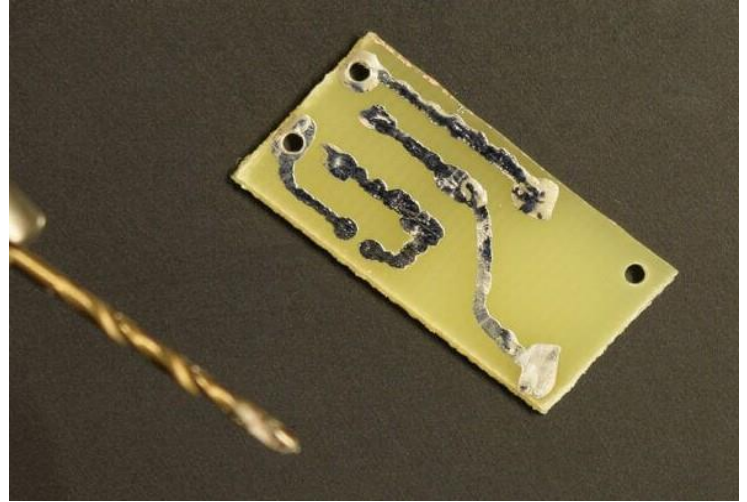
Step 5: Cleaning the Board

After the etching process wash the copper sheet and remove the marker lines using a metal scrubber.



Step 6: Drill Holes

After cleaning the boards drill holes on top of the plates.



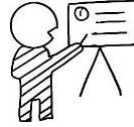
Reflection and Learnings (9 mins):

1. What do you think is the difference between a PCB and a breadboard?.
2. What do you think is the advantage of using PCB circuits?
3. What did you or your team struggle with while doing this activity and why? How can you improve next time?
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What communication challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings

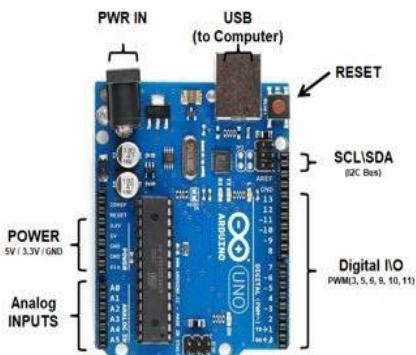


Introduction to Arduino Uno (10 mins):



Arduino UNO is a basic and inexpensive Arduino board and is the most popular of all the Arduino boards. Arduino UNO is considered to be the best prototyping board for beginners in electronics and coding.

We can interface and control various sensors and actuators with Arduino.



- Microcontroller Intel Curie
- Operating Voltage 3.3V (5V tolerant I/O)
- Input Voltage (limit) 7-20V
- Digital I/O Pins 14 (of which 4 provide PWM output)
- PWM Digital I/O Pins 4
- Analog Input Pins 6
- DC Current per I/O Pin 20 mA
- Flash Memory 196 kB
- SRAM 24 kB



Materials Required:

1. Arduino Uno
2. Servo Motor
3. IR Sensor
4. Jumper Wires

🕒 : 60 minutes

Module: Basic Electronics

Grade: 6th to 9th

Importance/ Value:

This session helps the students become familiar with the basics of electrical engineering and design, while building electronics projects that are limited only by their imagination. After the initial introduction to a few new keywords and skills, the Arduino is an easy-to-use tool for beginners.

Learning Goals:

1. Learners will be able to understand of different sensors.
2. Learners will be able to understand working of IR sensor and servo motor.

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker- Focus Activity
10 Min	Introduction to module
15 Min	Understanding Arduino UNO
20 Min	Activity- Interfacing IR Sensor and Servo Motor with Arduino
09 Min	Reflection and Learnings

Icebreaker (5 mins):

Scatter yourselves around the classroom and close your eyes once you have found your spot. The teacher will go around and tap one person on their shoulder and that student must make a noise (animal noises for example). The rest of the student must now find out who made the noise.

What are Sensors?

A Sensor is a device or part that can be used to measure the physical properties of our surroundings. Sensors are like Eyes, Ears, and hands for our Electronic system. It helps our Electronic system to sense Physical parameters and act accordingly. With the advancement in technology, there is tremendous growth in the type and number of sensors in the market. It is necessary as an Engineer or Enthusiast to be aware of the types of sensors available in the market. In this class, we have compiled the list of sensors that you need to be aware of and can use for your next projects.

What is LDR?

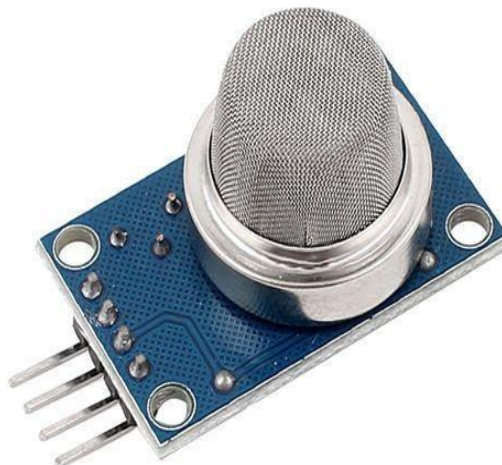
Light Dependent Resistor is a type of resistor that changes its resistance values when light is incident on it. This LDR exhibits high resistance when there is no light or darkness in the atmosphere and gives low resistance when there is a light incident on it or under bright conditions. The resistance value usually depends on the type of LDR we choose. But usually, Resistance under Dark conditions will be in the range of 1. Mega Ohm and the range of 100 Ohms when there is a maximum intensity light incident on LDR.

Types of Sensors:

SMOKE SENSOR:

This type of sensor detects the smoke or any type of gas present in the atmosphere (depends on the type of sensor) and usually they indicate the smoke/gas presence by means of a change in output voltage. This type of sensor uses an Optical test or Ionization to detect the gas present in the atmosphere. In Optical testing, the sensor uses an Infrared beam to monitor the atmosphere and when smoke enters the sensor the IR beam gets scattered. The scattered IR beam alerts the sensor module and gives the corresponding output. In Ionization methods, chemicals are used inside the sensor that tends to react with smoke and other gases. A successful chemical reaction indicates the presence of Smoke and therefore alerting the user by giving corresponding output.

Commonly used: MQ-5



COLOR SENSOR:

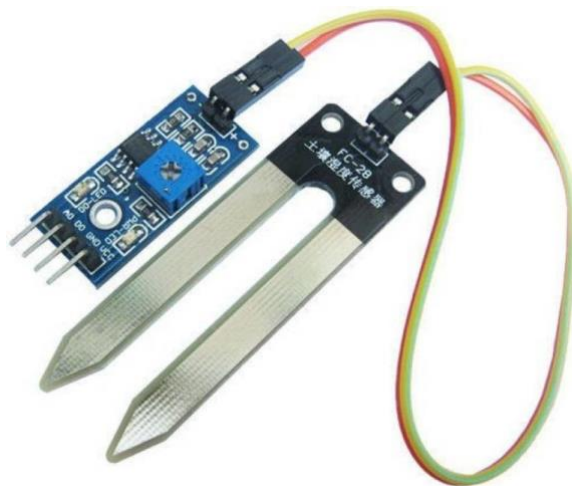
This type of sensor is used to detect the colors around the surroundings. This sensor basically works by lighting up the objects for color detection using LED's. Each color reacts to light differently. The reflected color from the object goes into an array of Photodiodes inside the sensor. These Photodiodes are covered with three different color filters R, G, B. Output current from these Photodiodes is used to obtain the RGB values of the color.

Commonly used: TCS3200



MOISTURE SENSOR:

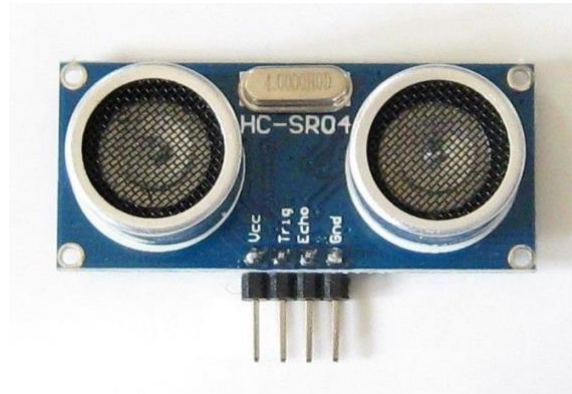
This is a common type of sensor used to measure the moisture present in the soil. This sensor uses the property of capacitance developed between two plates to measure the moisture present in the soil. This sensor measures the dielectric permittivity of the soil probed, which is the water content present in the soil. Upon measuring the dielectric permittivity, the sensor generates the voltage based on this. There is also a moisture sensor that applies a voltage between two electrodes and measures the resistance provided by the soil. The higher the water content, the less the resistance it offers to the current flow. Dry soil offers high resistance to the current flow. In this way, the sensor measures the amount of water content present in the soil.



ULTRASONIC SENSOR:

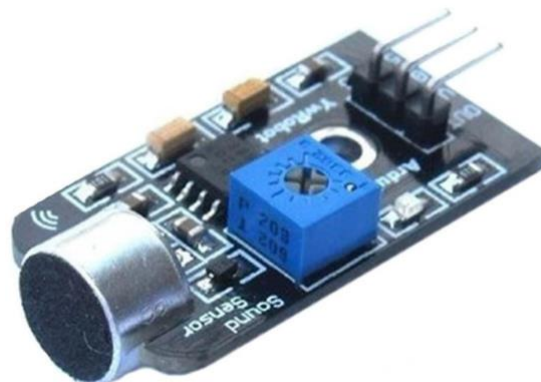
This sensor uses Ultrasonic waves as a medium to detect the distance or range. This sensor consists of an Ultrasonic wave transmitter that generates the wave. The transmitted wave bounces back by any medium or obstacle and returns to the sensor where it will be sensed by the receiver. Now the distance between the sensor and obstacle is calculated based on the time for the wave between transmission and reception. The further the obstacle is, the longer the time delay between transmission and reception.

Commonly used: HC-SR04



SOUND SENSOR:

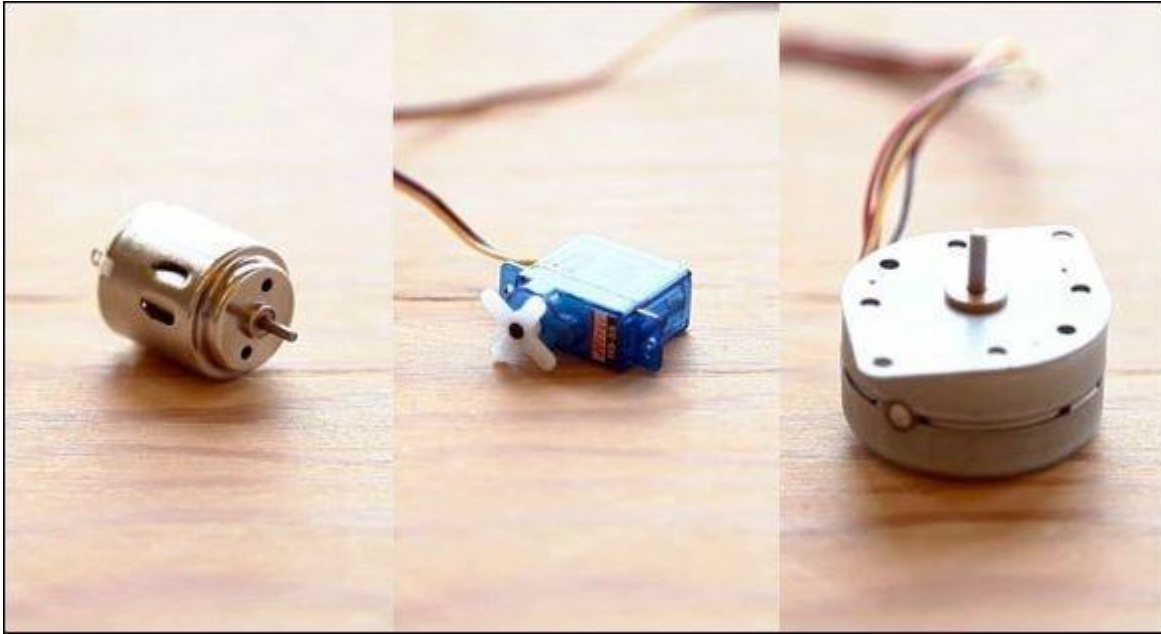
Popularly known as Microphone, this sensor converts sound to electrical signals. In a Microphone, when the sound waves hit the diaphragm, it vibrates based on the energy of the sound wave. This movement makes the coil attached to the diaphragm move back and forth as well. This coil was fixed around a permanent magnet so when the coil moves it produces an electrical signal proportional to the sound energy input. This sound energy is later amplified and used.



What is an Actuator?

An actuator is a component of a machine that is responsible for moving and controlling a mechanism or system, for example by opening a valve. In simple terms, it is a "mover". An actuator requires a control signal and a source of energy.

An actuator is a part of a device or machine that helps it to achieve physical movements by converting energy, often electrical, air, or hydraulic, into mechanical force. Common examples of actuators include electric motors, stepper motors, jack screws, electric muscle stimulators in robots, etc.



Different type of actuators

Working Principle

The basic working principle of electric linear actuators is to convert the rotary motion into a linear motion. This conversion of motion is done with the help of a gearbox and a lead screw. These are the two most important electric linear actuator parts.

Common Actuators used in Arduino Projects

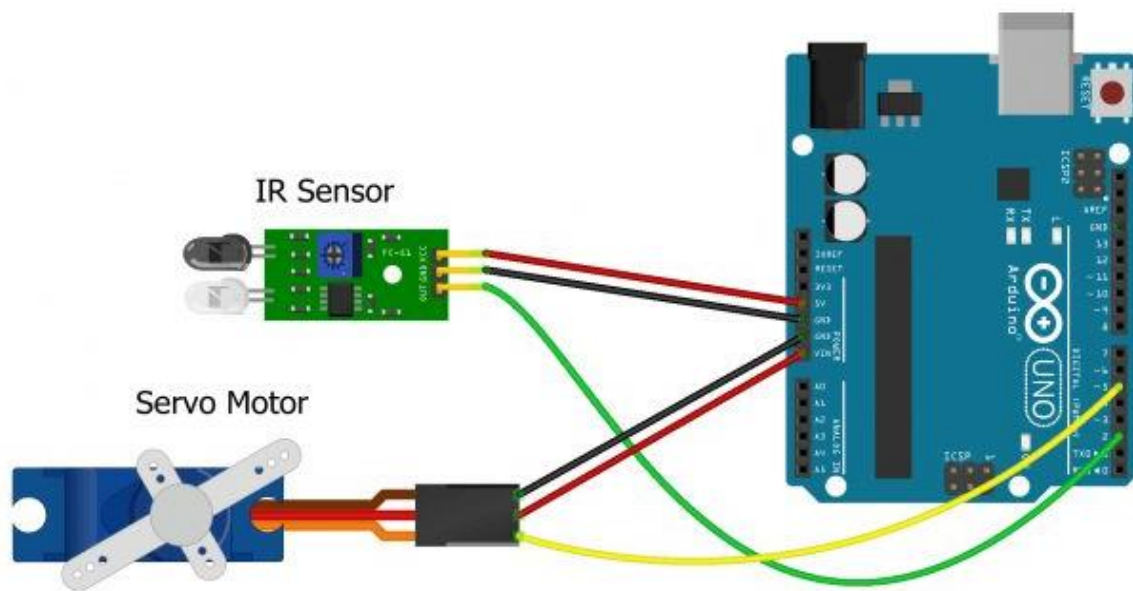
- DC Motor
- Gear Motor
- Servo Motor
- Stepper Motor

Activity: Interfacing IR Sensor and Servo Motor with Arduino

An actuator is a device that actuates something. In simple words, it produces motion. It helps other devices move and interact with their surrounding environment. The actuator takes in energy and uses it to help the device move. Servo motors and DC motors are types of electric actuators that control motors.

In this tutorial, we are going to see how to interface the servo motor to Arduino Uno and control it using an IR sensor

A servo motor, or simply, a servo is a rotary actuator that rotates or pushes parts of a machine to which it is connected, with precision. They rotate at a particular angle and then stop.



Step 1: Carefully do the connections as per the circuit diagram.

- First, connect the Servo to Uno.
- Connect the servo's brown wire to Uno's ground pin using a black male-to-male jumper cable.
- Next, connect the red wire to Uno's VIN pin using a red male-to-male jumper cable.
- Then, connect the orange wire to Uno's PWM pin 5 using a yellow male-to-male jumper cable.

Step 2: Now, let's connect the IR sensor to the Arduino Uno.

- Connect the sensor's VCC pin to Uno's 5V pin using a red male-to-female jumper cable.
- Next, connect the sensor's ground pin to Uno's ground pin using a black male-to-female jumper cable.
- Then, connect the sensor's out pin to Uno's digital pin 2 using a green male-to-female jumper cable. IR + Uno + Servo

Step 3: Connect Uno to the computer and Upload the code using Arduino IDE. Check the working of the program and try to move servo to 45 degrees.

Code :

```
/*
If Sensor detects any object Servo Motor will rotate 90 Degrees
*/

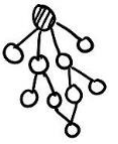
#include <Servo.h>
Servo Servopin;

int sensorpin=2;
int val=0;

void setup(){
  Servopin.attach(3); //Sevo signal pin connected to pin 3
}

void loop(){
  val = digitalRead(sensorpin); //Reading value from sensor
  if (val ==0){
    Servopin.write(90); //command for rotating 90 Degree
    delay(100);
  }
  else
  {
    Serv.write(0);
    delay(100);
  }
}
```

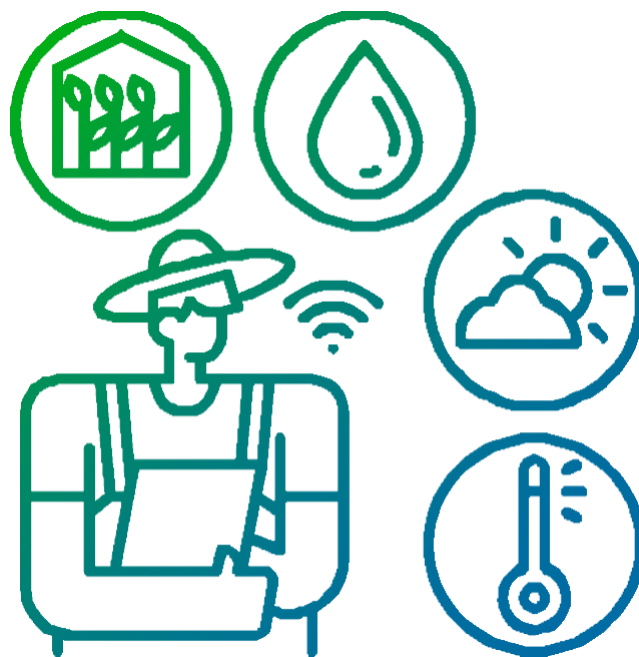
Reflection and Learnings (9 mins):



1. What do you think is the function of a microcontroller in an electronic circuit?
2. How will you apply these skills outside class?
3. What did you or your team struggle with while doing this activity and why? How can you improve next time?
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What communication challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings

INTERNET OF THINGS (IOT)





Introduction to IoT (05 mins):



What is IoT (Internet of Things)?

The Internet of Things, often referred to as IoT, are everyday objects that connect to the internet. These connected devices can be activated using voice commands, or controlled by downloading and using an app or via a Bluetooth or Wifi connection.

Examples of the Internet of Things include:

- Smart speakers
- Smart meters (for home electricity and water)
- Wearables such as smartwatches or fitness trackers

For Instance, Imagine you are going for a trip for a month and we need to monitor our plants? Do you think we can do that from our mobile app? Yes, we can build an IoT project with ESP32 microcontroller and a soil moisture sensor and this device will update live status of soil moisture level on your mobile app!



Image Source :<https://www.sap.com>

We can use Arduino based microcontroller boards like ESP8266, Nodemcu, ESP32 etc for experimenting with Internet of things.

Materials Required :

1. ESP32 Development Board
2. Breadboard
3. LED
4. 220 OHM Resistor
5. Male - Male Jumper Wires - 2 Nos



🕒 : 60 minutes

Module: IoT

Grade: 6th to 9th

Importance/ Value:

Our daily lives have become more connected than ever before. Internet-enabled devices can be found everywhere, from smart speakers to Bluetooth toothbrushes. So students will need to learn about building their own IoT projects and stay updated with the latest trends in Technology.

Learning Goals:

1. Learners will be able to understand the basics of ESP32 Programming
2. Learners will be able to do a basic LED blinking experiment in ESP32

Time	Description
01 Min	Check-in-Experience (CIE
05 Min	Icebreaker- What am I?
10 Min	Introduction to IOT and ESP32
35 Min	Activity - Blink LED using ESP32
09 Min	Reflection and Learnings

Icebreaker (5 mins):

What am I?

Modify the game of Pictionary by handing children sticky notes and letting them write down their favorite artist, movie, or athlete. Next, tell them to find a partner and to describe what they wrote down without using words. If their partner guesses correctly, the partner receives a point. If their partner guesses incorrectly, the actor receives a point. Have them find new companions three or four times.

Safety Measures:

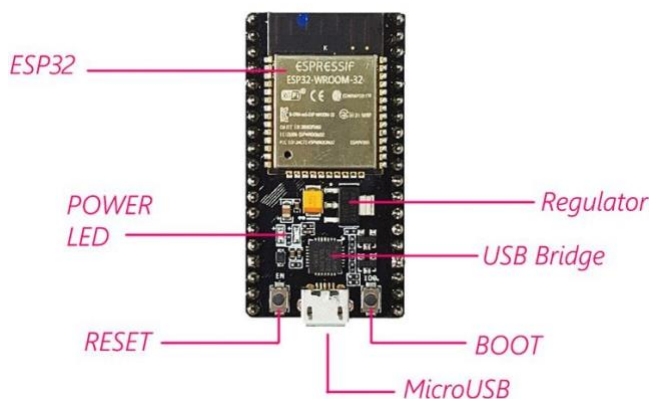


1. Never touch any electrical equipment wet hands.
2. Your work area must always be kept dry.
3. If you smell anything burning, immediately disconnect the power and examine your power supply to find out what went wrong.

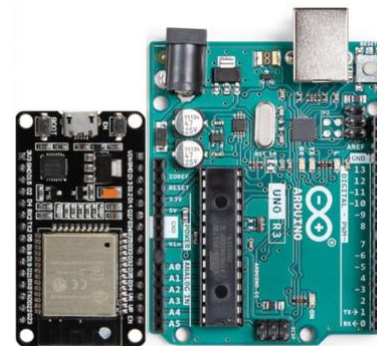


Hardware for IoT

ESP32 is a popular low-power microcontrollers with integrated Wi-Fi and Bluetooth, making it suitable for designing and prototyping IoT solutions. This module covers various basic tutorials and projects to start with ESP32 NodeMCU based IoT projects.



Source:<https://electropeak.com>



ESP32 **Arduino Uno**

Source:<https://linuxhint.com>

Introduction to ESP32 (05 mins):



ESP32 is a microcontroller development board like arduino uno which have inbuilt Wifi and bluetooth etc. It's mainly used for IoT projects because of its inbuilt wifi connectivity feature, we can connect ESP32 to nearby wifi hotspots and can communicate with remote devices in all over the world using the internet. We can program ESP32 using the same arduino IDE which we used for programming arduino Uno before.

In this module we are starting with LED blink using ESP32 board after that we will do sensor Integration and Mobile App Interfacing etc.

This session is divided into two parts

PART 1: Setup ESP32 development environment in Arduino IDE

PART 2: LED Blink using ESP32

Activity: Part1 : Setup ESP32 Development Environment in Arduino IDE

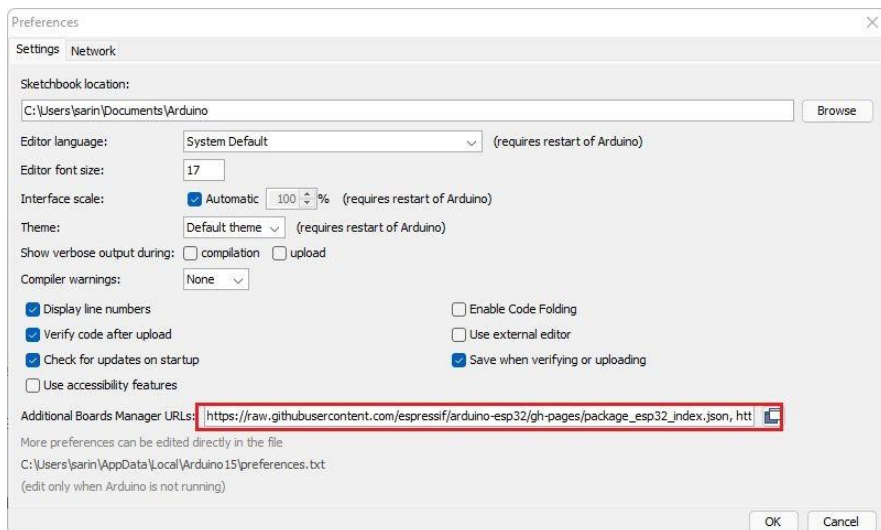
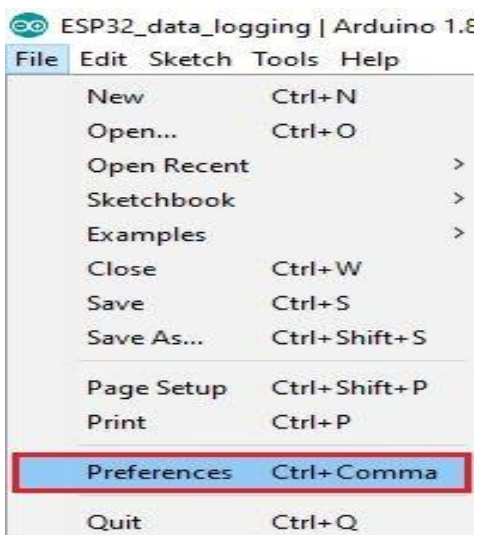
Software Required : Arduino IDE

Step 1: Download ESP32 Board Manager

To install the ESP32 board in your Arduino IDE, follow these next instructions

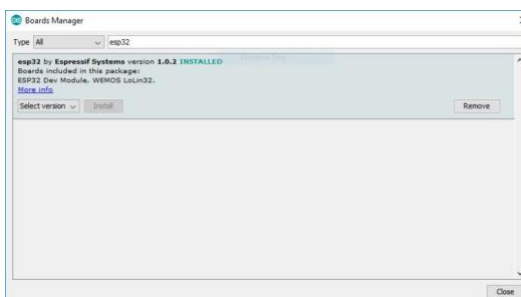
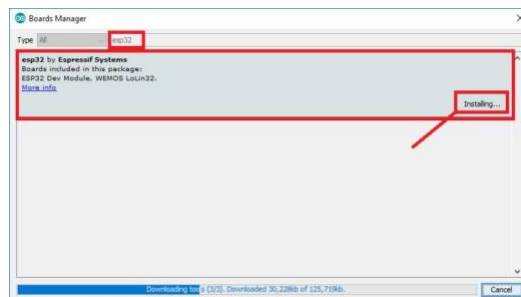
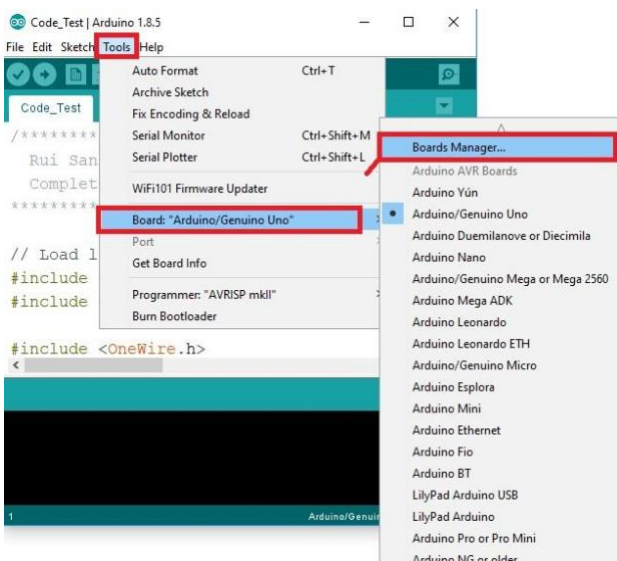


- In your Arduino IDE, go to **File > Preferences**
- Enter the following into the “**Additional Board Manager URLs**” field:
https://raw.githubusercontent.com/espressif/arduino-esp32/gh-pages/package_esp32_index.json Then Click **OK**



Step 2: Install ESP32 Board Manager

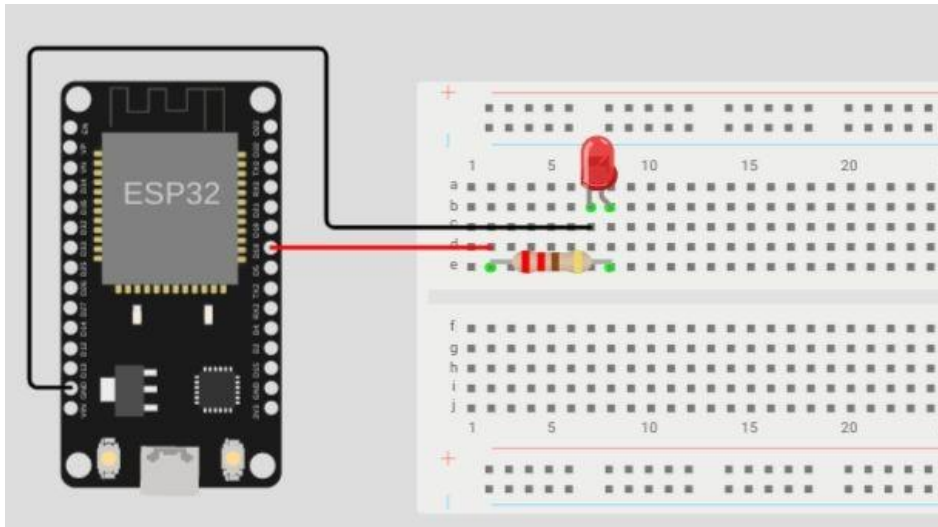
- Open the Boards Manager. Go to **Tools > Board > Boards Manager**
- Search for **ESP32** and press install button for the “**ESP32 by Espressif Systems**”:
- That’s it. It should be installed after a few seconds



Activity: Part1 2 : Blink LED using ESP32

Step 1: Connect LED and Resistor to the ESP32

Connect Anode of LED to Pin 18 of ESP32 through the resistor and Cathode of LED to GND of ESP32

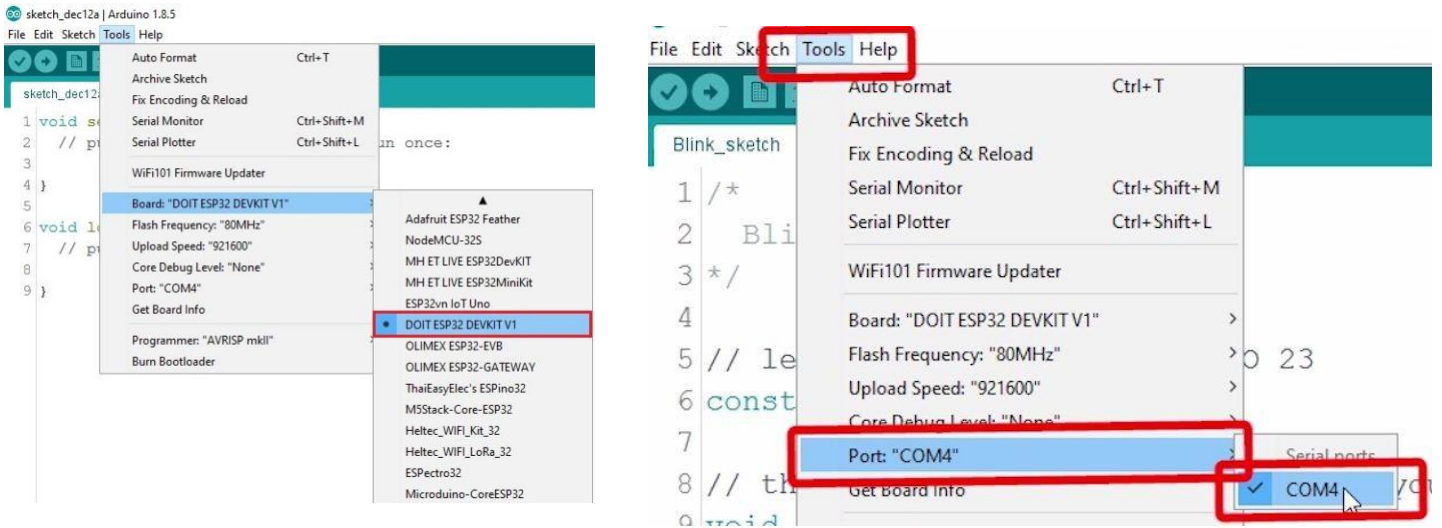


Step 2: Write the code in Arduino IDE

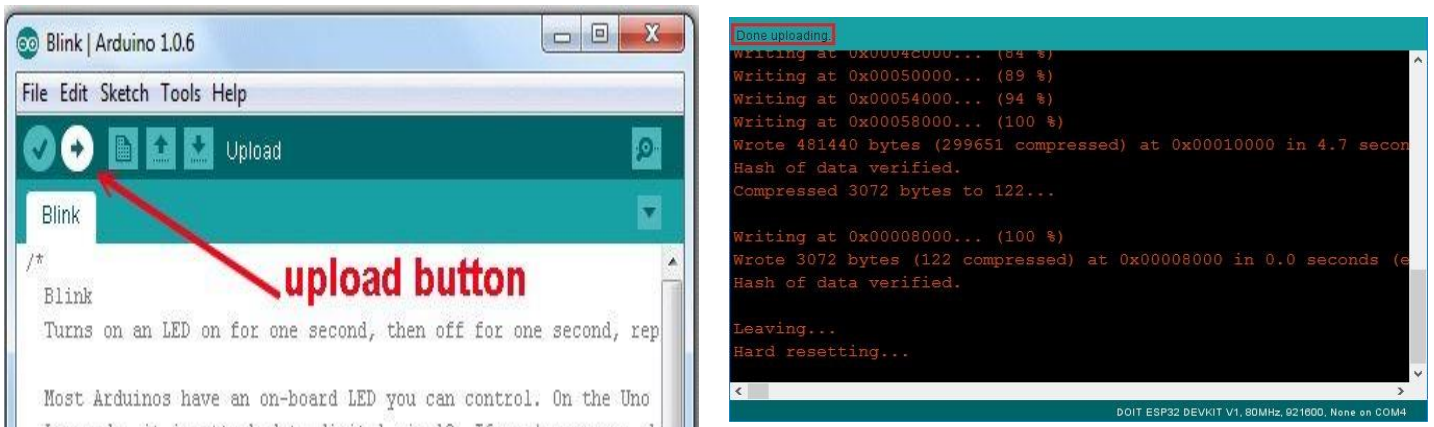
```
void setup() {  
  // initialize digital pin GPIO18  
  as an output.  
  pinMode(18, OUTPUT);  
}  
  
// the loop function runs over and  
over again forever  
void loop() {  
  digitalWrite(18, HIGH); // turn  
the LED on  
  delay(500);           // wait  
for 500 milliseconds  
  digitalWrite(18, LOW); // turn  
the LED off  
  delay(500);           // wait  
for 500 milliseconds  
}
```

Step 3: Select ESP32 Board & Port

- Select your Board in Tools > Board menu
- Select the Port



Step 4: Press the Upload button in the Arduino IDE. Wait a few seconds while the code compiles and uploads to your board ,if everything went as expected, you should see a “Done uploading.” message.



Then LED on the breadboard will blink in 0.5 seconds Interval , you can adjust the delay and pin number as we did in arduino uno.

Reflection and Learnings (9 mins):

1. How do you think you can use IoT in a real-world scenario?
2. What do you think are pros and cons of using IoT
3. Have you ever seen an IoT device? If yes, what is that?
4. What did you or your team struggle with while doing this activity and why? How can you improve next time?
5. How did you contribute to the team and how do you think it helped? How else could you have contributed?

Try it yourself!

Using the concepts you have learnt so far, Try creating a simple blinking LED circuit with multiple LEDs

Use the space to draw or write your reflections and learnings



Internet of Things

Session 2

Interfacing LDR with ESP32



Introduction to IoT (05 mins):



The main purpose of sensors is to collect data from the surrounding environment. Sensors, or 'things' of the IoT system, form the front end. These are connected directly or indirectly to IoT networks after signal conversion and processing. But all sensors are not the same and different IoT applications require different types of sensors.

One of the main functions of sensors that has the Internet of Things is the monitoring of the variables of an environment or the factors that determine success in the performance of an activity, such as the control of the operation of a machine in a company

Sensors are the important part of Internet of Things , we need to use sensors for different applications such as Temperature Monitor, Light Monitor, Human Presence Detection, Water Level detection etc .

Today we are going to use an LDR (Light Sensor) with ESP32



LDR Module have 4 Pins , they are

- 1)VCC - 5V
- 2)GND - GND
- 3)D0 - Digital Output
- 4)A0-Analog Output

We are going to use VCC,GND and Digital Output only now

Materials Required :

1. ESP32 Development Board
2. Breadboard
3. LED
4. 220 OHM Resistor
5. Male - Male Jumper Wires - 5 Nos
6. LDR Sensor Module
7. Software : Arduino IDE



🕒 : 60 minutes

Module: IoT

Grade: 6th to 9th

Importance/ Value:

Our daily lives have become more connected than ever before. Internet-enabled devices can be found everywhere, from smart speakers to Bluetooth toothbrushes. So students will need to learn about building their own IoT projects and stay updated with the latest trends in Technology.

Learning Goals:

1. Learners will be able to understand interfacing of the LDR with ESP32

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker
10 Min	Introduction to the Module
15 Min	LDR Interfacing with ESP32
20 Min	Activity

Icebreaker (5 mins):

Try not to smile or laugh

Have the children sit in a circle. Then explain that no one is supposed to smile or laugh except for one individual. Everyone must look at the kid smiling and laughing and keep a very straight face.

Start with a child and tell them to laugh and smile for 1 minute and see how many other people do so.

Now proceed around the circle until everyone has a chance to take and perform the challenge

Safety Measures:

1. Never touch any electrical equipment wet hands.
2. Your work area must always be kept dry.
3. If you smell anything burning, immediately disconnect the power and examine your power supply to find out what went wrong.



What is ESP 32:

The ESP32 is an advanced IoT microcontroller board possessing WiFi and Bluetooth Low Energy capabilities, as well as limited compatibility with the Arduino Core. ESP32 is a low-powered, low-cost microcontroller (MCU) board, with both Wifi and Bluetooth built in, and is based on a dual-core processor mechanism.

Due to its low-cost, multiple-component support design, built-in Wifi and Bluetooth and ready compatibility with Arduino and many other boards, ESP32 is becoming a fast popular choice for IoT projects.

Engineered for mobile devices, wearable electronics and IoT applications, ESP32 achieves ultra-low power consumption with a combination of several types of proprietary software. ESP32 also includes state-of-the-art features, such as fine-grained clock gating, various power modes and dynamic power scaling.

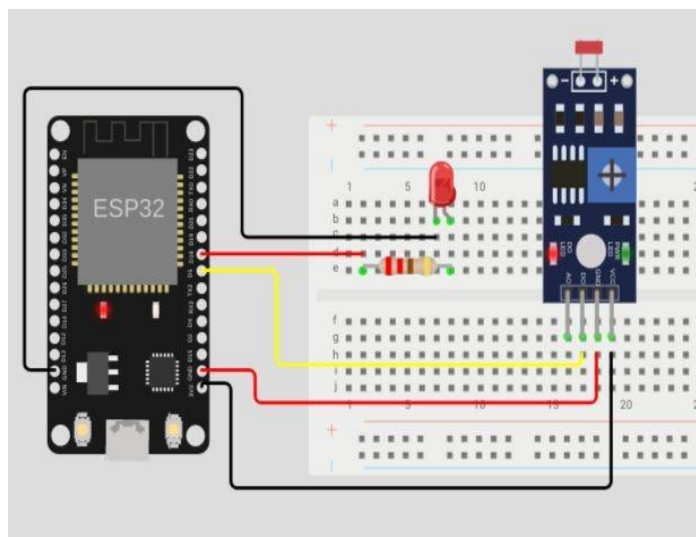
Activity: LDR Interfacing with ESP32:



Today we are going to create an automatic light using LDR module and LED , This light will turn on in night and turn off in day time.

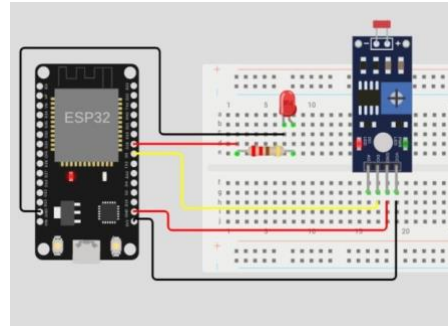
Steps:

Step 1: Place LDR, Resistor and LED as per the circuit diagram.



Step 2: Connect the circuit.

VCC of LDR Module - 3.3V of ESP32
GND of LDR Module -GND of ESP32
D0 of LDR Module - D5 of ESP32
Negative of LED - GND of ESP32
Positive of LED -220 OHM Resistor-D18 of ESP32



Step 3: Upload the following code to the ESP32 as you have done in the previous session.

```
void setup() {  
  // initialize digital pin GPIO18 as an output.  
  pinMode(18, OUTPUT);  
  pinMode(5, INPUT);  
}  
  
// the loop function runs over and over again forever  
void loop() {  
  if(digitalRead(5)==HIGH) //Check LDR module output  
  {  
    digitalWrite(18, HIGH); // turn the LED on  
  }  
  else  
  {  
    digitalWrite(18, LOW); // turn the LED on  
  }  
}
```

Conclusion:

Without light the LDR Module output(D0) will be LOW and in bright light D0 will be HIGH
We are reading output of LDR Module using **digitalRead** and checking the output using an **if** condition
If reading from LDR module is HIGH it will turn on the LED and if the reading in LDR module is LOW then the LED will be turned off



Reflection and Learnings (9 mins):

1. What is a Sensor?
2. How sensors plays an important role in IoT currently?
3. How can you identify on what terms the LED stays on and and goes off?
4. What do you think is the role of ESP32 in an IoT circuit?
5. What do you think is the difference between Artificial Intelligence and IoT?

Use the space to draw or write your reflections and learnings

Try it yourself!

Using the concepts you have learnt so far, Try creating a Street light system as shown in the image.





Introduction to IoT & Blynk(05 mins):

We already learned to connect sensors and LEDs with the ESP32 board now we need to experience real IoT use cases, today we are going to control an LED using mobile app from remote location.

We need a server for our project but now we are not setting up our own server instead of that we are going to use an IoT platform called Blynk

Blynk Mobile App

Blynk is a highly accessible smartphone-based application available for both Android and iOS operating systems. It provides an interactive dashboard where the user can build their own IoT projects by placing components. This will as a result create a mobile app through which the user will be able to control microcontrollers connected through WIFI. You can control LEDs, relays, electric motors and many more. No internal programming is required to build your project in Blynk. You only need to drag and place your electronic components and it is as easy as that. Thus, building your IoT projects through Blynk is extremely easy and requires very little effort




Source: <https://www.factoryforward.com/blynk-program-multiple-wifi-networks/>

Materials Required :

1. ESP32 Development Board
2. Breadboard
3. LED
4. 220 OHM Resistor
5. Male - Male Jumper Wires - 2 Nos



 : 60 minutes

Module: IoT

Grade: 6th to 9th

Importance/ Value:

With IoT, mobile apps can now interact with physical objects and devices. For example, a mobile app could be used to control a smart home device such as a thermostat or a security system. Or an app could be used to track the location of a person or object in real time. So it is important for the students to learn about building their own IoT projects and stay updated with the latest trends in Technology.

Learning Goals:

1. Learners will be able to learn about Blynk IoT Platform.
2. Learners will get hands on experience with IoT.

Time	Description
01 Min	Check-in-Experience (CIE
05 Min	Icebreaker- Snowball fight
10 Min	Introduction to IOT and Blynk mobile app
35 Min	Activity - Control LED using mobile app
09 Min	Reflection and Learnings

Icebreaker (5 mins):

Snowball fight

Have students write at least two identifying facts about themselves on a plain sheet of paper. Afterwards, everyone should gather in a circle, crumple their sheets of paper, and throw them in a pile inside the circle. Students should scramble to pick up a new paper and take turns reading the identifying characteristics. When someone recognizes his/her paper, they should raise their hand and elaborate on what they wrote.

Safety Measures:

1. Never touch any electrical equipment wet hands.
2. Your work area must always be kept dry.
3. If you smell anything burning, immediately disconnect the power and examine your power supply to find out what went wrong.



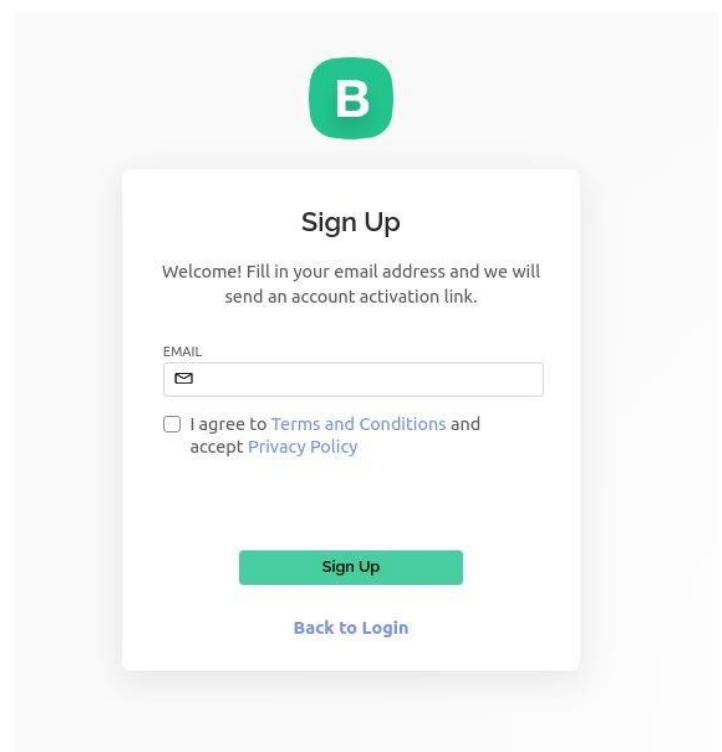
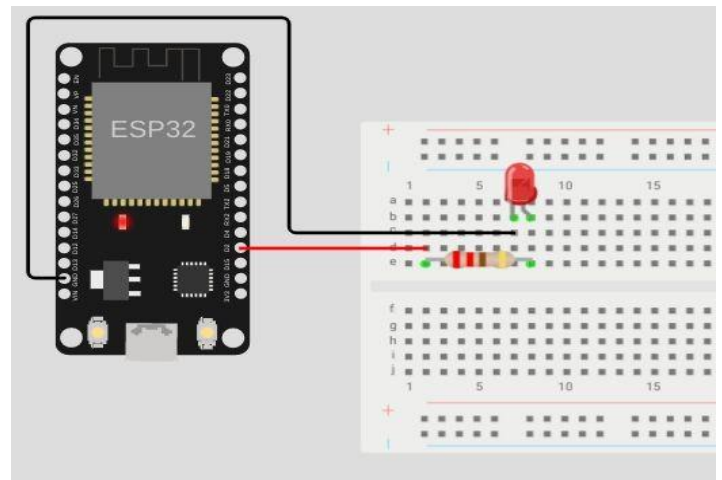
Activity: Control an LED using Mobile App

Software Required : Arduino IDE, Blynk Mobile App

Step 1: Place the LED and Resistor as per the circuit diagram.

Step 2: Connect the cathode of LED to GND of ESP 32 and Anode of LED to D2 Pin of ESP32 through a 220 OHM Resistor.

Step 3: Go to <https://blynk.cloud/dashboard/register> on your browser and create an account .



Step 4: After creating and account a window will open, Click on create new template.

Step 5: Click on New Template. Select a Template name, Select hardware as esp32, Select connection type as WiFi. Click on done.

After that the BLYNK_TEMPLATE_ID, BLYNK_DEVICE_NAME and AUTH_TOKEN will appear on screen. These will required while do programming in esp32.

Step 6: Create a Data stream.

Select DataStream tab
Click on New DataStream and select Virtual pin.
Enter a Name. Select the virtual pin V1, & select datatype be Integer.
Click on Create.

Start by creating your first template

Template is a digital model of a physical object. It is used in Blynk platform as a template to be assigned to devices.

[+ New Template](#)

Create New Template

NAME
myIoT

HARDWARE ESP32 CONNECTION TYPE WiFi

DESCRIPTION
This is my template

19 / 128

Cancel Done

TEMPLATE NAME myIoT

HARDWARE ESP32 CONNECTION TYPE WiFi

DESCRIPTION This is my template

19 / 128

TEMPLATE ID TmplHdzP0yyZ MANUFACTURER My organization 8348EJ

OFFLINE IGNORE PERIOD 00 hrs 00 mins 00 secs

HOTSPOT PREFIX Hotspot Prefix

myIoT

TEMPLATE IMAGE (OPTIONAL)
Add image
Upload from computer or drag-n-drop .png or .jpg, minimum width 500px

FIRMWARE CONFIGURATION
#define BLYNK_TEMPLATE_ID "TmplHdzP0yyZ"
#define BLYNK_DEVICE_NAME "myIoT"

Template ID and Device Name should be included at the top of your main firmware

Info Metadata **Datastreams** Events Automations Web Dashboard Mobile Dashboard

Datastreams

Datastreams is a way to structure data that regularly flows in and out from device. Use it for sensor data, any telemetry, or actuators.

[+ New Datastream](#)

Virtual Pin Datastream

NAME v1 ALIAS v1

PIN V1 DATA TYPE Integer

UNITS None

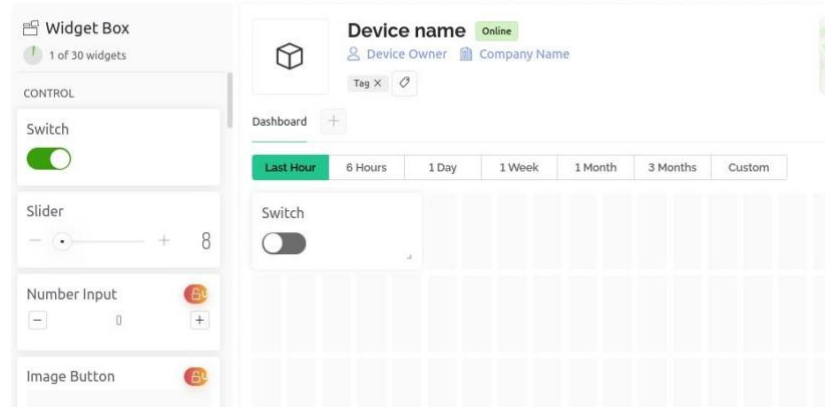
MIN 0 MAX 1 DEFAULT VALUE 0

[+ ADVANCED SETTINGS](#)

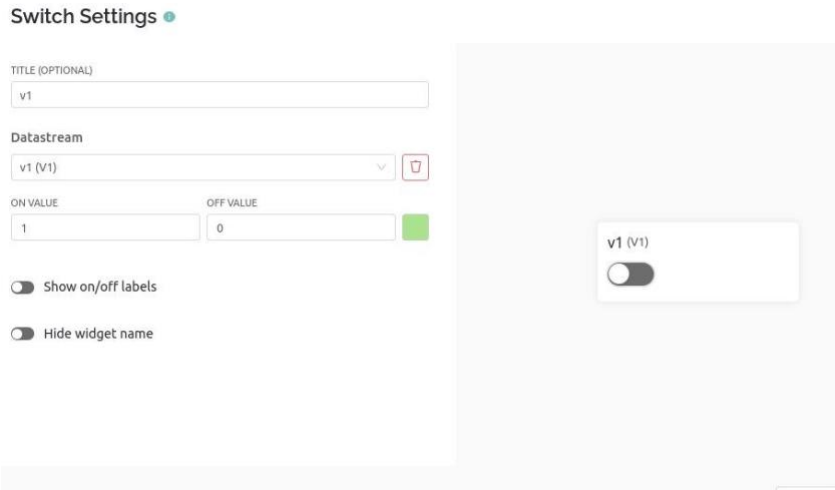
Cancel Create

Step 7: Setting up Blynk web Dashboard.

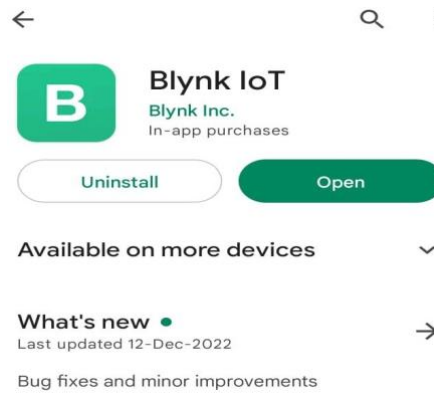
Go to Web Dashboard Drag and Drop Switch Widget



Go to Settings of Switch Widget and Select Data Stream

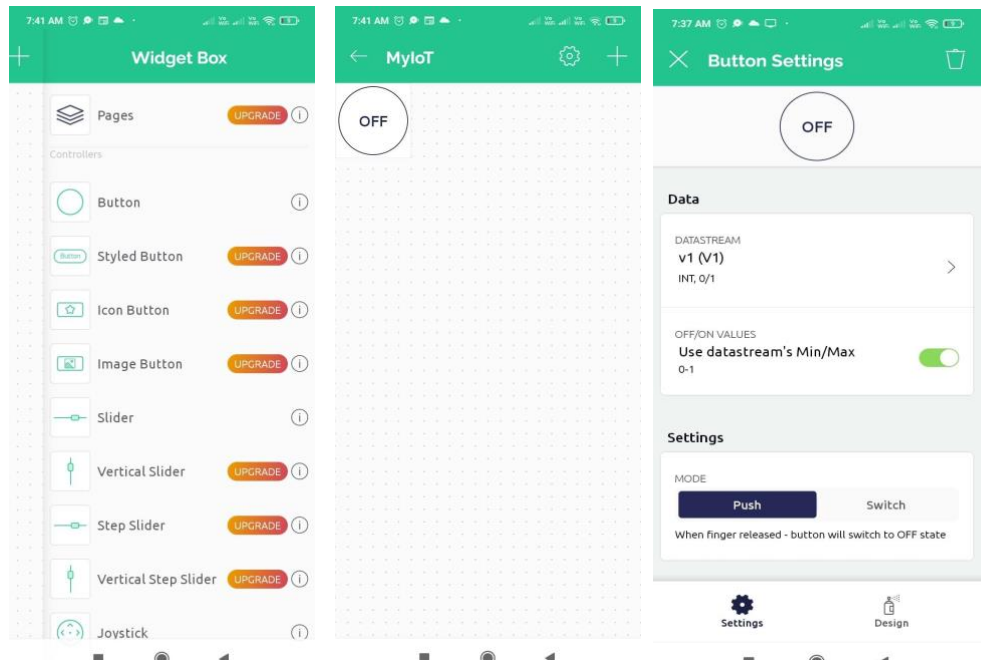


Step 8: Install Blynk IoT app from Play Store.



Download the blynk lot app from google play store.
Log in with the same account that you have created before.
Select developer option.
Select the template that you have created before.
Select the Hamburger button on the left side of your screen.
The widget box will open.

Select Button and Tap on Datastream and Select Datastream v1

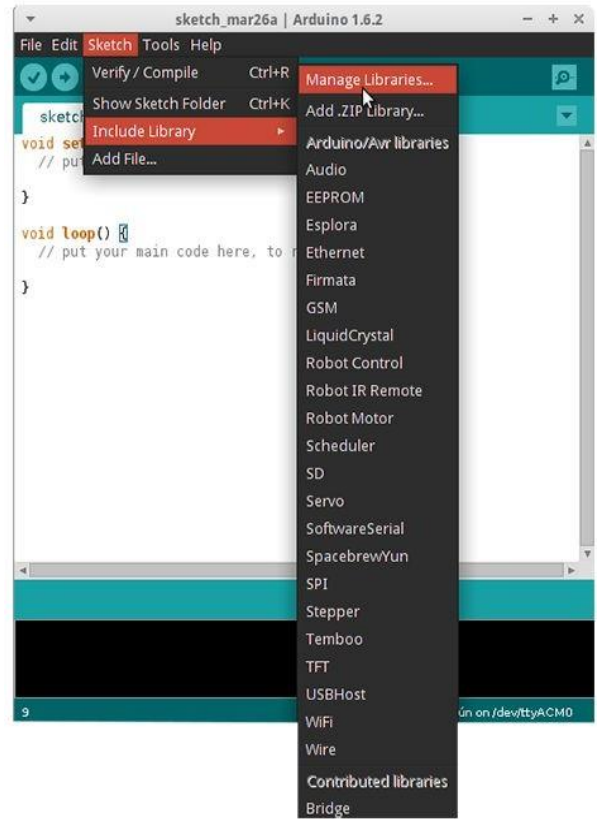


Step 9: Install Blynk Library in Arduino IDE

To install a new library into your Arduino IDE you can use the Library Manager (available from IDE version 1.6.2). Open the IDE and click to the "Sketch" menu and then Include Library > Manage Libraries.

Then the Library Manager will open and you will find a list of libraries that are already installed or ready for installation. Search for Blynk library and in the version selection choose the latest version to date

Finally click on Install and wait for the IDE to install the new library. Downloading may take time depending on your connection speed. Once it has finished, an Installed tag should appear next to the Blynk library. You can close the library manager.



Step 10: Code ESP 32

Note : We need to Copy paste TEMPLATE ID & DEVICE NAME from Blynk Dashboard

FIRMWARE CONFIGURATION

```
#define BLYNK_TEMPLATE_ID "TMPL5Qk88T_2"  
#define BLYNK_DEVICE_NAME "myIoT"
```

Template ID and Device Name should be included at the top of your main firmware

Code :

```
#define BLYNK_TEMPLATE_ID
"TMPLxxxxxx"
#define BLYNK_DEVICE_NAME
"Device"

#define BLYNK_FIRMWARE_VERSION
"0.1.0"

#define BLYNK_PRINT Serial
//#define BLYNK_DEBUG

#define APP_DEBUG

#include "BlynkEdgent.h"
BLYNK_WRITE(V1)
{
  int pinValue = param.asInt(); // assigning
incoming value from pin V1 to a variable
digitalWrite(2,pinValue);//LED Connected to
pin2 (D2) of ESP32
}

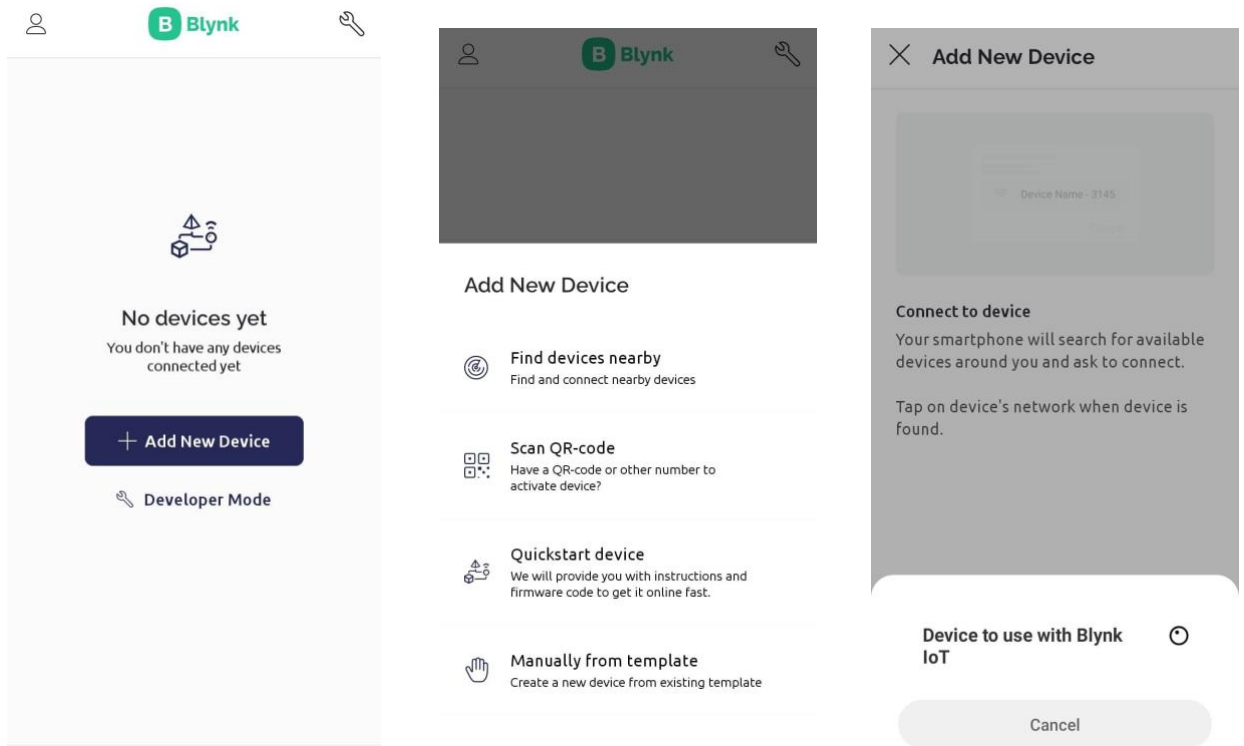
void setup()
{
  pinMode(2, OUTPUT);
  Serial.begin(115200);
  delay(100);

  BlynkEdgent.begin();
}

void loop() {
  BlynkEdgent.run();
}
```

Step 11: Upload the Code to ESP32 Board.

Step 12: Open Blynk IoT Mobile App and Add your ESP32 Device.



App will scan your nearby wireless devices and it will detect your ESP32 , you need to add that.

Step 13: Testing

We can Turn on and off LED using the button we have already created in mobile app

This is the simplest IoT project we can add more components and features in this project using the same Blynk App

Reflection and Learnings (9 mins):

1. What is the purpose of using a Blynk App in this activity?
2. What do you think is the difference between a smart bulb and a normal bulb?
3. What did you or your team struggle with while doing this activity and why? How can you improve next time?
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What communication challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings.



Introduction to IOT Plant Monitoring (10 mins):

IoT soil moisture sensors have become very popular nowadays as we constantly looking for unique solutions to solve global warming and food shortages. Integrating IoT sensors in agriculture for monitoring is crucial for our future

What is Soil Moisture Sensor ?


Soil moisture sensors are sensors that are able to sense the amount of moisture in the soil. By knowing the amount of moisture, we can translate the digital and analog data into a human language, to know whether the plants need more water or not. By incorporating such sensors you can make better decisions for your smart garden, irrigation system, or it-based solution. Traditionally, soil moisture sensors used to be analog. Over time, IoT-based soil moisture sensors became more popular with the ability to integrate cloud and database.



Materials Required :

1. ESP 32
2. Soil Moisture Sensor(Capacitive)
3. F-M Jumper Wires - 3
4. Plant Pot with Soil



 : 60 minutes

Module: IOT

Grade: 6th to 9th

Importance/ Value:

Data collected through plant monitoring helps us to ensure that common species remain common and that rare, threatened, and endangered species receive continued protection and assistance. Internet of Things technology is one such technology that is suitable for the smart plant monitoring system that enables the users to check the soil conditions as well, which may help to start a better growth of a plant.

Learning Goals:

1. Learners will be able to understand working of IoT sensors
2. Learners will be able to working of IoT soil moisture monitoring

Time	Description
01 Min	Check-in-Experience (CIE
05 Min	Icebreaker- Birthday lineup
45 Min	Activity - Plant Monitoring System
09 Min	Reflection and Learnings

Icebreaker (5 mins): Birthday lineup

Call out any month of the year and have all students born in that month come up to the front of the room. It is up to the students to decide who stands first, second, etc., so they are standing from the first day of the month to the last day of the month. Now call out another month (don't call the months in order), and have those students try to position themselves correctly by day and by where they should stand as an entire month. This is a great way to get kids working together and knowing each other. Once all of the kids have lined up, test them to see if they are correct.

Safety Measures:

1. Never touch any electrical equipment wet hands.
2. Your work area must always be kept dry.
3. If you smell anything burning, immediately disconnect the power and examine your power supply to find out what went wrong.

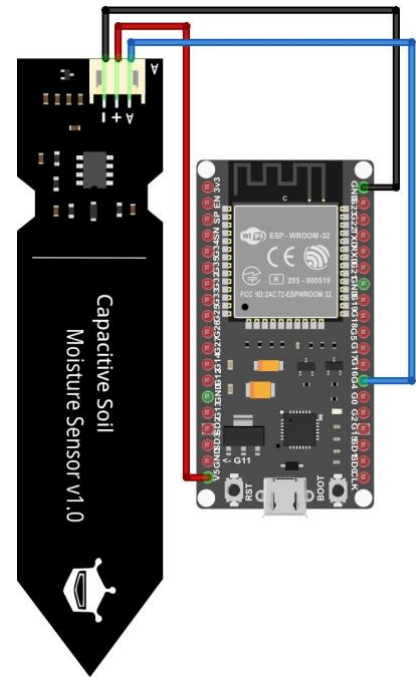


Activity: Plant monitoring



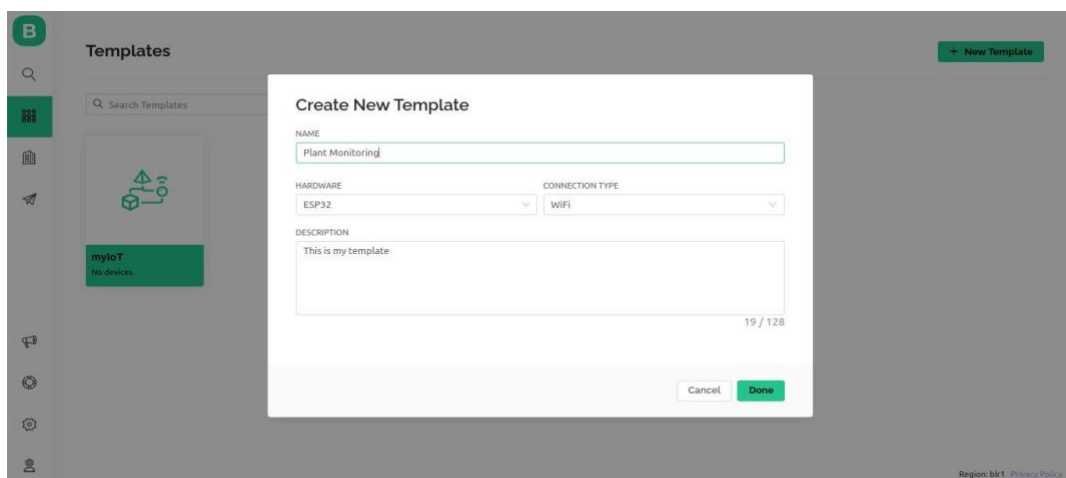
We are going to build a live soil moisture monitoring project , we can monitor soil moisture levels of a remote plan in our computer dashboard

Step 1: Connect soil moisture sensor and ESP32 as per circuit diagram.

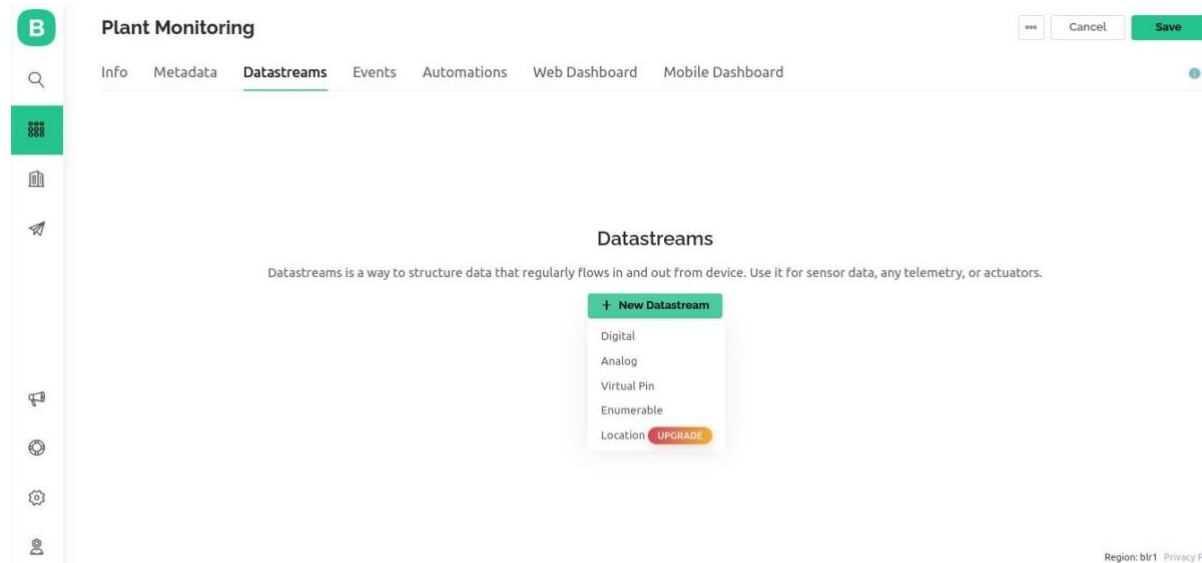
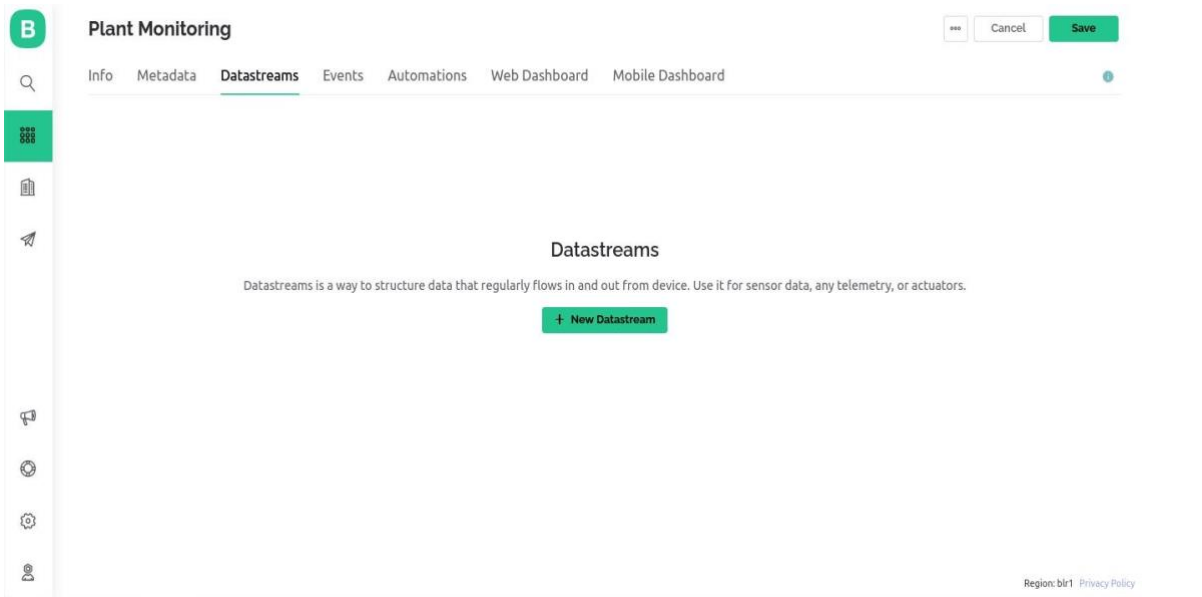


Step 2: Login to <https://blynk.cloud/dashboard/login> using the account we already created for previous activity (Control LED using Mobile App)

Step 3: Go to the templates tab and click New Template and give a name for template (Plant Monitoring), Hardware(ESP32), Connection Type (WiFi).



Step 4: Go to Data Streams, Click New Data Stream and Create Virtual Pin.



Step 5: Create a Virtual Pin with following details

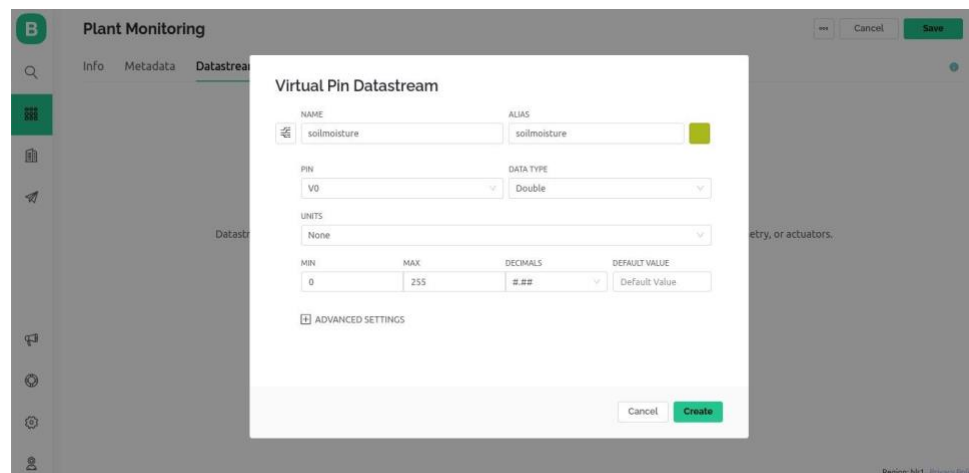
Name: soilmoisture (we can give any name)

Pin: V0

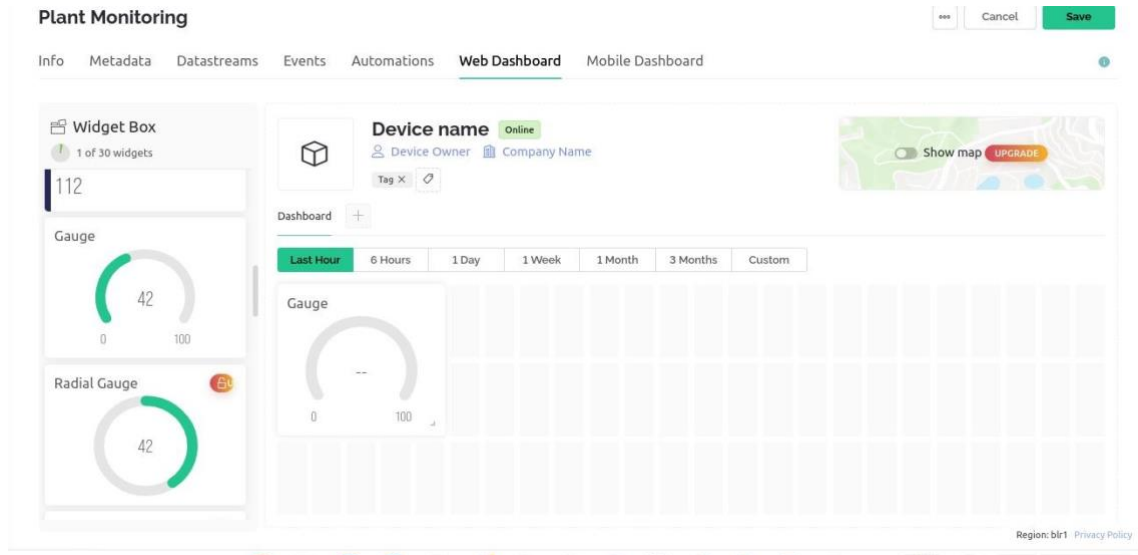
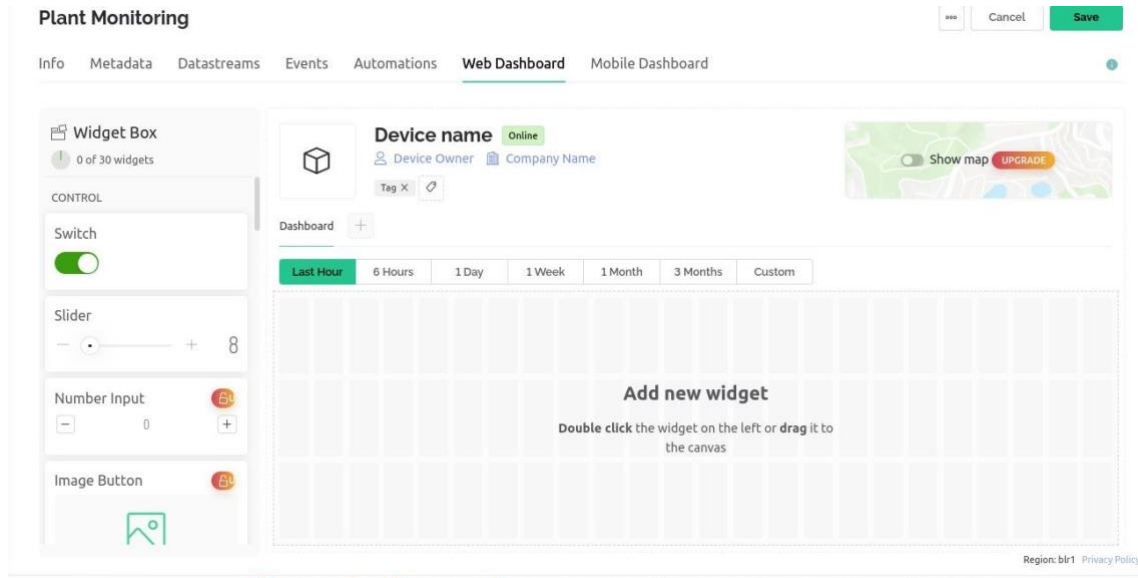
Data Type : Double

Min: 0

Max :255

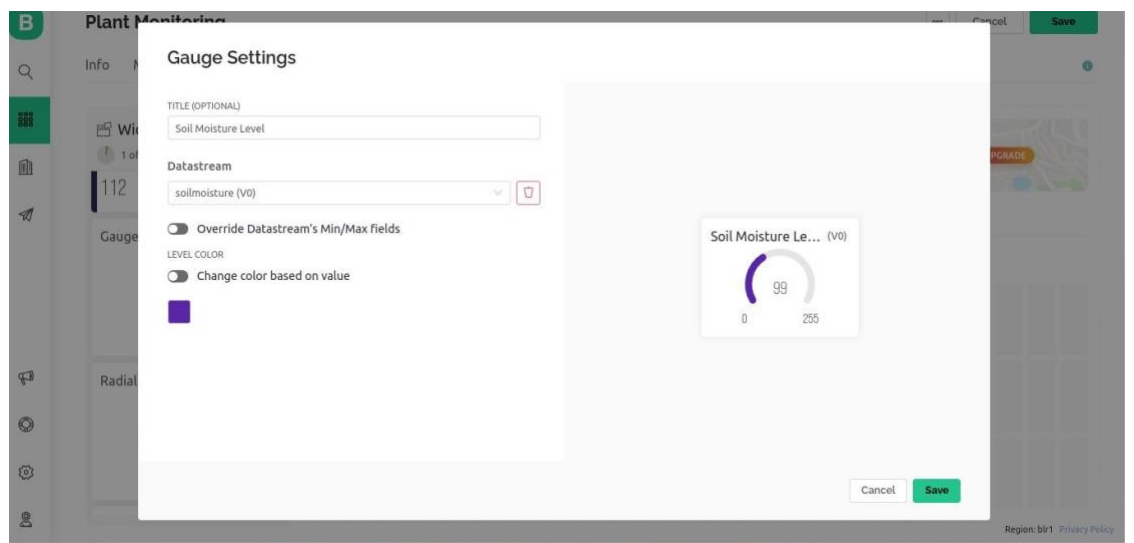


Step 6: Go to the Web Dashboard and insert Gauge Widget

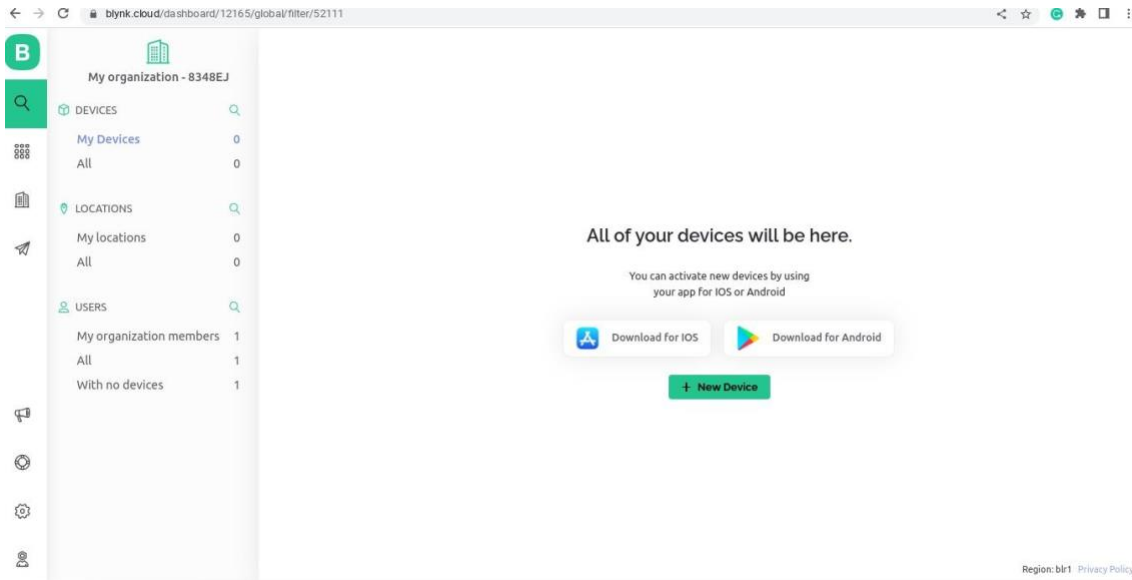


Step 7: Go to Gauge Settings and change name, then select virtual pin V0

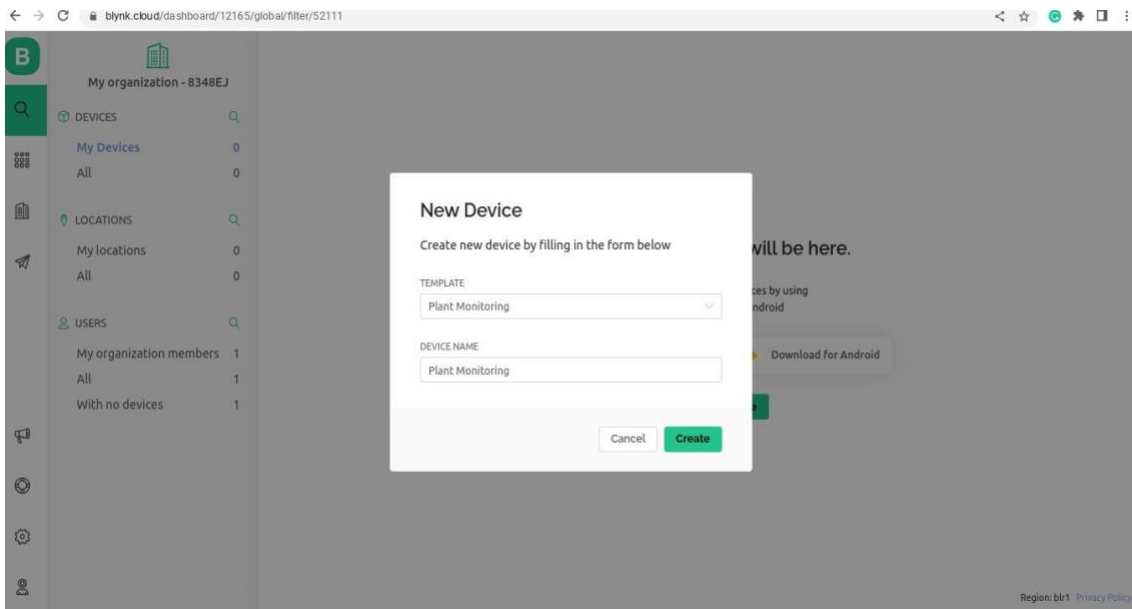
And Click on "Save"



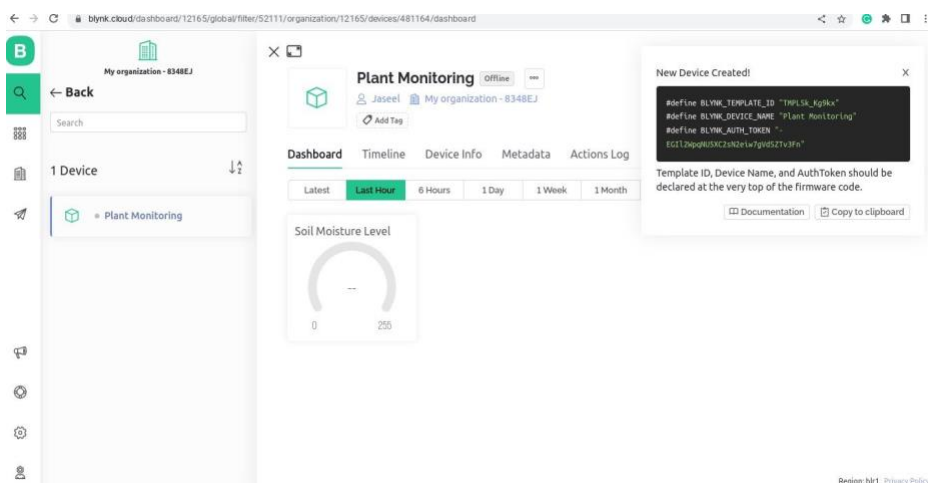
Step 8: Go to the search option and click on the New Device.



Select the template we have already created (Plant Monitoring) and click on create



Step 9: Copy the Template ID, Device Name and Auth Token.



Step 10: Open Arduino IDE and Enter the code given below and upload.

Note : Change Template ID, Device Name and Auth Token
Change SSID and Password of your Wifi hotspot

```
//IoT Plant Monitoring
//Copy paste your Template
ID, Device Name and Auth Token
#define BLYNK_TEMPLATE_ID ""
#define BLYNK_DEVICE_NAME ""
#define BLYNK_AUTH_TOKEN ""

#define BLYNK_PRINT Serial
#include <WiFi.h>
#include <BlynkSimpleEsp32.h>

char auth[] = BLYNK_AUTH_TOKEN;
char ssid[] = ""; // type your
wifi name
char pass[] = ""; // type your
wifi password

BlynkTimer timer;

void sendSensor()
{
    float soilmoisture =
analogRead(34);
    Blynk.virtualWrite(V0,
soilmoisture);
}
void setup()
{
    Serial.begin(115200);

    Blynk.begin(auth, ssid, pass);
    timer.setInterval(100L,
sendSensor);
}
void loop()
{
    Blynk.run();
    timer.run();
}
```

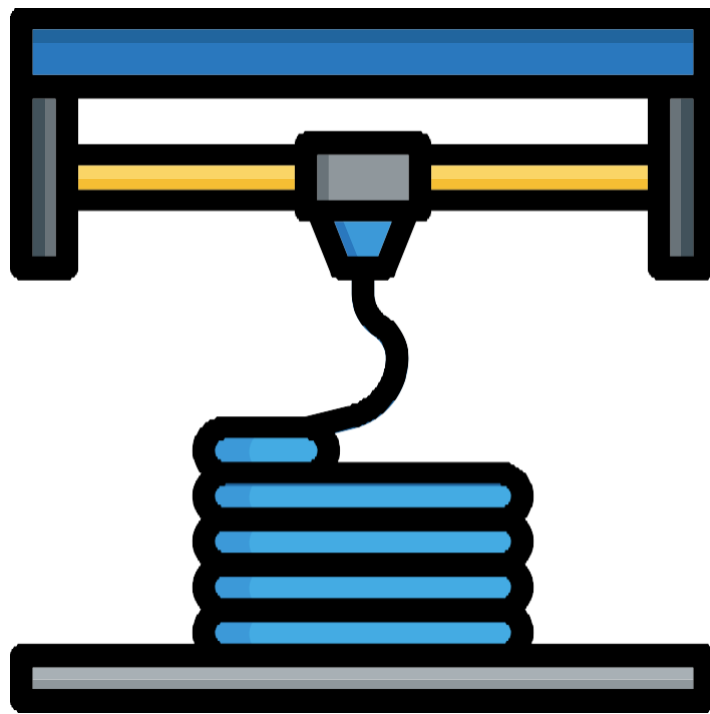
Step 11: Open Blynk web dashboard then you can see the real time value of soil moisture

Reflection and Learnings (9 mins):

1. Share at least 3 skills or lessons that you learned today.
2. How will you apply these skills outside class?
3. What do you think is the difference between a Moisture Sensor and a UV Sensor?
4. How did you contribute to the team and how do you think it helped? How else could you have contributed?
5. What communication challenges did you and your team face? How can your team communicate better next time?

Use the space to draw or write your reflections and learnings

3D DESIGNING & PRINTING





Introduction to Levers



🕒 : 60 minutes

Module: 3D Design and Printing

Grade: 6th to 9th

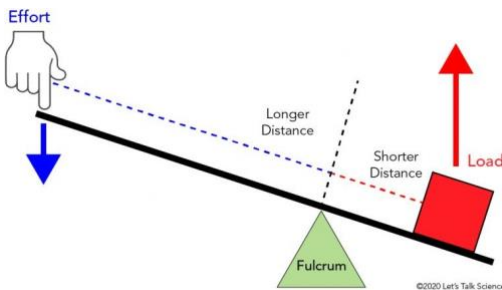
Importance/ Value:

3D Printing and Design allows children to think, visualize their imaginative concepts and create prototypes on their own. It also enables the children to understand the basic design concepts while differentiating between 2D and 3D images.

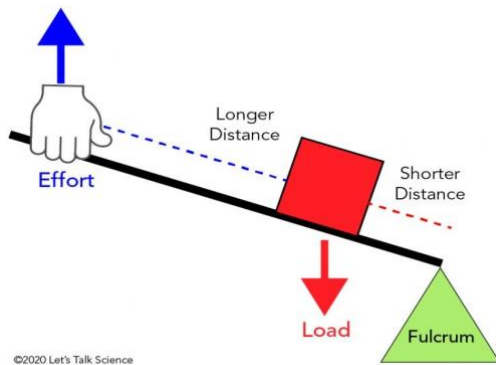
Learning Goals:

1. Learners will be able to understand the basic concepts of 3D design.
2. Learners will explore and learn to use a simple 3D design software called Tinkercad.
3. Learners will design and 3D print a spanner exploring the possibilities of 3D Printing.

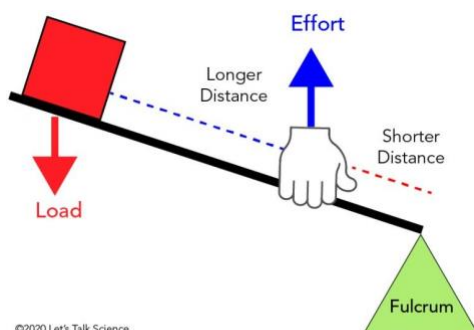
A lever is a simple machine made of a rigid **beam** and a **fulcrum**. The **effort** (input force) and **load** (output force) are applied to either end of the beam. The fulcrum is the point on which the beam **pivots**. When an effort is applied to one end of the lever, a load is applied at the other end of the lever. This will move a mass upward. Levers rely on **torque** for their operation. Torque is the amount of force required to cause an object to rotate around its **axis** (or pivot point).



First class: In a first class lever, the fulcrum is located between the load and the effort.



Second class: In a second class lever, the load is located between the effort and the fulcrum.



Third Class: In a third class lever, the effort is located between the load and the fulcrum.

Source: <https://letstalkscience.ca>

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker
10 Min	Introduction to module
35 Min	Activity
09 Min	Reflection and Learnings

Icebreaker (5 mins):

Play a beat!

Music brings people together and time for you to guess the song! Sit in a circle, Take turns whistling, tapping, or humming to the tune of a popular song and have your teammates guess the name. You can also play this game by dividing into two groups.

Materials Required :

1. Laptop with Internet Connection
2. 3D Printer



Safety Measures:



1. Put your 3D printer in an area which isn't easily accessible.
2. Wear gloves when handling your 3D printer.
3. Keep a mental note in your head that your 3D printer gets very hot.
4. Only reach for your printer when you are certain it's off.



Activity: Design a Spanner



In this activity you will learn how to use a 3D design software called TinkerCad and Design a simple 3D Spanner and 3D print it.

Step 1: Design the Ring

Step 1.1 - Divide and conquer: A key principle in 3D modeling is “divide and conquer.” It means that when modeling a complex real world object, we should divide it into smaller geometric shapes and then design these smaller units individually. In the final step, we should put these small units together. This makes modeling a complex object easy.

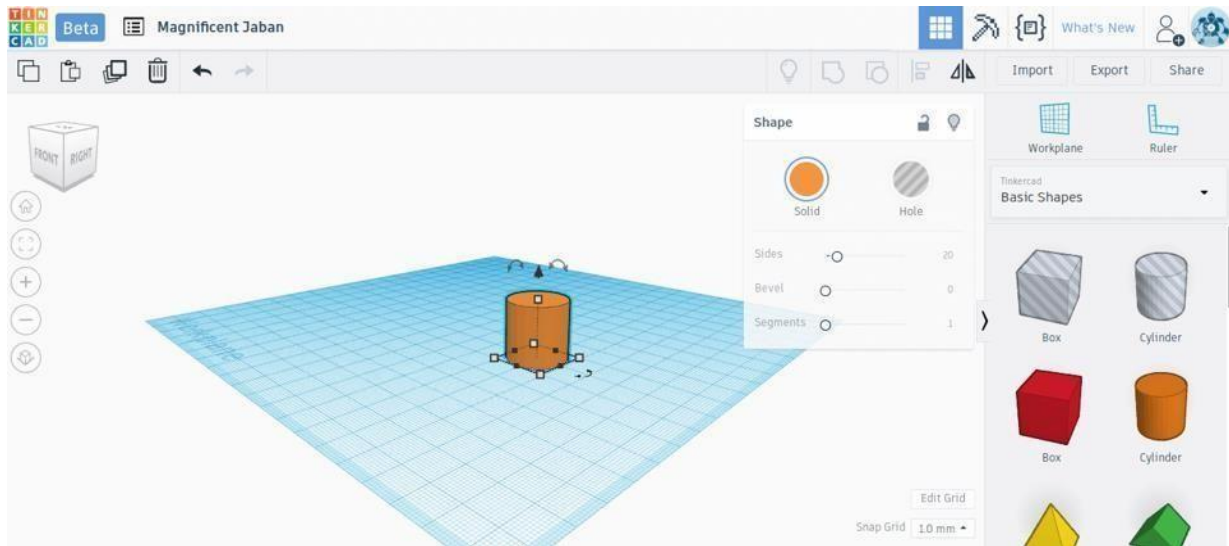
Applying this principle to the spanner, we divide it into three basic units:

1. The ring
2. The handle
3. The Jaw



The different parts of a spanner - the ring, the handle, and the jaw. We will start by designing the ring. The ring of a spanner can be approximated by a solid circular disk with a hollow circular area in the middle.

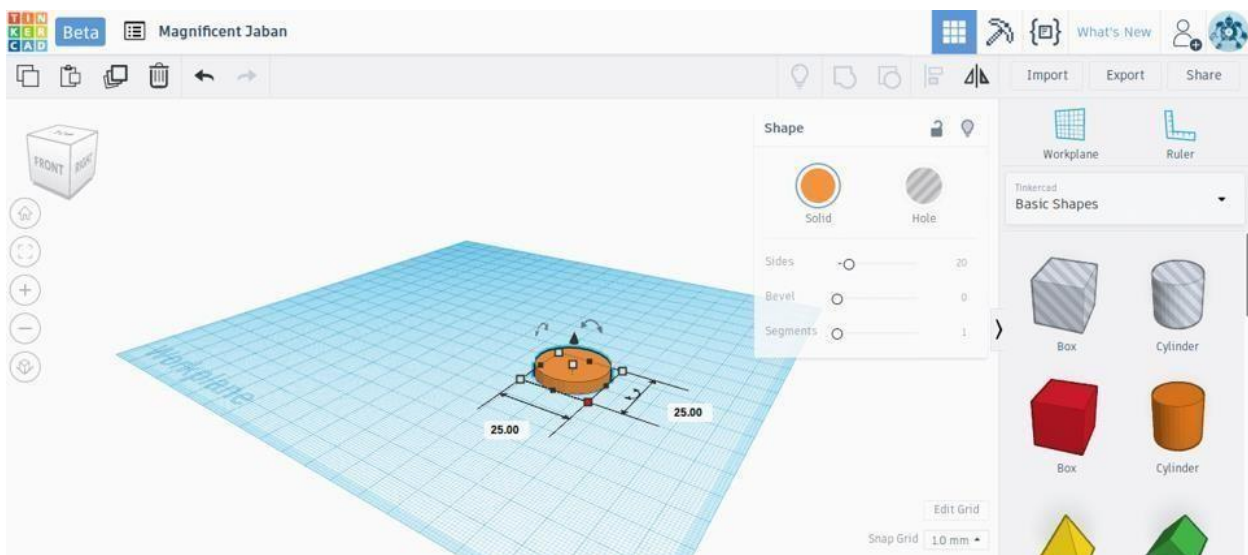
Step 1.2: Creating the solid circular disk - To create this shape, we will first drag a cylinder from the Basic Shapes panel to the workplane. You will notice that the cylinder has five white square handles, four of which are on the plane and one of which is above the cylinder.



The white handles let users change the dimension of a Tinkercad shape.

The four handles on the plane can be used for adjusting the cylinder's length and width. We want our ring to have a diameter of 25 mm. Therefore, drag the square handles till the cylinder has a length and width of 25 mm.

The one above the cylinder can be used for adjusting its height. We want our spanner to have a height of 4 mm. Therefore, click the handle with the left mouse button and drag it down till the cylinder has a height of 4 mm.



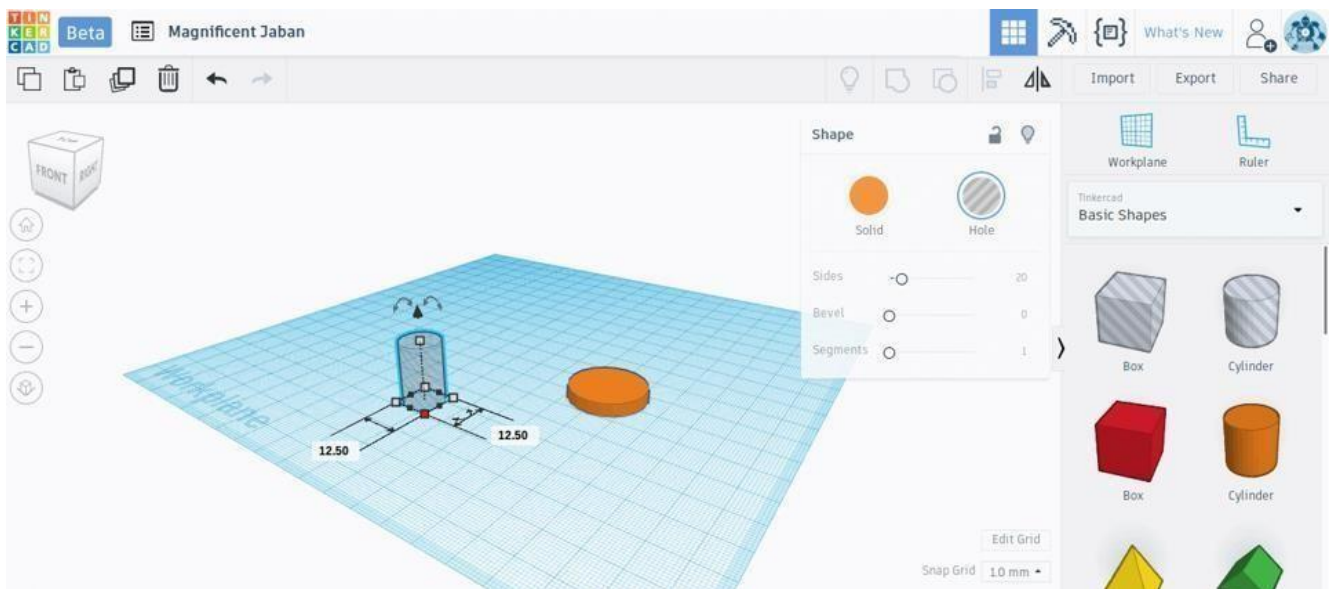
We changed the dimensions of the Tinkercad cylinder to make a disk with diameter 25 mm and height 4 mm.

We are making progress: We now have the solid disk. But how do we make the circular hole in the middle?

Tinkercad allows you to subtract objects to create hollow areas or add objects to join two shapes. In this case, we will need to use subtraction to create the circular hole in the middle of our ring. Let's see this in the next step below.

Step 1.3: Creating the circular hole - First, drag another cylinder to the workplane. Use the white handles on the plane to adjust the length and width of the cylinder to 12.5 mm, which is the diameter of the hole that we want to create.

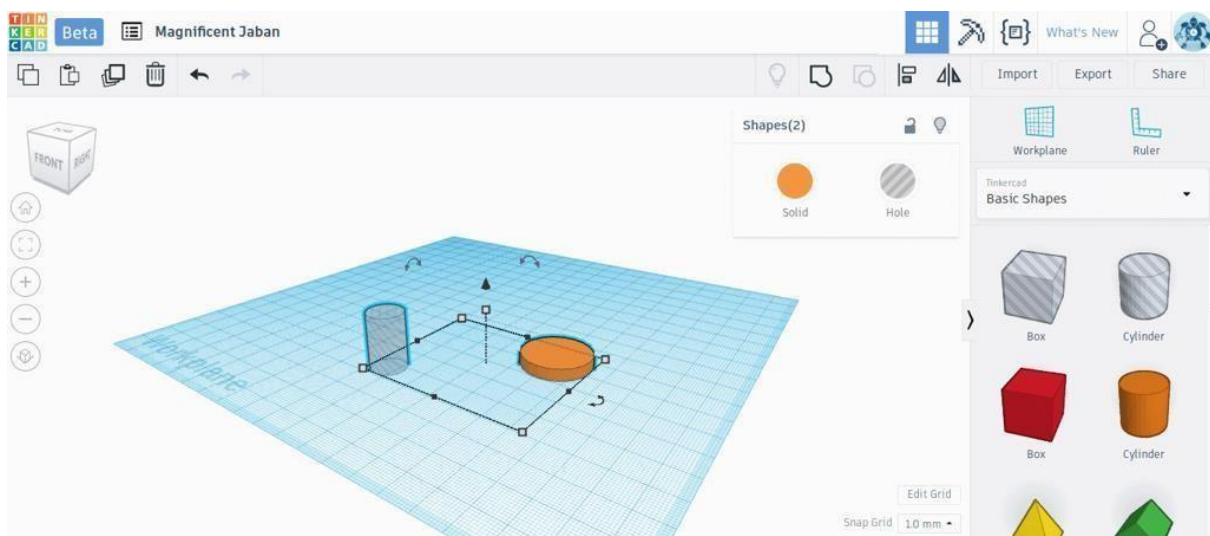
Now comes the fun part. With this cylinder selected, choose "Hole" in the panel on the upper right corner (marked by the blue rectangle in the image). This prepares this shape to be subtracted out.



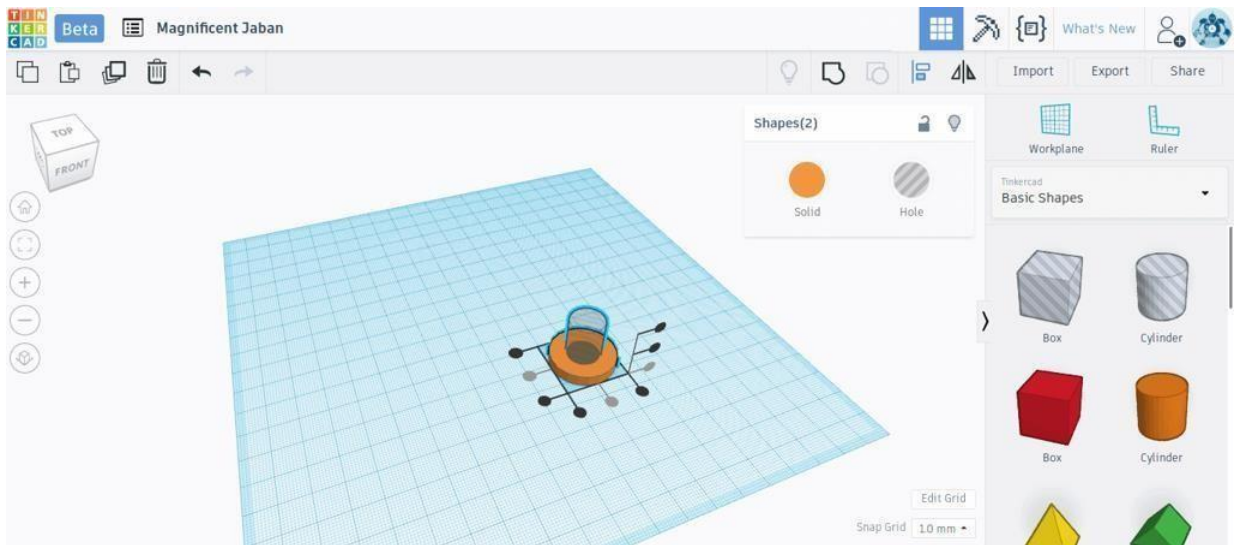
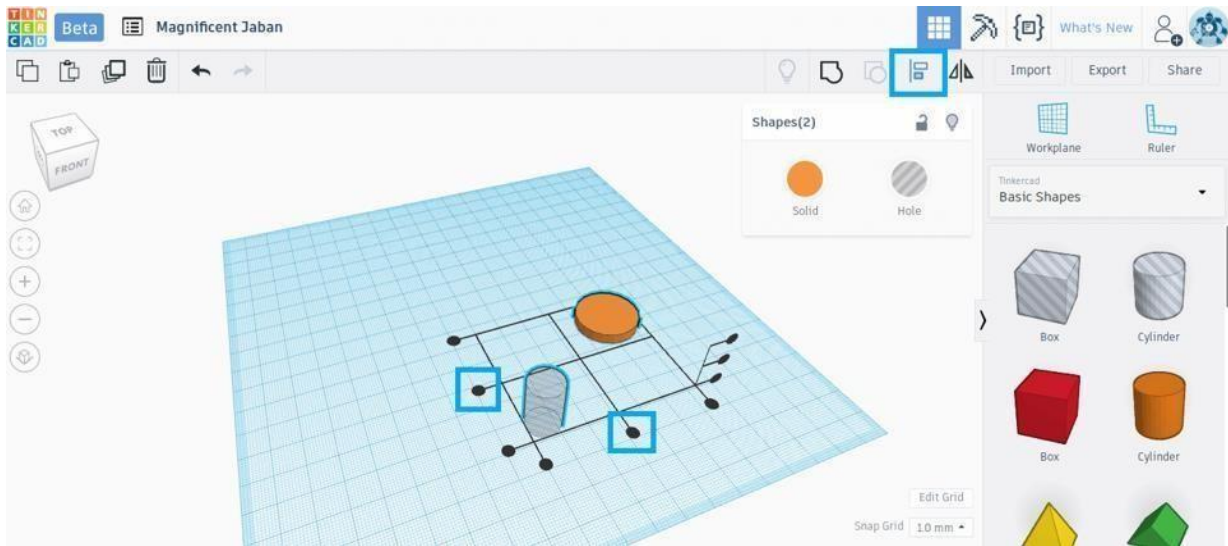
Step 1.4: Aligning the hole and the disk

Next, we need to bring this cylinder-shaped "hole" in the middle of the solid disk. We will use the alignment tool in the top menu to achieve this.

To use the alignment tool, select the cylinder-shaped hole by left-clicking. Now press the shift button and select the solid disk. If you do this correctly, you will see that both objects are now simultaneously selected and highlighted.



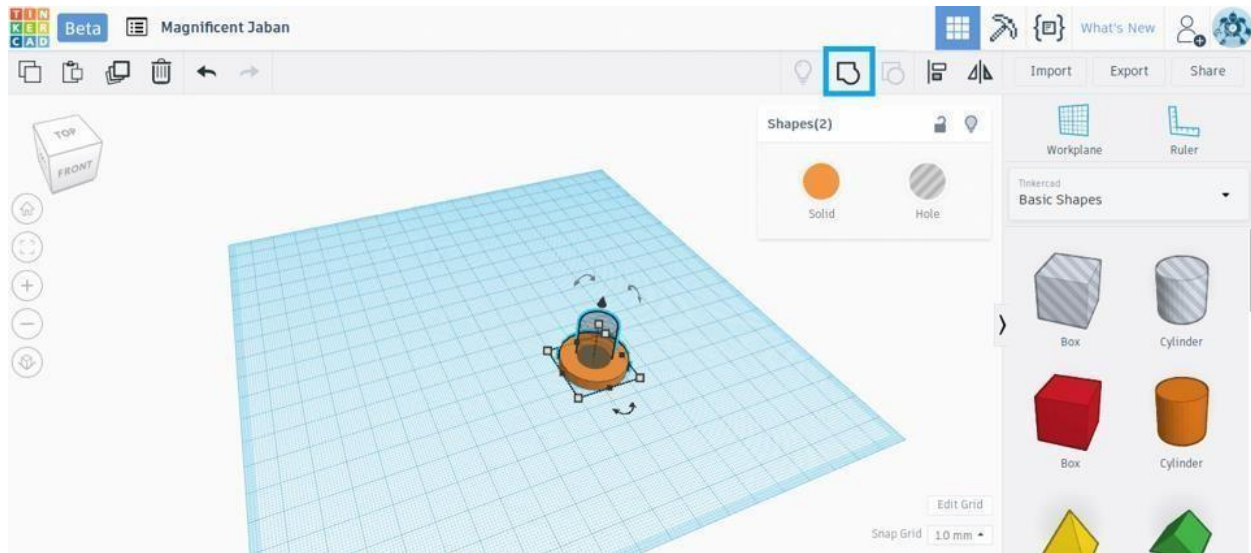
Press the Align button on the top menu (marked with a blue rectangle). Black alignment handles will appear on the workplane. Click on the appropriate handles (also marked with blue rectangles) to bring the solid cylinder in the middle of the solid disk.



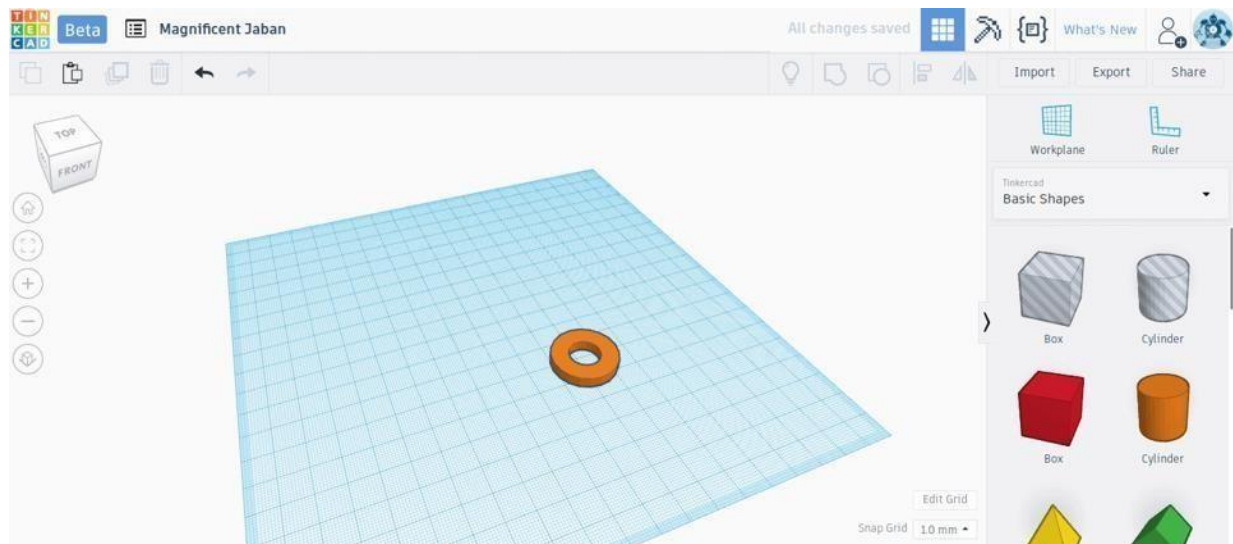
Note - The black alignment handles help align two shapes in Tinkercad.

Step 1.5: Grouping the cylinder shaped hole and the disk to create the ring

When the two shapes are aligned, press the “Group” button in the top menu (marked in the blue rectangle). The Group button essentially joins two shapes together. However, if one of the shapes is a hole, then it creates a hollow area instead.



Note - The Group button merges two Tinkercad shapes.



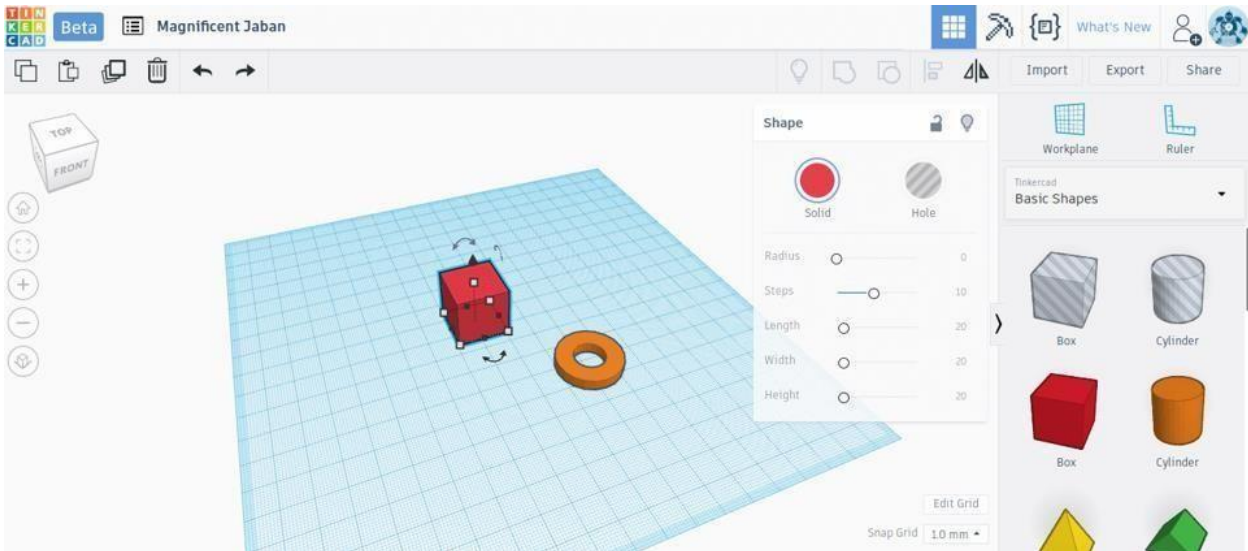
Great! We now have a beautiful ring and have finished the first part in creating our spanner.

Step 2: Design the Handle

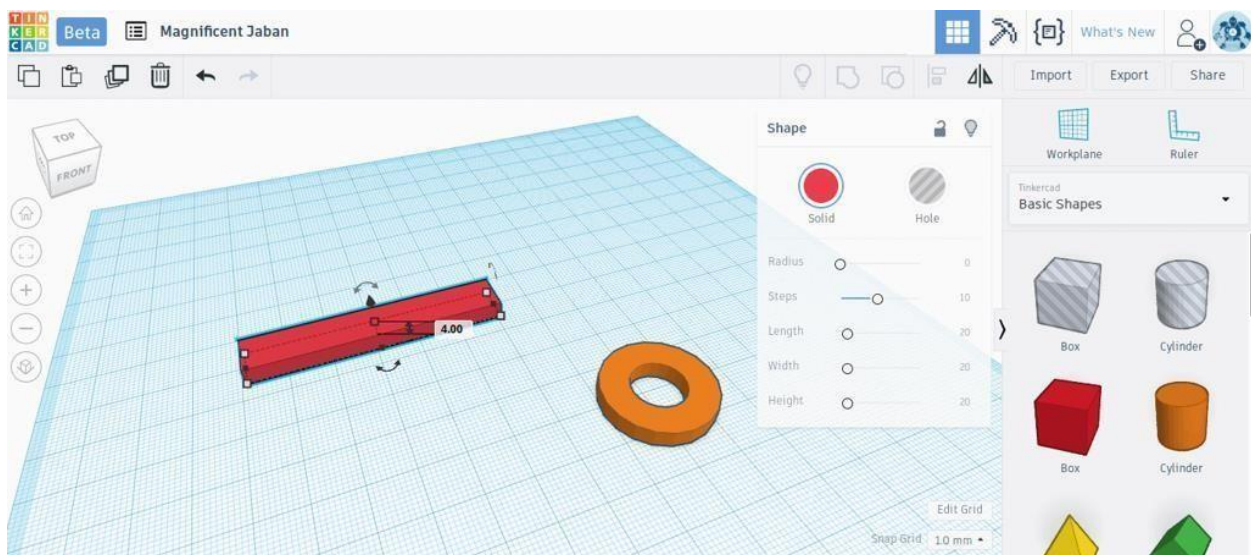
Step 2.1: Resize the Box Shape

The handle is probably the easiest part of the spanner.

The handle is rectangular. So we simply drag a box from the basic shapes panel into the workplane.



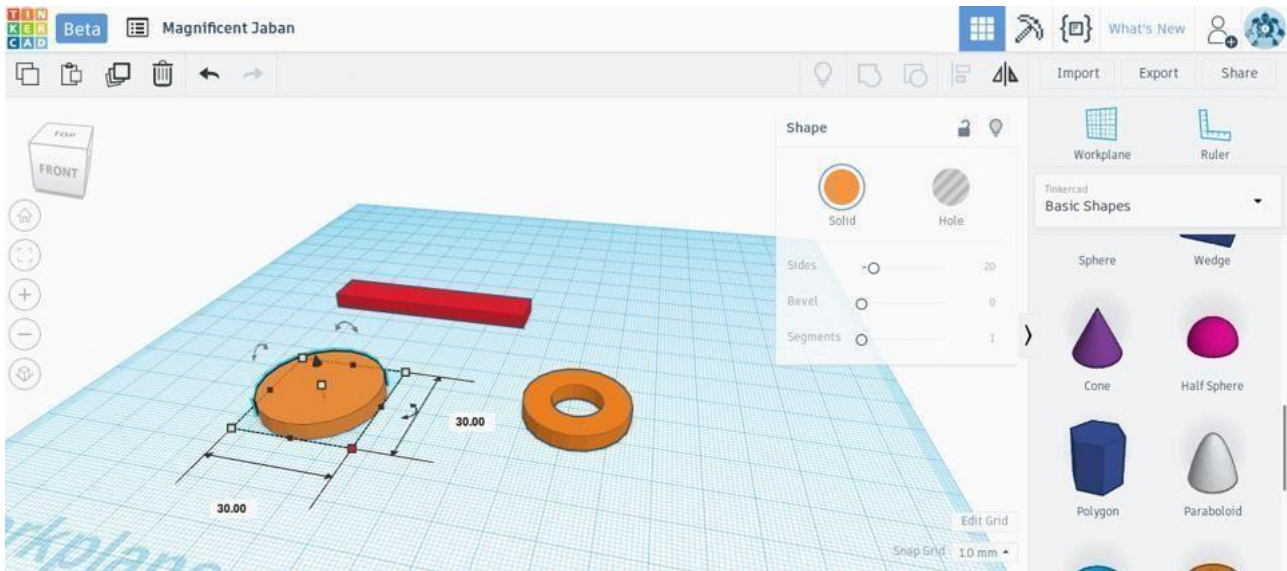
Note - Using the white handles on the plane, we set the length of the box to 100 mm, the width of the box to 10 mm. By dragging the white handle on the top of the box, we set the height to 4 mm so that it matches the height of the solid ring.



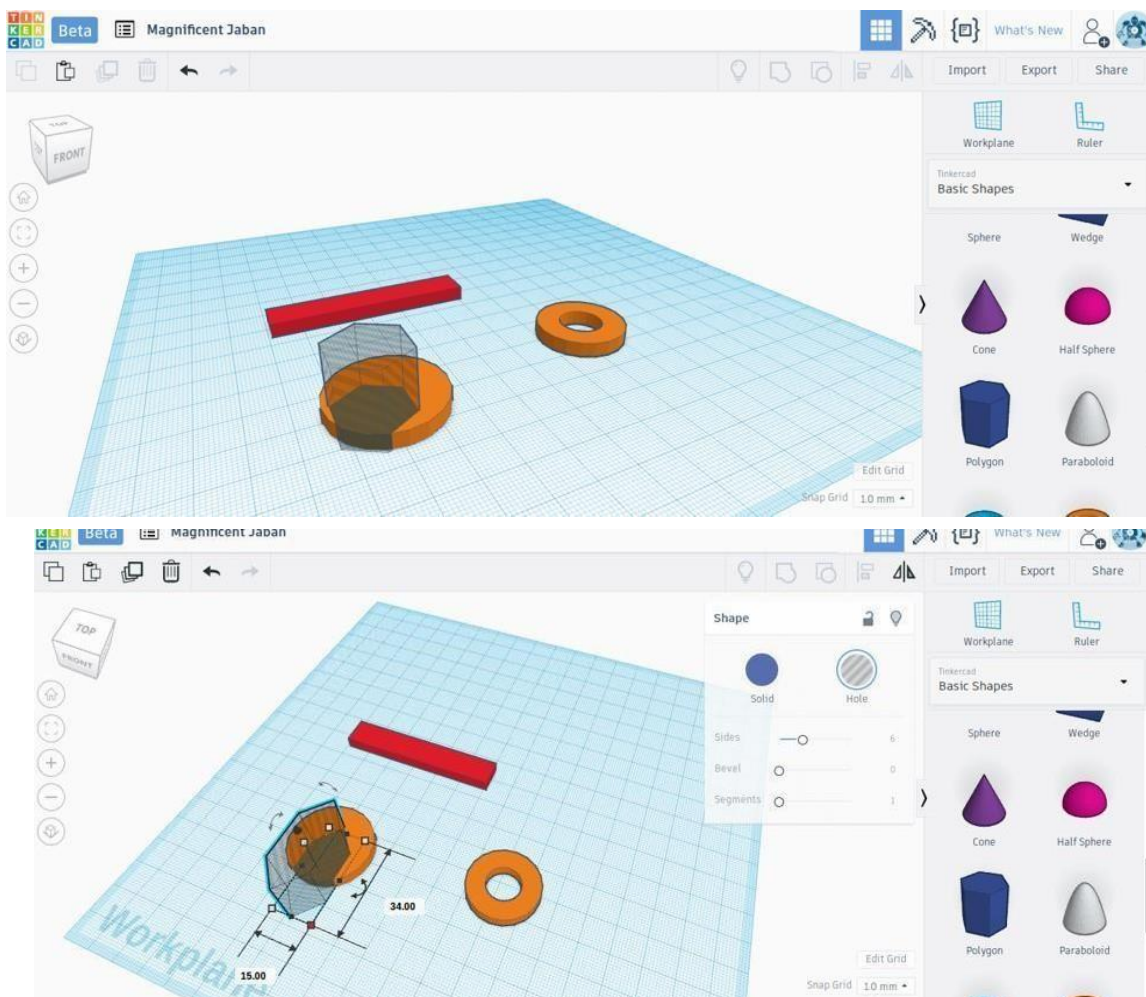
That's it. The handle is ready to go.

Step 3: Design the Jaw

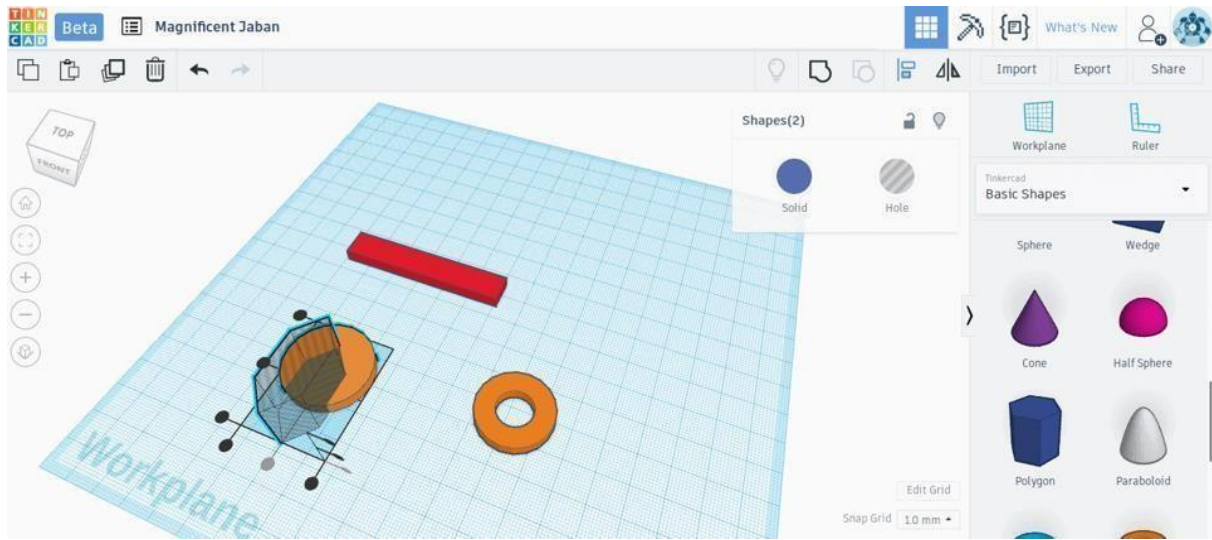
Step 3.1: Create the Jaw Shape - To create the jaw, we first create a disk with diameter 30 mm and height 4mm. To create the jaw-like shape, we will use the basic shape called “Polygon”. Drag the Polygon to the workplane, select it, and turn it into a hole (as we did earlier).



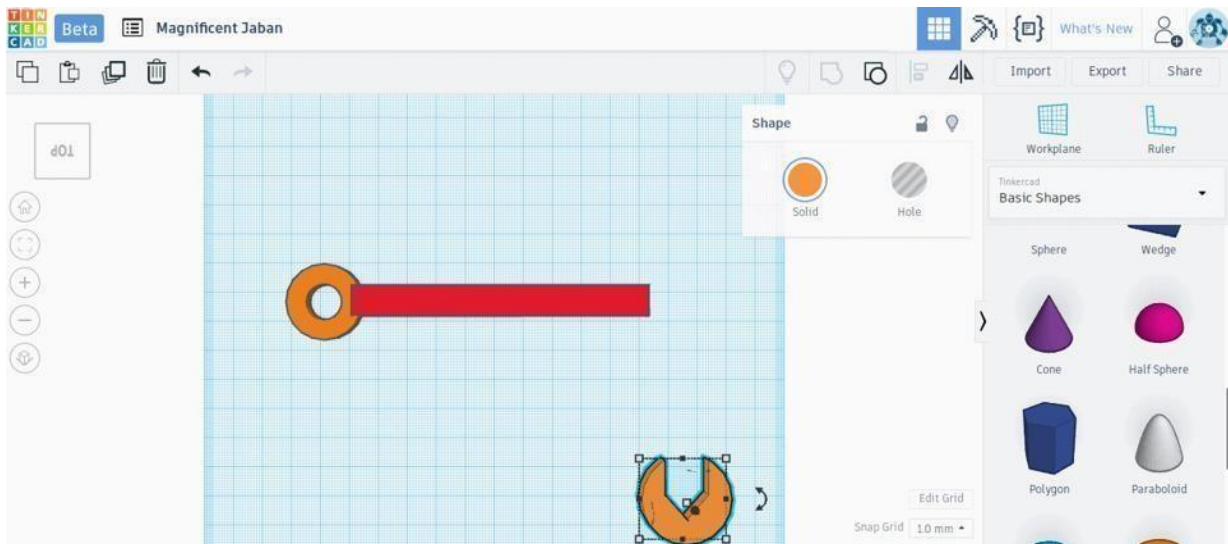
Step 3.2: Change the Dimensions - Now position the Polygon and adjust its dimensions. We will use a 15 mm jaw and adjust the width of the polygon to 15 mm accordingly.



Make sure the polygon is aligned with the center of the disk by using the alignment tool. Select both the polygonal hole and the disk by holding shift and selecting both. When they are selected simultaneously, press the Group button on the top menu (marked in the blue rectangle).



Step 4.1: Align and Merge the ring with the handle - First, position the handle so that it goes a little bit into the body of the ring.

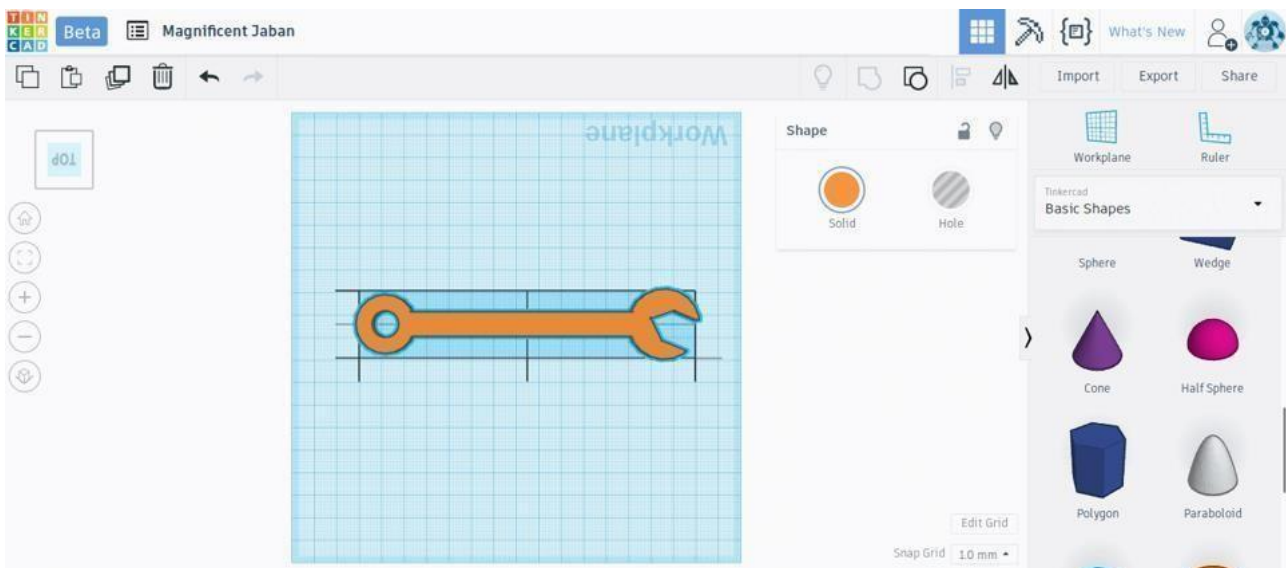
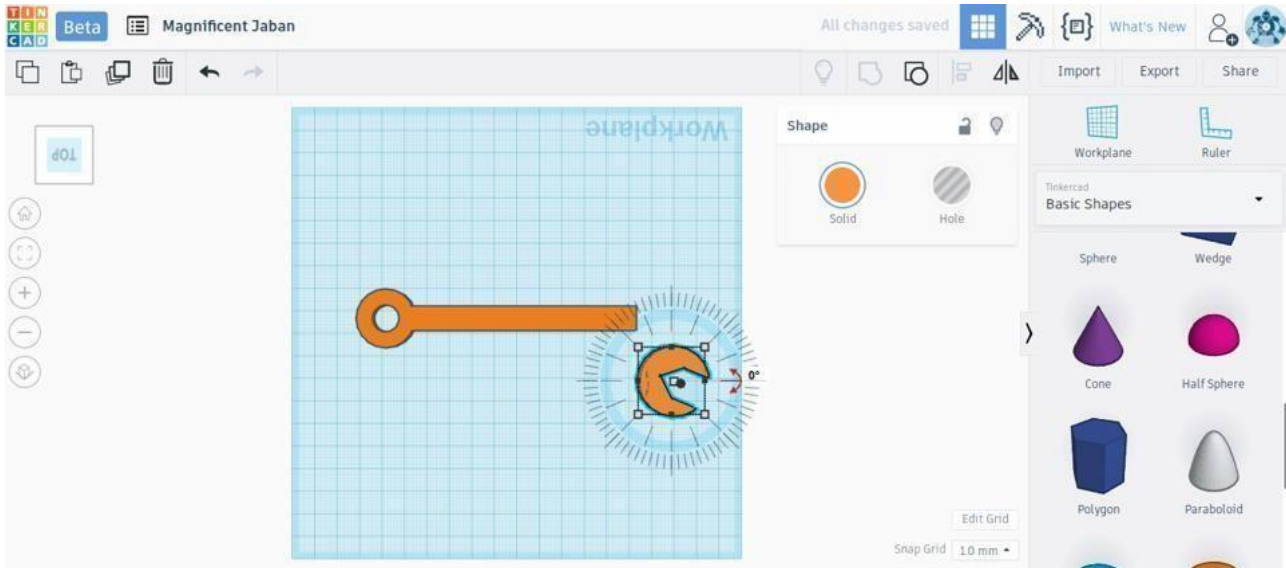


The handle should go just a little bit inside the ring. Select the handle and the ring together and align it so that the handle aligns with the center of the ring. Now press the “Group” button. This should merge the handle and the ring into one continuous unit.

Notice that the merged unit now has a single color instead of two colors.

Step 4.2: Combine align and Merge all the shapes together

Now, Drag the jaw and position it so that the handle goes a little bit inside the body of the jaw. Select the jaw and the merged unit simultaneously and align them so that the handle aligns with the center of the jaw. Press the “Group” button to merge them.



Source: mneudorf.weebly.com/tinkercad

Note: The jaw should make a small angle to the handle.

Congratulations! You have successfully and amazingly completed your activity. Similarly you can design your required things with these basics steps.

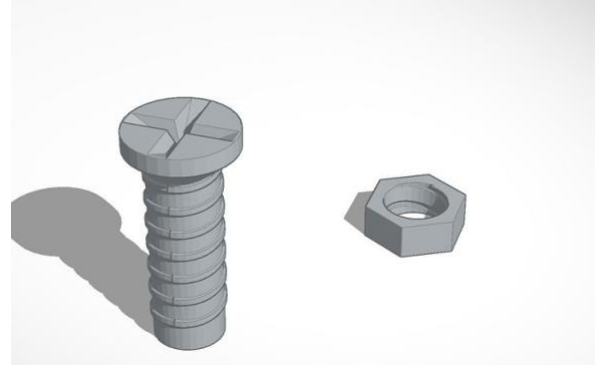
Reflection and Learnings (9 mins):

1. What is a Simple Machine?
2. What will happen when you use the Align option in TinkerCad?
3. What is a Lever? What are the different classes of Levers? Research and find out which category of lever does spanner fall into?

Use the space given below to draw or write your reflections and learnings:

Try it yourself!

Using the concepts you have learnt so far, Try creating a simple Bolt and Nut as shown in the image.



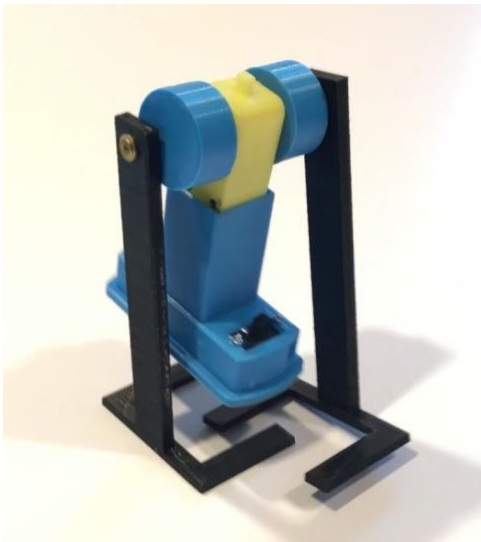


Introduction to Robotics



Robotics is the branch of science focused on learning about and creating robots or machines that can do work.

Engineers, mathematicians, and computer scientists work together to build robots that move, have power and sensors, and complete tasks.



Source:CHEP youtube channel

We are already learned to design stationary objects in Tinkercad today we are going to design and fabricate a movable robot using Tinkercad, we are using the following additional materials to build this robot



Toy Motor



Battery Pack



Screws



Soldering Kit

⌚ : 60 minutes

Module: 3D Design and Printing

Grade: 6th to 9th

Importance/ Value:

3D Printing and Design allows children to think, visualize their imaginative concepts and create prototypes on their own.

Learning Goals:

1. Learners will be able to understand mechanical assembly in Tinkercad.
2. Learners will be able to design simple robots in Tinkercad.

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker
10 Min	Introduction to module
20 Min	Activity
15 Min	Challenge
09 Min	Reflection and Learnings

Icebreaker (5 mins):

I went to market and bought a_____

To play, Form a circle, one person starts off by saying, 'I went to market and bought a_____', adding a grocery item he or she would buy. The next player continues by saying, 'I went to market and bought a <first player's item> and a _____'. Each player continues, adding items to the list as they go along. When a player makes a mistake, they are eliminated and the game continues until there is only one person left.

Safety Measures:



1. Put your 3D printer in an area which isn't easily accessible
2. Wear gloves when handling your 3D printer.
3. Keep a mental note in your head that your 3D printer gets very hot.
4. Only reach for your printer when you are certain it's off



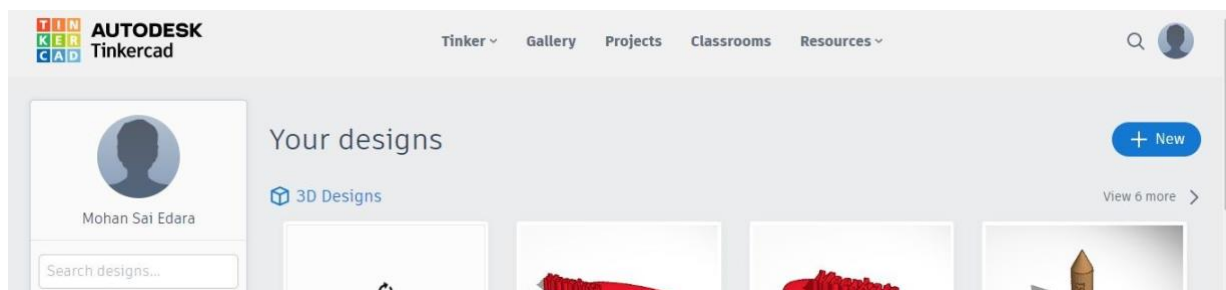
Activity: Design & 3D Print a Walking Robot

Today we are going to design a walking robot using Tinkercad and after that, we will 3D print it, we need to attach a toy motor, battery pack, etc after 3d printing to make robot operational.

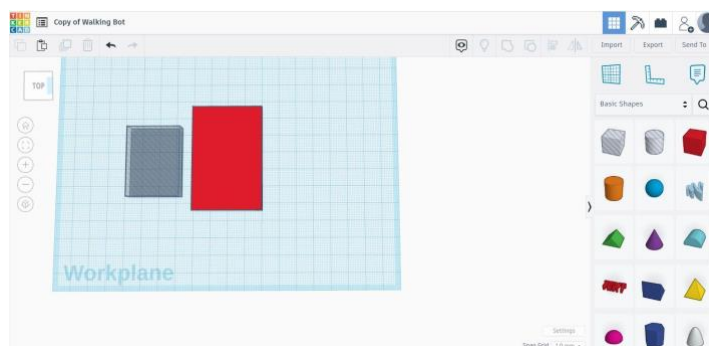
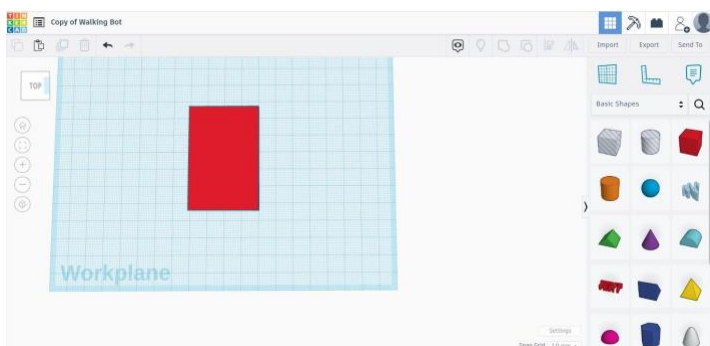
This robot will walk on a flat surface, optionally we can add a switch to on/off.

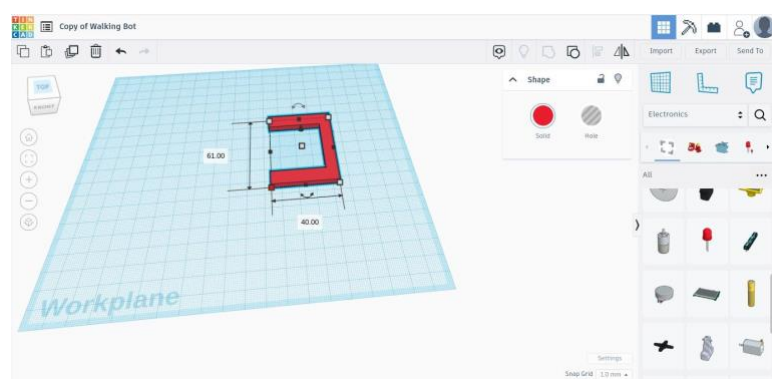
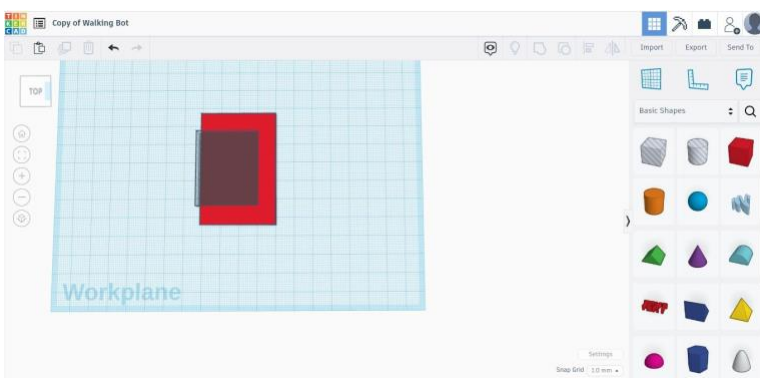
Step 1: Open a browser and type tinkercad in the url and press enter. Click on the first result www.tinkercad.com and you will be redirected to a tinkercad website. Click on sign in and use your google account or autodesk account to sign in to the tinkercad website.

Step 2: After logging in, click on “+ New” to start a new design.



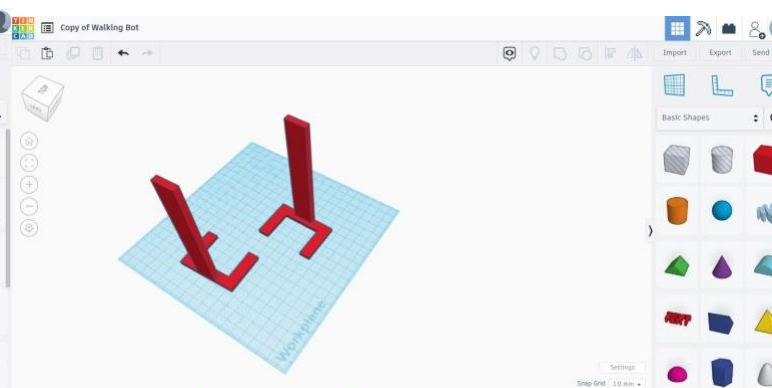
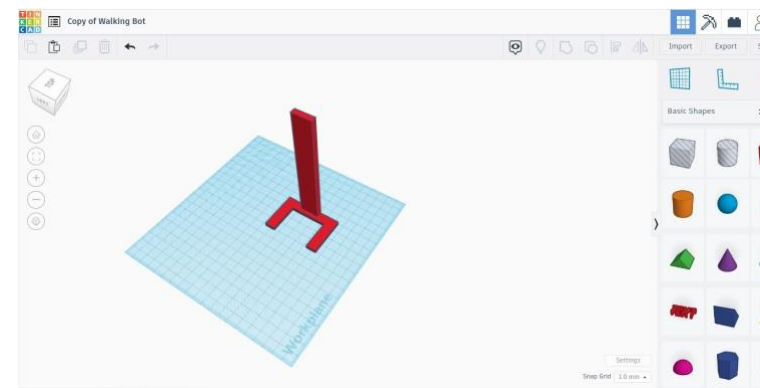
- Step 3:** First we need to create the base of the Robot leg
- Insert a solid box and change its dimensions to 60MMX40MMX3MM
 - insert another hollow box with 40MMX30MMX5MM
 - Group this two shapes and will get base of leg.





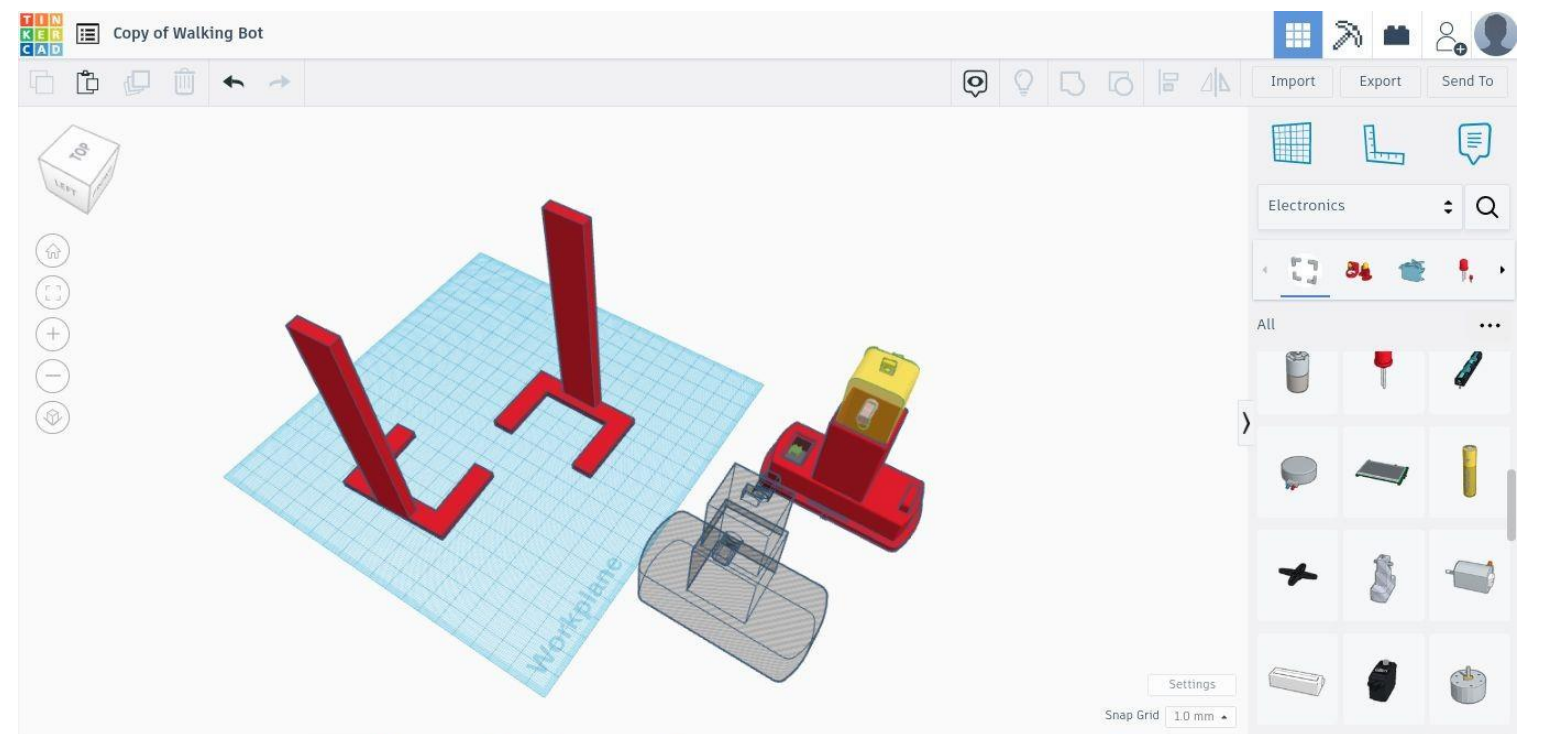
Step 4:

- Insert a solid box, change the dimensions 10MMX5MMX120MM and place it as shown in the image.
- Group the two parts of leg.
- Copy and paste the leg, we need two legs.



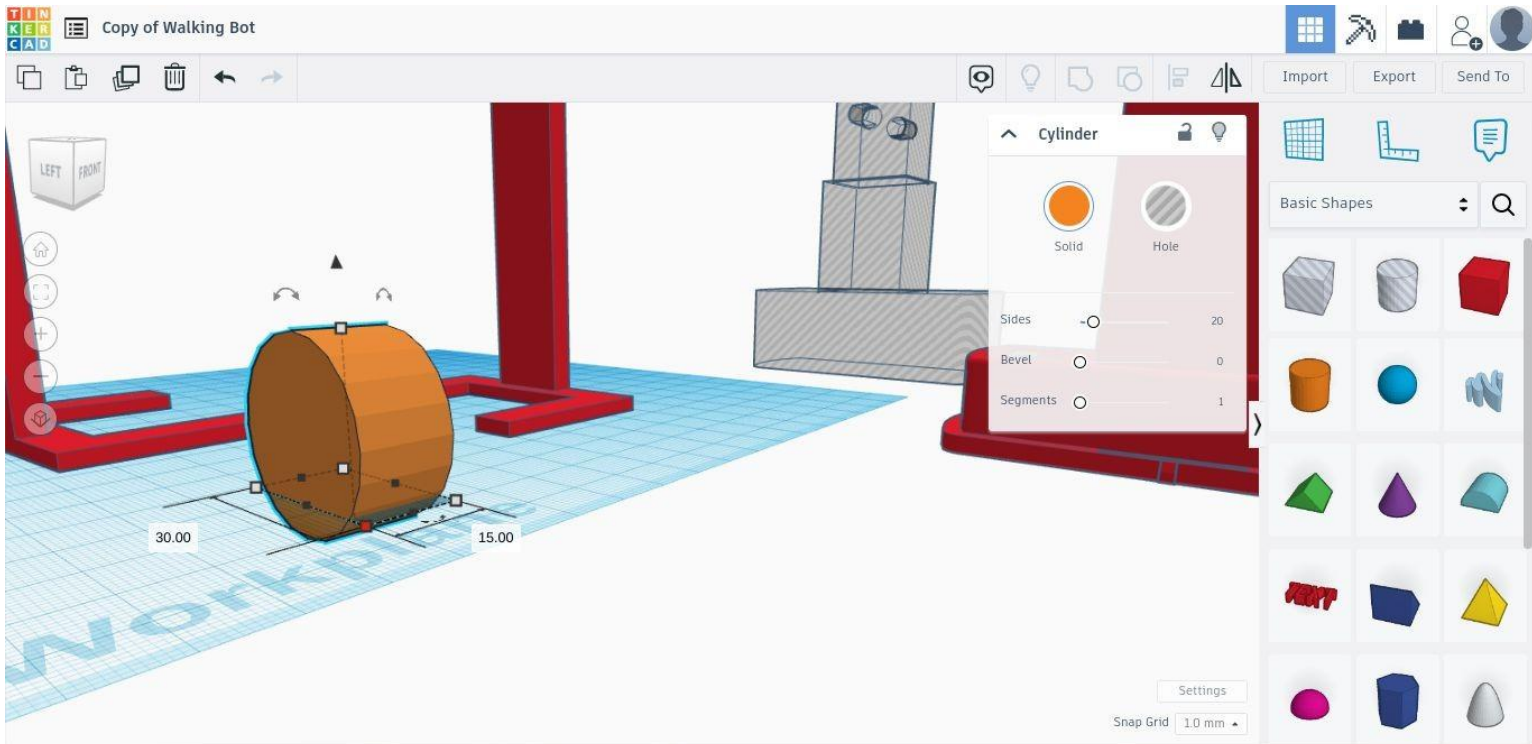
Step 5: Insert the motor part from the tinkercad assembly library for getting accurate measurements, we will need both the 3D Model and the Hollow cut part.

- Go To Toolbar (Right Side) -> Select Electronics -> Scroll Down and Select Spin
- Similarly insert Spin Cutout



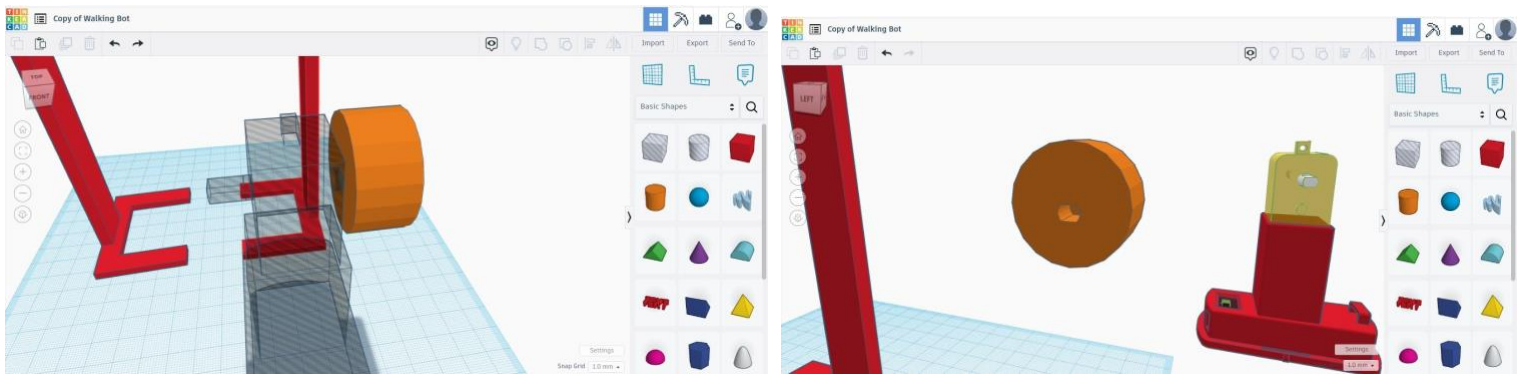
Step 6: Design an attachment for connecting the robot leg and motor.

- Insert a cylinder and change dimensions (Diameter 30MM, Height 15 MM)



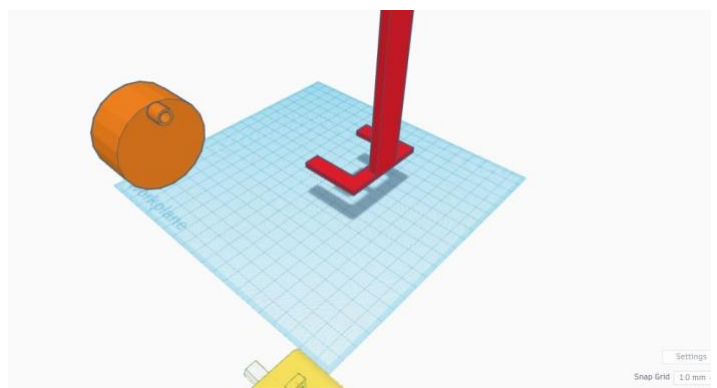
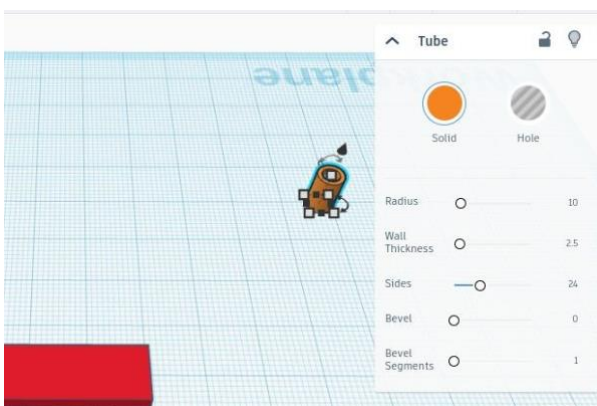
Step 7: Design an attachment for connecting the robot leg and motor.

- First we need to take the hollow cut out model of motor for making holes.
- Group motor hollow part and cylinder for getting a hole for holding motor.

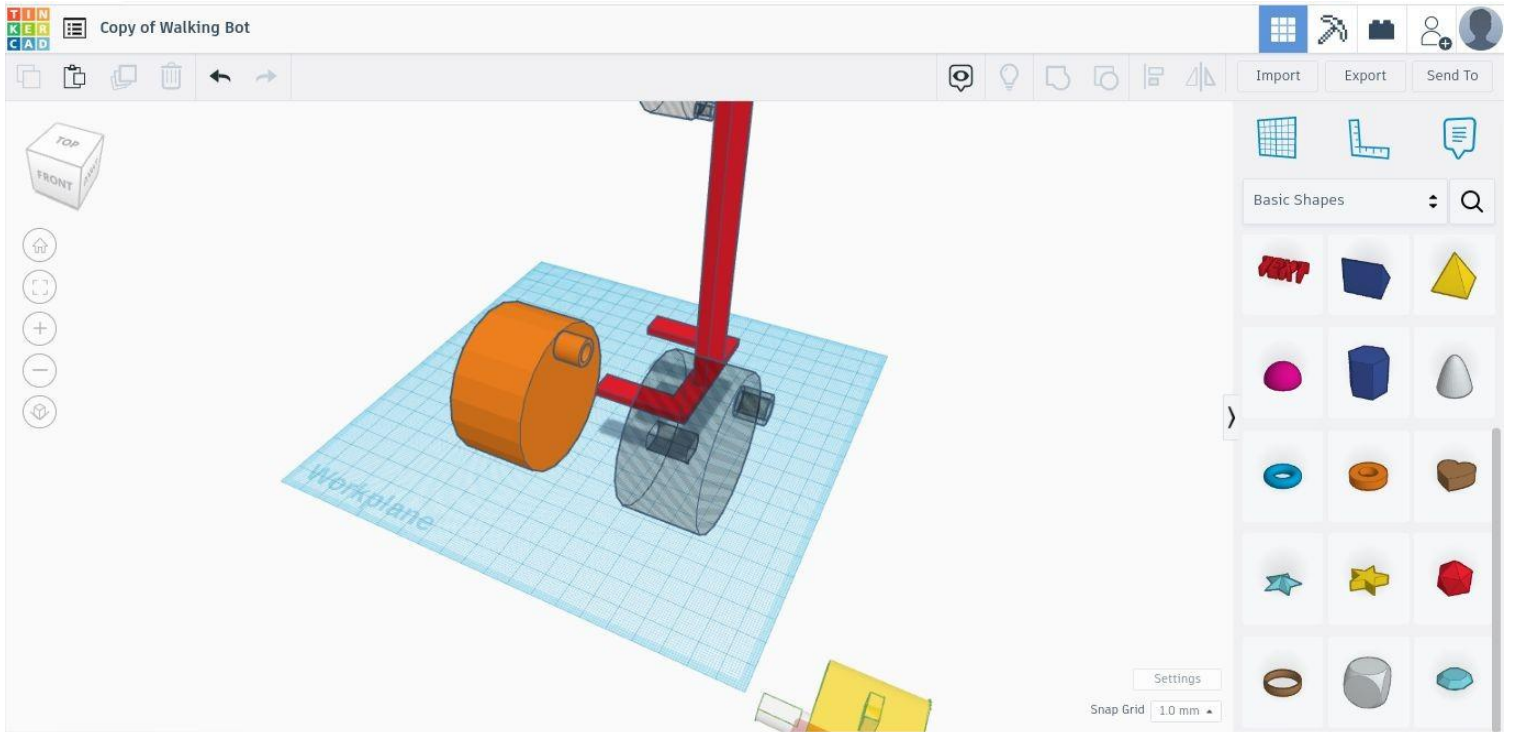


Step 8: Add a small cylinder to hold the attachment and leg.

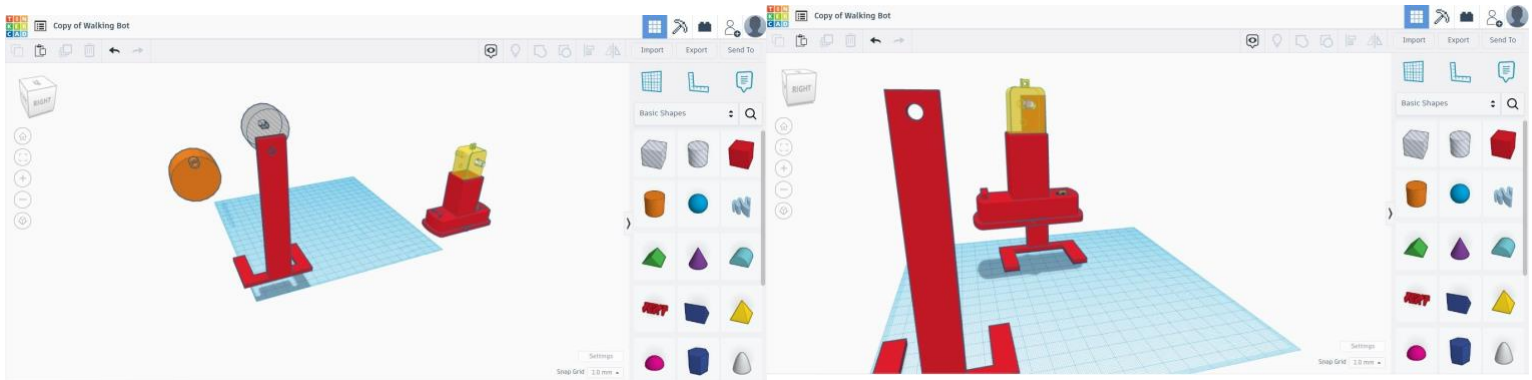
- Insert a tube with a 5MM radius and 5MM length.
- Attach the tube to the cylinder already created and group them.



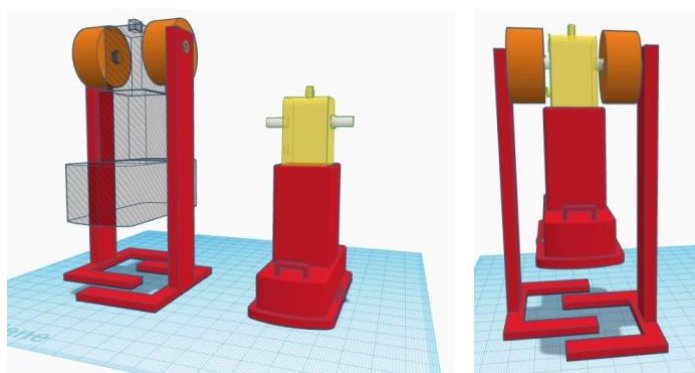
Step 9: Make a copy of the newly created attachment and make it hollow (we need a hollow model to make a hole in the robot leg).



Step 10: Group robot leg & the hollow attachment to make a hole as shown in the image given below.



Step 11: Make two copies of leg & cylinder attachment and assemble the robot.



Step 12: Export all STL files and 3D print it

Step 13: Assemble the robot using 3d printed parts and motors using a screw

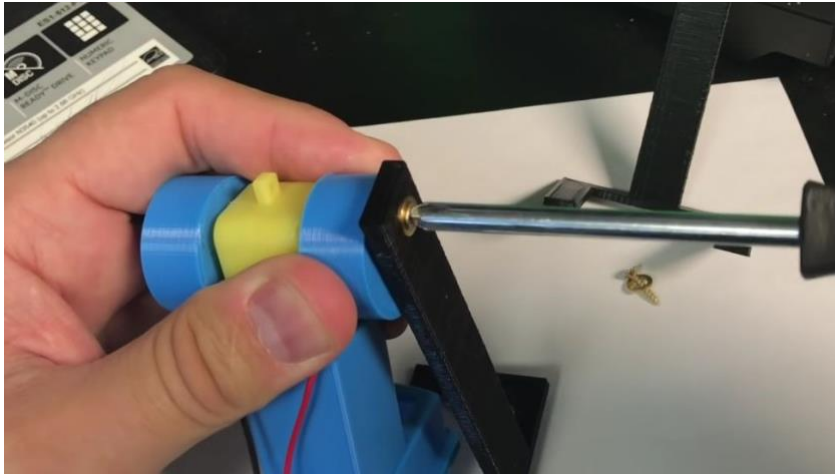


Image Source : CHEP Youtube Channel

Step 14: Take battery box and solder positive and negative terminals of battery to toy motor (Optionally you can add a switch otherwise connect battery terminals directly to battery).



Image Source : CHEP youtube channel

Congratulations! You have successfully fabricated your first robot using Tinkercad.



Reflection and Learnings (9 mins):

1. What do you think is the difference between a Robot and Human ?
2. What will happen when you use the “Hole” option in TinkerCad?
3. Imagine you got a chance to 3D print an item that solves a problem in your locality, what you would you 3D print and how will it solve the problem?
4. What did you or your team struggle with while doing this activity and why? How can you improve next time?

Use the space given below to draw or write your reflections and learnings

WOODWORKING





Introduction to Woodwork (10 mins):




Woodworking is a productive craft that involves cutting, shaping, and joining wood to create decorative and/or useful things. It encompasses techniques like wood carving, joinery, and woodturning. It is relatively simple to learn basic woodworking skills, and with every project you will gain new expertise.

Woodworking has become an ideal for most of the people for today. It has been transformed from necessary skill to some awe-inspiring. Learning woodworking in high school is the best time to learn and develop such amazing skill. There is nothing physically demanding about woodworking and you can build at your own pace.



Source: www.pinterest.com

 : 60 Minutes

Module: Woodworking

Grade: 6th to 9th

Importance/ Value: This woodworking session helps students to build a hobby that will always remain fresh and challenging as the students skills evolve. It will also allow the students solve real-world problems and how to work on details.

Learning Goals:

- Learners will learn about the basics of woodworking techniques
- Learners will learn what are the different types of tools and joints
- Learners will work as a team to come up with possible solutions

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker
05 Min	Introduction to Woodwork
10 Min	Introduction to Tools and safety measures
30 Min	Activity: Learn to make Joints
09 Min	Reflections and learnings

Materials Required :



1. Pencil/Pens
2. Ruler
3. Wood Pieces
4. Fevicol
5. Try Square
6. Nails
7. Hammer
8. Hack Saw
9. Glue Gun
10. Saw - with black decker

Icebreaker (5 mins):

Everyone has to loudly shout YES, LET'S and pretend to do what that person suggested. Once your turn is done, pick another person to do this. Be ready for your turn!

For example - Let's swim! Everyone has to say YES, LET'S and then pretend to swim. Do another one: Let's dance! Everyone has to say YES, LET'S and then pretend to dance. Now pick a student to do the next one.

Safety Measures:



1. Carefully hear the instructions from the trainer.
2. Do not touch anything unless asked by a trainer.
3. For all the denting and cutting work, call the trainer to your place while working in groups.
4. Tools can cause severe injuries so please be careful with it towards your friends.
5. Make sure the equipment is properly grounded before use
6. Always wear safety glasses or goggles, or a face shield (with safety glasses or goggles).



Woodwork Tools:



Hammers - It can be used to drive nails into woods

Hackshaw - It is used for cutting through materials like wood or plastic



Level meter - It helps you to know how to level a surface is

Screwdriver - Used for insertion or removal of screws in any work



Sandpaper - It is used to smooth any surface of wood or maybe any metal sometimes

Tape - These are used to measure distance or size



Glue - It is a form of adhesive for bonding or joining two or more pieces of wood together

Safety glasses/goggles - Protects your eyes from any possible hazard



Activity: Learn and make joints (25 Mins)



Materials Required: Pencil, nails, hacksaw, sandpaper, glue, wooden sheets, hammer, try square.

Woodworks Joints

In woodworking, joints are one of the most important aspects all workers should be good at because almost all projects have a specific type of joint. Wood joinery is one of the most common aspects of woodworking. There are several basic wood joinery which you can find below but yes!! Definitely it will be more enjoyable if you try these joints out on your own with the help of your teacher or trainer.

Basic Butt Joint - A butt joint is nothing more than when one piece of wood butts into another one. This type of joint is often used in wall framing on construction site.



Mitered Butt Joint - A mitered butt joint is nearly the same as a basic butt joint, except that the two boards are joined at an angle. The advantage is that mitered butt joint will not show any end grain and as such is a bit more aesthetically pleasing. But its not strong enough to last longer if pressure applied,



Mitered Butt Joint - The half-lap joint is where half of each of the two boards being joined is removed so that the two boards join together flush with one another. It is also not that strong but a bit stronger than the basic butt joint

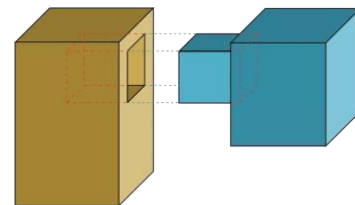


Tongue and Groove Joint - When joining two boards square to one another along a long edge, one can simply butt the joint together and hold it with fasteners. It is the most strong joint of all as it is also reliable



Source: www.thesprucecrafts.com

Mortise and Tenon Joint - The mortise and tenon joint is a classic wood joinery method. These joints have been used since the early times of woodworking, and are still among the strongest and most elegant methods for joining wood.



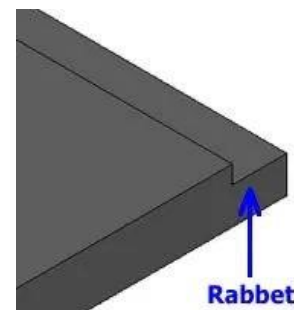
Biscuit Joint - Another method for joining boards along the edges (like the tongue and groove joint) is to cut slots and use beechwood wafers (known as a biscuit to hold the board in place



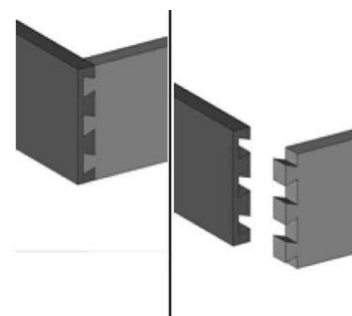
Pocket Joint - The pocket joint is a type of wood joinery that involves cutting a slot and pre-drilling a pilot hole at an angle between two boards before connecting the two with a screw



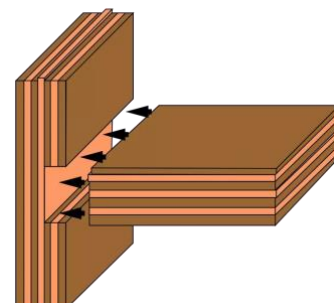
Rabbet - A rabbet is essentially a dado cut along the edge of a board. Rabbets are often used at the back of cabinets and other similar assemblies



Half-blind Dovetail Joint- Where you don't want to see the end of the through dovetail on the face of the drawer. For this type of joint, the best choice is a Half-blind dovetail joint.



Dado - A dado is nothing more than a square-grooved slot on the board where another board will fit. Similar to tongue and groove joinery, this is a commonly-used wood joint for connecting plywood.



Reflection and Learnings (5 mins):

1. What are some different joints you have seen around yourself?
2. What are the different ways of making such joints?
3. How did you enjoy working on carpentry with your friends? Which part did you like the most?
4. What was the most challenging part in this session?

Use the space to draw or write your reflections and learnings



Introduction to Birdhouse (10 mins):



No garden is complete without the peaceful sounds of chirping words. So many animals in the world, like birds. so many ways to bring birds to you.

Season changes and the animals or the birds they don't have a perfect space to live or to rest completely. They move around here and there to find a perfect spot so that they can have their family secure for a season which is also very temporary. We the humans are the ones who only can these beautiful creatures to have a comfy space with food and water.

Now we will make a bird feeding house. Not expensive but easy. You can put this in the forest, home, garden, and any place for your birds by which you can hear them chirping all the time.




Source: <https://www.thespruce.com>

Materials Required :



1. Wooden boards (choose the best)
2. Saw
3. Pencil
4. Ruler
5. Bird food container
6. Some stick
7. Hot glue gun

 : 60 minutes

Module: Basic Woodworking

Grade: 6th to 9th

Importance/ Value: It will help children to develop their teamwork, builds friendship and boost self-confidence. It will also encourage the kids to explore and enhance their creativity and problem- solving skills and also minimizes the screen time. This activity will also help the kids to learn and explore the world.

Learning Goals:

- Learn about the basics of woodworking techniques
- How to make your own Birdhouse with woodworking tools

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Recap
10 Min	Activity Introduction
40 Min	Activity: Birdhouse
04 Min	Key Learnings and reflections

Icebreaker (5 mins):

So now everyone has to imagine themselves as one piece of furniture that they think of themselves and share the reason behind the same.

One student, please take the lead and tag another student when he has shared his idea and the rationale behind that. For example - Student A says SOFA or a COUCH because I get good Sleep on it, Tag Student B.

What is Woodworking:

Woodworking is the activity or skill of making items from wood and includes cabinet making, wood carving, joinery, carpentry, and wood-turning. Woodwork has a significant impact on children's self esteem and confidence and it develops a sense of agency-that "can do" mindset. It is a medium for expressing the creativity one has and his/her imagination.

Woodworking is productive crafts that involves cutting, shaping and joining wood to create decorative and useful things.



Source: <https://diyprojects.com>



Curious?

Is there a difference between woodworking and carpentry?

Yes! there is a difference that is the woodworkers make things out of wood like any wood carvings, any decorative items out of wood and etc carpenters on the other hand install those things made out of wood (think of installing cabinets, floors and doors)

Woodwork Tools:



Hammer



Hackshaw



Screwdriver



Level meter



Sandpaper



Tape



Gluer



Safety glasses

Source: <https://www.electronicshub.org/>

Safety Measures:



1. Carefully hear the instructions from the trainer.
2. Do not touch anything unless asked by a trainer.
3. For all the denting and cutting work, call the trainer to your place while working in groups.
4. Tools can cause severe injuries so please be careful with it towards your friends.
5. Make sure the equipment is properly grounded before use



Activity: Birdhouse (40 mins)



Now you are all familiar with what is woodworks and what all the materials do we need for the activity with all the tools that are important for any woodworks. So, without any further due let's make a Birdhouse using woodworks.

Steps to make a Birdhouse:

Step 1: Make the template with a pencil & ruler, then cut it and wash it.



Step 2: Rub the surfaces so that you can save your fingers from small splinters from wood if they had any. This will also make the surface smooth and fine.



Step 3: Use nails and a hammer to connect the template as shown in the image.



Step 4: Glue the stick with hot glue and leave it for a couple of minutes to dry so that it stays connected strong.



Step 4: Glue the bird feed container for the birds and let to dry for a minute so that it stays still when the bird tries to eat its food out of it.



Are you done??????

Now it will look something like this as shown below. Similarly you can modify or create as per your creativity like colouring it or etc.,



Source: <http://diyprojects.in>

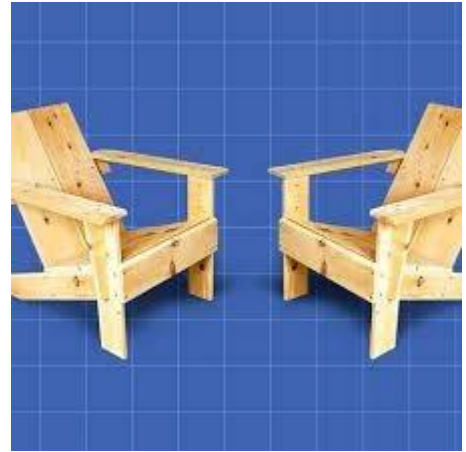
Reflection and Learnings (9 mins):

1. What is you learning from today's activity?
2. How many more ways you can create such birdhouse? List at least 3 new creative ways?
3. Can you recall joints in woodworking?
4. Can you name any alternative material apart for wood to make a birdhouse?
5. Think out of the box and draw your own birdhouse in the space given below.

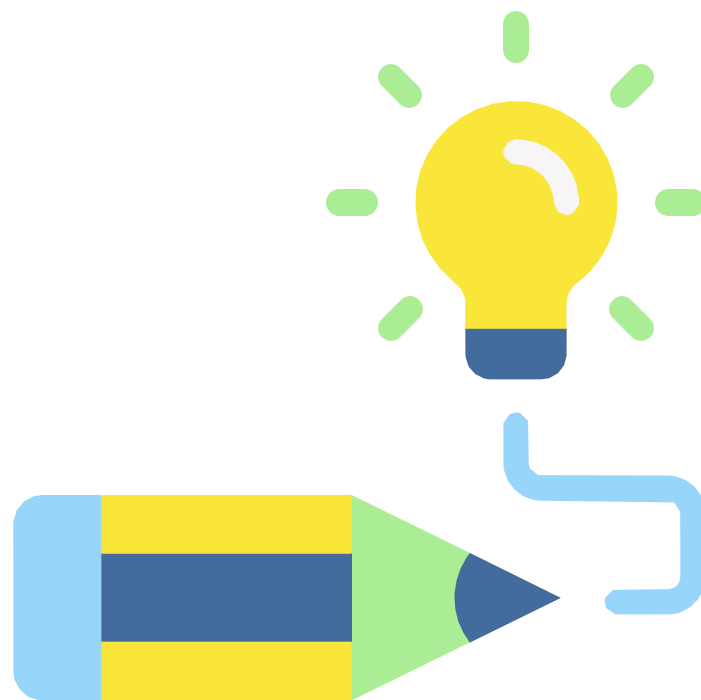
Try it yourself!

Using the concepts you have learnt so far, Try creating a simple Wooden chair as shown in the image

Use the space to draw or write your reflections and learnings

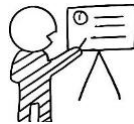


DESIGN & ENTREPRENEURIAL THINKING





Introduction to Design Thinking (10 mins):



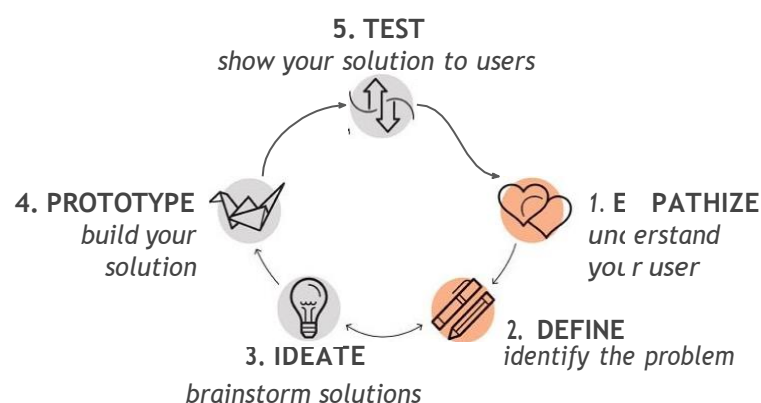
Have you ever paid attention to the objects in your environment and thought about who designed it and why? Why did someone create the TV remote? So that, you can change the channel from a distance instead of walking to the TV. Someone designed the TV remote to solve a problem.

Design is part of our everyday life and shapes the way we interact with the world, but we frequently do not realise it. Everything from the tables and chairs you are sitting on, to the pen in your hand, your water bottle and lunchbox was designed by someone.

Today, we will learn about the design process! There are 5 steps to this process:

Empathise, Define, Ideate, Prototype, and Test.

In this chapter, we will learn about these steps and practise them. But in real life, the design process can take months. Designing is a time-taking process, but it is definitely worth the wait because that is how a good product is created.



Materials Required :



1. Colourful Pens
2. Post-it notes
3. Chart Paper
4. Wall space if available to stick post-it notes
5. Any other materials in your environment!

🕒 : 90 minutes

Module: Design and Entrepreneurial Thinking

Grade: 6th to 9th

Learning Goals:

1. Learners will understand the process of identifying problems and creating solutions.
2. Learners will have the necessary skills to rapidly design and sketch.

Time	Description
01 Min	Check-in-Experience (CIE)
05 Min	Icebreaker- Build a story
10 Min	Introduction to the module
15 Min	Understanding Design Thinking and the 5-step process
50 Min	Activity- Redesigning the Rickshaw
09 Min	Reflection and Learnings

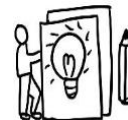
Icebreaker (5 mins):

Let's create a story! Form a circle and sit down. The teacher will give the first word of the story. Then, one by one, each student will add one word and create a sentence and eventually create a story.

For example, if the teacher gives the first word as, "Once", the first student can add to it by saying, "upon". The second student can say, "a" and the third student can say, "time."

Try to make sure that your story has at least one character, one problem that the character faces and a solution to that problem.

Activity: Sustainable Home model (50 mins)



As the world grapples with minimum resources to meet the scaling high demand for a better living. We must take sufficient measures to create a sustainable way of living. These initial steps can start at home with simple actions that save us resources and learn to use them efficiently.

For today’s activity, we will be building out a sustainable home model which you will build a functioning prototype using concepts we have learned from our previous modules

Steps to build a sustainable home model:

Step 1: EMPATHISE: To understand the users and see things from their perspectives



Source: bootcamp.uxdesign.cc

The word empathise means to understand someone’s feeling and thoughts from their perspective and not your own. This step is the foundation of all design. It means that you need to think about who you want to design for and really understand their behavior. There are many ways to do this: observing people, talking to them, or doing some kind of activity with them. The aim of this step is making sure that the you see the other person’s point of view. By the end of this step, you will have a clear area of why we need sustainable living and how various issues in your home have affected your personally. To do so, you can ask a series of questions and write down the answers.

Now, let us do the interviews! For this step you will need to get into pairs to conduct the interviews.

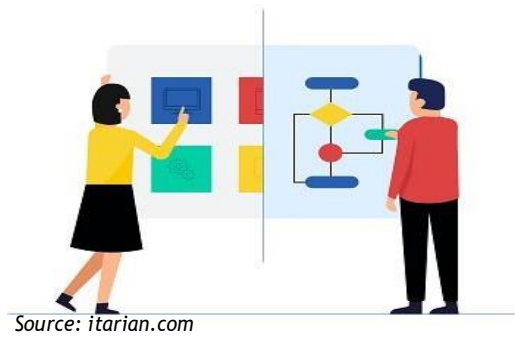
Take turns to ask each other the following questions on Sustainable living. Fill out what you learned below. You get 3 minutes each.

1. What are some problems you have encountered in your home?
2. How do you think you can contribute to sustainable living at home
3. Do you think sustainable methods in your home can help you live better and how?

You can ask them your own questions!

Person 1:
Person 2:
Person 3:
Person 4:

Step 2: DEFINE: The goal for the next step is to come up with a problem statement



What is the problem that sustainable living is trying to solve? You will now *synthesise* what you learned from the interviews. (Synthesise means to combine different parts into one unified whole). You can use this template to define your problem statement.

Sustainable living is (the problem it's trying to solve) and so (whom is it affecting) helps (how it impacts them).

Make sure to include the problem, whom it affects and how it affects them in your problem statement.



Source: deccanherald.com

There are many different problem statements that you can come up with depending on what you give the most importance to. You will have a different point-of-view depending on the problems you have encountered such as affordability, availability, energy efficiency, environmental impact and resource management

The problem statement that you choose to write down depends on what matters to you. In the real world, different people will have different opinions so it is really important to have a problem statement that reflects values that are important and relevant to multiple people.

Write down your problem statement below in 1-2 sentences.

Problem Statement:

Step 3: DESIGN: Come up with design alternatives



Source: architecturaldigest.com

Now comes the fun part! Thinking of your problem statement, come up with as many solutions as possible. Do not limit yourself! Your solutions could involve technology, humans, policy/rule/law, or something else. Write down your ideas on post-it notes and find a wall or chart paper to stick it on.

Now as a team, discuss the ideas that you came up with. Which ideas did everyone like? What were common themes? What was unexpected?

Write down three ideas that you liked as a team below. Make sure that everyone's ideas were considered fairly. You can even combine ideas that are similar or that you think go well together. Pick one idea to proceed with for the rest of the class (you can circle the number 1, 2, or 3). If you are struggling to decide what ideas to pick, you can vote on each one.

Idea 1:
Idea 2:
Idea 3:

Finally, reflect on your decision-making process? Why did you pick these ideas over others?

Reflection:

The teacher can organise a presentation for each group. Each group can pitch their ideas to the class in 5 minutes.

Step 4: PROTOTYPE: Build your own design solution



Source: uptophealth.com

Prototyping is the process of experimenting with ideas, and trying to bring it to life. You work on implementing your idea using various materials---paper, cardboard, wood, digital, clay, electronics. The purpose of prototyping is not necessarily to create a perfect product, but to quickly test out what the product should look like, feel like, and how it will function.

For example, while building rockets scientists and engineers will first create a miniature, or small version, of the rocket to get an idea of the actual rocket will look like.

This step is essential as it helps to visualise what the final product will look like and see if your solution helps to solve the problem.

As a team, sketch a prototype of your favorite solution from the previous step.

Step 5: TEST: Get feedback on your design



Source: dreamstime.com

For this next step, you will share your prototype with another team. In real life, you would show your idea to real consumers and get their feedback. Each team will 2 minutes to present their idea, and 3 minutes to hear feedback. Note down the feedback that you received.

Remember to give feedback in the format below. Record the feedback that you got from the other team.

I like:
I wish:
What if:

Once you are done, go back to the drawing board! Improve your solution based on the feedback you received. Record the improved design below. (5 minutes)

Now that you have gone through the entire exercise, share your final design with the class! You have exactly 5 minutes to present your final prototype. In real life, the next step would be for you to repeat this process multiple times to improve the design until users are satisfied!

Conclusion:

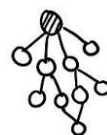
Design is a skill that takes time to cultivate. The best designers are those that practise their skill and have learned to see the world as full of opportunities for better design. But even without being a professional designer, you can benefit from applying design tools to your everyday life. It forces you to think about your environment, and identify ways that things can be done better. It can even help you find opportunities to build a product that others may want to buy!

In your everyday life, be more conscious about the items and services you use. Observe your environment carefully and engage with people different from you to understand their point-of-view and values. Keep a diary to record interesting observations or ideas that come to your mind and share it with others for feedback!



Source: blog.bit.ai

Reflection and Learnings (9 min):



- 1) Share at least 3 skills or lessons that you learned today.
- 2) How will you apply these skills outside class?
- 3) What did you or your team struggle with while doing this activity and why? How can you improve next time?
- 4) How did you contribute to the team and how do you think it helped? How else could you have contributed?
- 5) What communication challenges did you and your team face? How can your team communicate better next time

Use the space below to draw or write your reflections and learnings



Design Thinking and Rapid Prototyping



In our previous sessions, we learned the **5-step process: Empathize, Define, Ideate, Prototype, and Test**. Let us do a quick recap of how we applied this step-by-step process to redesign a Rickshaw

The foundation of all design is that you need to think about whom you want to design for and understand their behavior. There are many ways to do this: observing people, talking to them, or doing some kind of activity with them. This is the first step - Empathy! Empathy is when you are able to understand and share the feelings of another person. From the last sessions we were able to some extent understand what the problems a rickshaw had with its design are and empathize with users.

The second stage is “define” which we did in the last session where all of us came up with a problem statement and discussed the problems that need to be solved with the Rickshaw

The next stage was ideation, we discussed ideas to solve the problem and finally, rapid prototyping. Building/sketching a model of your solution and receiving feedback on it.

For this session we will use the 5 step process to design your final project!

🕒 : 60 minutes

Module: Design and Entrepreneurial Thinking

Grade: 6th to 9th

Learning Goals:

1. Learn to independently come up with solution to problems using the design thinking approach.
2. Learn to rapidly design and sketch to solve problems.

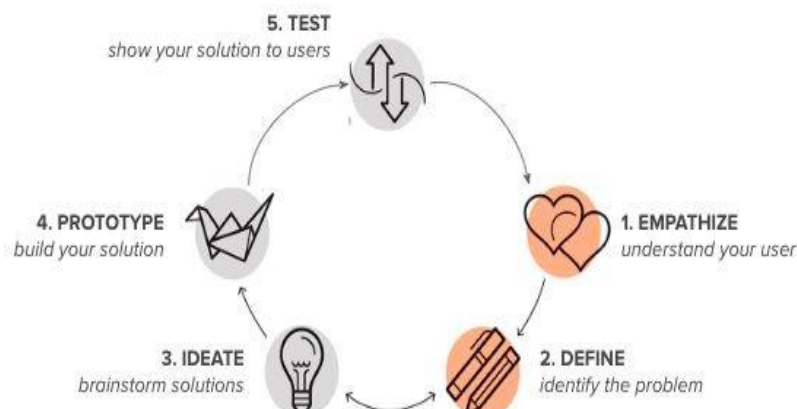
The final project is an opportunity to use these 5 steps and create your own solutions for a problem in your community! You will get to put in practice the problem discovery process and rapid prototyping.

Remember, there is no right or wrong. Each design solution is unique to their own and it is more important to enjoy the process!

Materials Required :



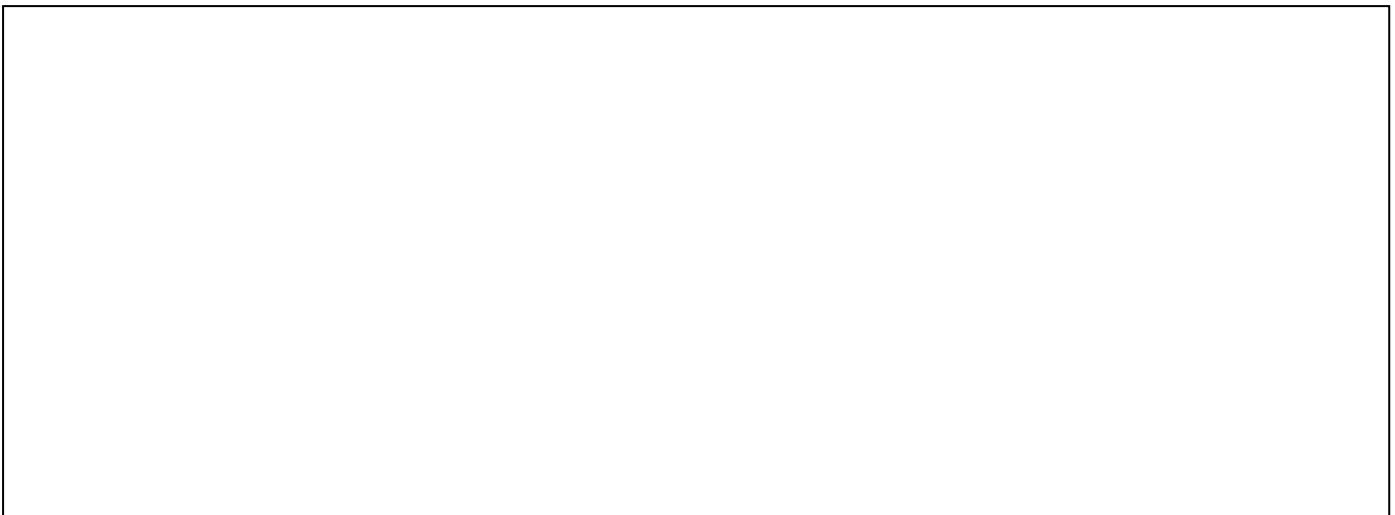
1. Colourful Pens
2. Post-it notes
3. Chart Paper
4. Wall space if available to stick post-it notes
5. Any other materials in your environment!



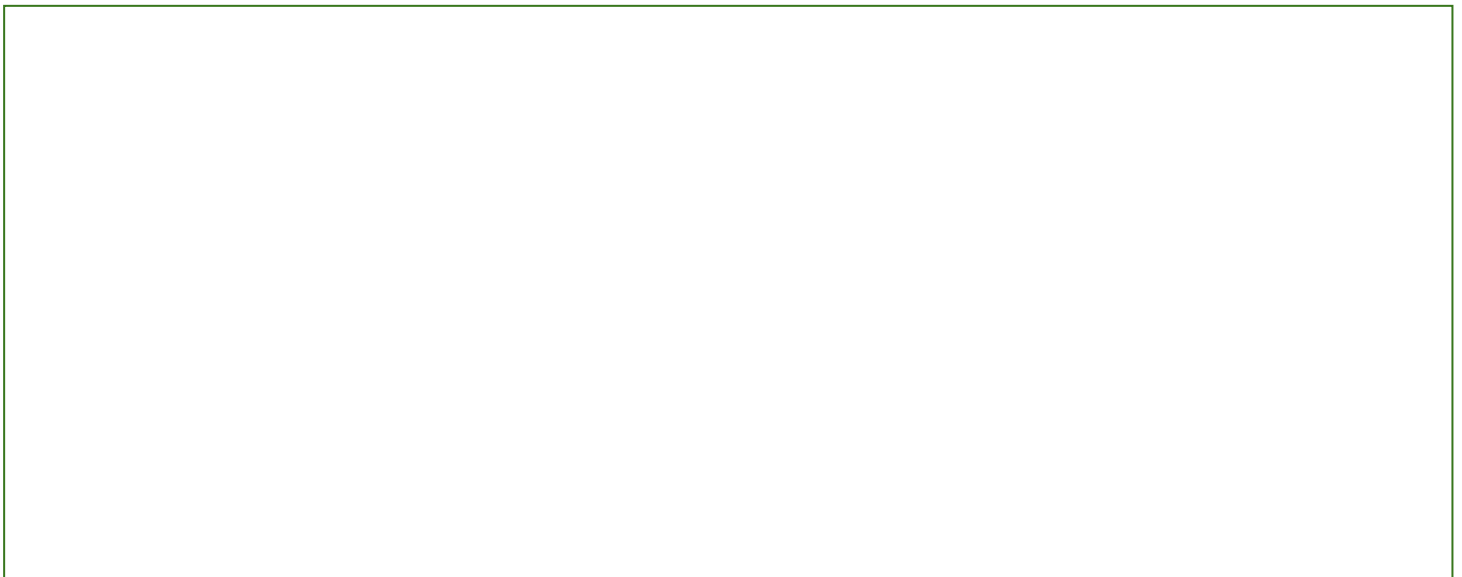
Step 1: EMPATHISE: To understand the users and see things from their perspectives

As we learned in the previous session, this is the foundation of all design. It means that you need to think about who you want to design for and really understand their behavior. There are many ways to do this: observing people, talking to them, or doing some kind of activity with them.

For the final project, here are a few problems you can find solutions for in a community, your task is to build a sustainable village model. What does that mean? Many parts of rural India still lack the basic necessities and resources to live a comfortable life. What are some innovative designs you would think of implementing in your village. Remember to use all the concepts and materials from the previous modules while building out your village mode. Be as creative and imaginative as possible, it doesn't matter if it is workable or not. The idea here is how you use maker tools and concepts in a socially innovative way. Use the space below to draw your sustainable village model first



Now that you have drawn your sustainable village model. Think about at least one problem you want to solve in your village and think of ways you can design to help solve that problem. You have 5 minutes for this.



Once you have chose which problem to solve, it is time go a bit deeper on what the problem is. For this step you will need to get into pairs to conduct the interviews.

You can come up with your own interview questions by using these guiding questions:

- 1) What *should be* happening (ideal condition) and what *is currently* happening (reality)
- 2) Ask "Why?, Why?, Why?"
- 3) Try to define who all are affected by the problem
- 4) How are they currently trying to solve the problem?
- 5) What will happen in the future if the problem is solved/ not solved?
- 6) Try and see the problem from different perspectives

Use the space below to write your interview questions along with the responses. You get 5 minutes each.

Step 2: DEFINE: The goal for the next step is to come up with a problem statement

You will now *synthesize* what you learned from the interviews. (Synthesize means to combine different parts into one unified whole).

Write down the common problems you saw people having that you interviewed.

There are many different **problem statements** that you can come up with depending on what you care about. You will have a different *point-of-view* depending on the *stakeholder* that you care about: e.g. a young child, teenager, parent, woman, a shopkeeper, government, traffic police etc.

Think about the **values** that you care about as a team---affordability, availability, energy, health efficiency, environmental impact, safety, etc. The problem statement that you choose to write down depends on what matters to you. In the real world, different stakeholders will have conflicting values so it is really important to have a problem statement that reflects values that are important and relevant to multiple people.

Once you identify the problem, record the problem statement in the following format and share it with the class. Write down your problem statement below or in your notebooks in the following format. Here is an example of a problem statement from the choices given:

Here is an **example** of a problem statement:

The problem I have identified is there are *frequent power cuts in our village*. I wanted to do something about this because *this affects day-to-day activities, schools and small-scale businesses*.

The problem I have identified is (1)_____ and it affects (2)_____. I wanted to do something about this problem because (3)_____”

Slot 1 - write what is the issue you have identified

Slot 2 - Define the stakeholders (whom all it affects and are involved)

Slot 3 - Put down your “why” to address this problem (personal motivation)

Take Home Activity: Problem Research

Research is a critical step in the problem-solving process. It helps us identify the problem better and get more information on it. Through this, we can understand thoroughly what problem we are dealing with and who all are affected by it.

TASK: Do more research on the problem statement you have identified. If you didn't get enough time to come up with questions in class, you can take the time now to come up with questions.

Once you have finalized your problem statement and have come up with the questions which you want to research more, In teams you have to go and ask as many people as possible to get the research for this. You must ask at least 10 people these questions and note down what they say.

As a team decide when you will meet and where you will go.

After you have the required information from the people you spoke to, you have to see what Information you can use and what you have to remove.

The way you can do this is to see if the answers given by people are related to the problem statement you want to solve.

REMEMBER: Safety is the top priority. You must always be in teams. You should not enter any strangers' houses or go to unsafe locations in the community.

* Always inform your teacher and parent before you go to any specific area and ask for advice if is safe and which locations you must avoid.

*Bring your responses to the next session and share a few of them with the class.



Design Thinking and Prototyping

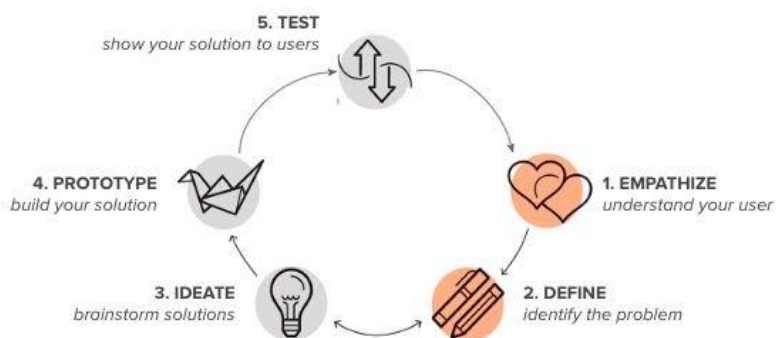


In our previous sessions, we learned the **5-step process: Empathize, Define, Ideate, Prototype, and Test.**

In the previous session you were asked to choose one problem and explain why you chose the problem and what you want to solve. The first step was empathy which means that you need to think about whom you want to design for and understand their behavior. We saw that there were many ways of doing this and learned some guiding questions to help learn about the problem more and their perspective. We learned what the problems of our community are and empathize with them. The second step was “define” where all of us came up with a problem statement and did research to back it up as a take home activity.

Take **5 minutes** to quickly share with the class some findings from the take home activity.

In our previous sessions, we have completed the first two steps now it is time to look at ideation!



Materials Required :

1. Colourful Pens
2. Post-it notes
3. Chart Paper
4. Wall space if available to stick post-it notes
5. Any other materials in your environment!



: 60 minutes

Module: Design Thinking and Rapid Prototyping

Grade: 6th to 9th

Learning Goals:

1. Learn about ideation and how to solve the problem better
2. Learn to rapidly design and sketch
3. Learn how to build a prototyping

Activity: Impossible objects

Think about any object around you. Now pair up and begin the ideation process—you have to connect the two objects and come up with a hybrid (combination of both of the objects). Try imagine the item that comes out of it and what details it entails

Draw a picture of it on a piece of paper or in your notebook. This is just an ideation process, it need not be a real object. You have to use your imagination to come up with something.

You have **5 minutes** to do this in your pair. You to be honest and not change objects for convenience of this activity. In fact the more creative the idea the better, Go as crazy as possible!

Once the 5 minutes are done, share it with the class.

IDEATION

From the previous activity, keep up the same spirit of coming up with crazy ideas.

We will use the same creativity from the last activity and use it for our projects.

In your project groups (group of 5) think of your problem statement, **come up with AS MANY SOLUTIONS AS POSSIBLE to the problem statement.**

For example: If you interviewed the elderly and they said they need help with remembering what medicines to take and when then you can make them a medicine reminder box.

GO WIDE, GO BIG! Think of crazy ideas, don't limit yourself by physical constraints or common-sense limitations.

This is an ideation process. Each person in the team should come up with as many ideas as possible. You should note it down individually in this guide or paper. You have 5 minutes to come up with as many ideas as they can.

Once you are done, count how many ideas each person on your team came up with below.

Person 1:

Person 2:

Person 3:

Person 4:

Person 5:

Now in your team, share the ideas that everyone came up with. You can take 5 minutes for this.

The next step is to discuss the **following questions-**

1. Which ideas did everyone like?
2. What were common themes?
3. What was unexpected?

Now, you have to decide on the top 3 ideas that you like.

Make sure that everyone's ideas were considered fairly. You can even combine ideas that are similar or that you think go well together. If you are struggling to decide what ideas to pick, you can vote on each one!

Idea 1:

Idea 2:

Idea 3:

PROTOTYPING

The next stage that comes in the design process is prototyping.

Prototyping is the process of experimenting with ideas and trying to bring them to life. You work on implementing your idea using various materials---paper, cardboard, wood, digital, clay, electronics. A prototype is used to test different working aspects of a product before the design is finalized.

A prototype is a working model of a product that is used for testing before it is manufactured. The advantages of prototyping are :-

1. They help the people understand what all is required to make the product. Basically they understand the manufacturing process
2. How users will use the product
3. How the product could fail or break.

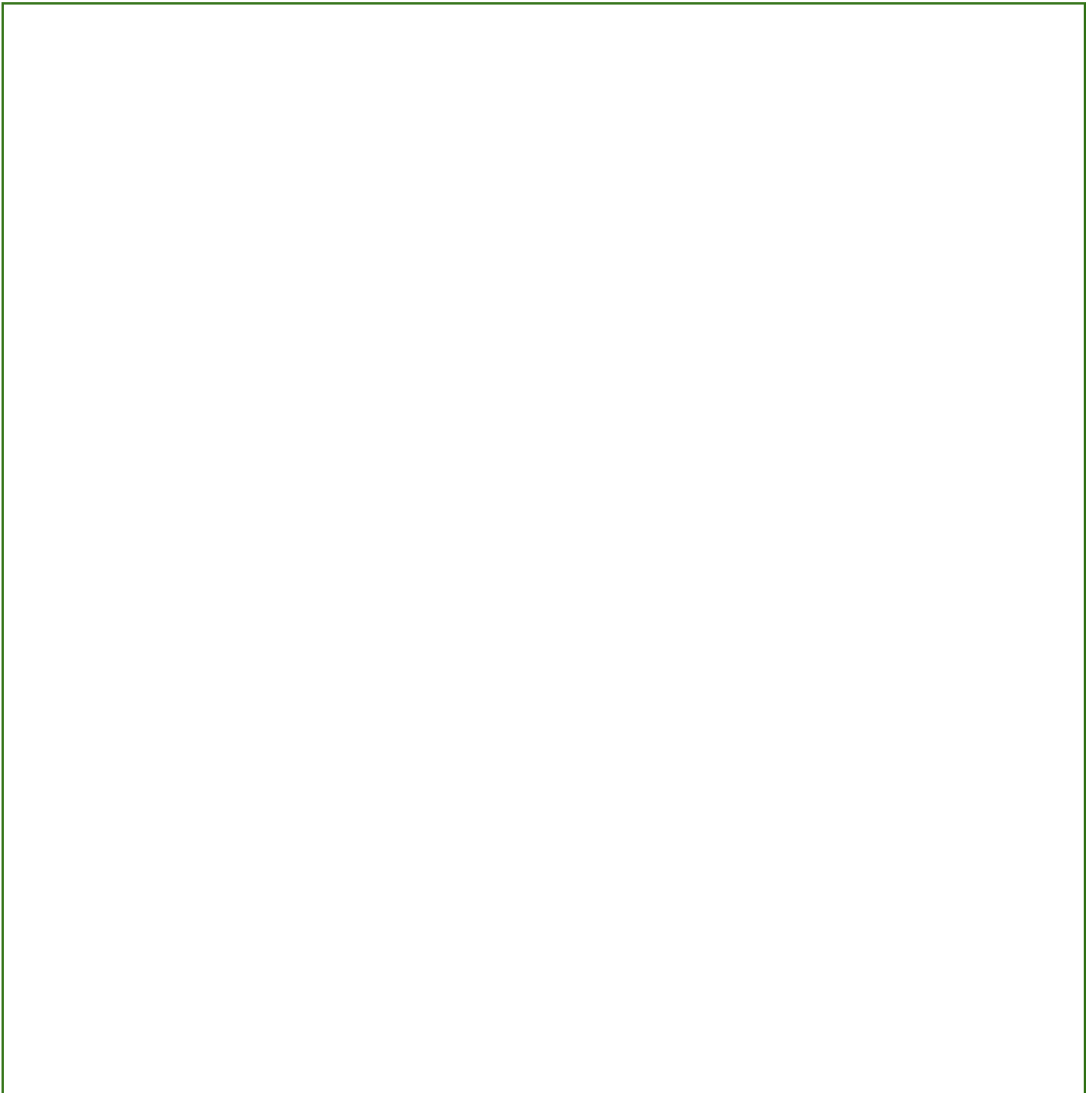
For example, a team of engineers designing a new cell phone might produce several cardboard and paper models to illustrate how the final product would look and feel. They may survey the general public to gain feedback about how the cell phone could look. The team might build a sturdier plastic prototype to test how easily the cell phone could break when dropped. If the prototype does not meet the team's design requirements, then they may try again to come up with a better prototype.

For this activity you will stay with your group created before. As a team, sketch/draw a prototype of your favorite idea you had selected from the last session using the space below or on a piece of paper. You can use any material you need, the Idea is to make a prototype of the product you will implement.

While creating the prototype these are few things you can keep in mind:

1. What will be the name of your product?
2. What will it look like ?
3. What materials will you need to make it?
4. What do you want your final product to do?

The teams have 30 minutes to come up with the drawing of the prototype.

A large, empty rectangular box with a thin black border, intended for teams to draw their prototype. The box occupies most of the lower half of the page.

Once you are done with the drawing of your prototype, each team has **5 minutes** to come up and present your ideas to the class!

Now, we need to examine and evaluate your final prototype to see what works and what doesn't. Once you have finalized it on paper you have to make a physical prototype of the product. You can use the components that you actually plan to use or use material like cardboard and chart paper to give a feel of what it will look like.

***Please get your prototypes and come to class for the next session.**

Take Home Activity: Solutions Research

For this assignment, you will have to do more research on the solution just as you did for the problem itself. When you identify a problem, more often than not there is already a solution out there!

Find out whether:

- a. People have tried to solve this before
- b. If a solution to this problem already exists
- c. If there is already a solution, why hasn't it been implemented it
- d. What you plan to do with your solution would help the different stakeholders

Use the space below to write your responses:



Feedback and User Survey



As we saw in the previous session, A prototype is used to test different working aspects of a product before the design is finalized. One of the main advantages of prototyping is that we understand the experience of the user and improve on the model

User feedback is essential to guide and inform your decision making and influence innovations and changes to your product

For ideas to be workable we have to make products that your users like. How do we get inputs from the minds of our users It is difficult but not impossible! The best way to improve your product is to understand through customer experience.

Measuring user satisfaction allows you to understand potential problems at an individual and aggregate level. More importantly, it helps you improve over time!

In this session, let us try improving our design with the feedback given from the users of our product!

🕒: 60 minutes

Module: Design Thinking and Rapid Prototyping

Grade: 6th to 9th

Learning Goals:

1. Learn about the problem discovery process
2. Learn about creating user survey and valuable feedback

A user survey help to provide insights and help with overall quality of product. If you are in the early stages of your design project and just want some simple and rough feedback, it's good enough to test on your classmates. However, towards the end of your project, when you create more detailed prototypes, you should test on a users from your community to get the most relevant feedback.

Materials Required :



1. Colourful Pens
2. Post-it notes
3. Chart Paper
4. Wall space if available to stick post-it notes
5. Any other materials in your environment!



Activity: Creating a User Survey

For this activity, we will be creating a User survey. To prepare the questionnaire, work with your groups in which you had worked with for your previous session. Appoint one person to write neatly on a blank sheet of paper or use the space below and create multiple choice questions as this sheet will be shared with other groups. Following are some sample questions that you can have in your User survey

1. Name, age, occupation?
2. Which area are they living in?
3. What are some of the problems they are facing in and around their community?
4. What is their opinion on the idea you have come up with?
5. Do they think it will work ?
6. What are some ways they can improve on this idea?

Use the space below to write your sample questions for your user survey. You have 15-20 mins for this.

The User survey should be short, simple and direct to the point. User will not have time to talk to you for more than 10 minutes so make use of all the time you get!

Presenting your Prototype

Now you will require to collaborate with groups. You will pair with another group and will be presenting your prototype to them.

Pair with your partner group and take 15 minutes to present your prototype and ask your customer survey questions. After this they will receive feedback from the other team for 5 minutes. Then the reverse will happen. The other team will present for 15 minutes and then take feedback for 5 minutes.

Some of the questions may not come in use because they are talking to students. So they can just ignore such questions!

Use the space below to write the feedback you received for your prototype.

Through these activities we came to know how effective and useful user surveys are to improve your prototype. Always keep in mind the guidelines that we had discussed while creating the user survey. We have almost come to the end of our final project with this step!

In the next session, we will present our final prototype to the class.



Group Presentations

Before presenting your final prototypes it is important to set some norms.

- Make sure that when a group is presenting, we must respectfully listen and support your peers.
- Each group has **15 minutes** to present.
- Make sure to encourage all your group members to participate and speak up
- Once the group presentation is done, make sure to encourage your peers and clap for a job well done!

Once the team is done presenting, it will be time for a feedback session. For this you will need to follow the format below while sharing your feedback

I like, I wish, What if

As we come to the end of the program, we hope all of you have some important things to take away from each module. It is essential to understand the values and thought process that drive hands-on-making and tinkering. What we hoped to achieve through this program was to foster problem solving and critical thinking while having a humanistic outlook to situations/scenarios.

let us take **5 minutes** and write on a piece of paper and write down 3 words to describe your experience with hands-on-making.

Materials Required :

1. Colourful Pens
2. Post-it notes
3. Chart Paper
4. Wall space if available to stick post-it notes
5. Final Prototype



: 60 minutes

Module: Design Thinking and Rapid Prototyping

Grade: 6th to 9th

Learning Goals:

1. Learn about effective communication and self confidence

Team Awards

For this activity, you design unique **titles/awards** for each team member. The groups collectively decide which person gets what title and select one person to read the list out to the class and explain why they've got that title. Keep it funny, unique and appreciate all your team members in some way. For example - we can have one member's title as the 'fire extinguisher' - this person puts out everyday fire like a pro and always keeps calm and composed, the peacemaker during conflicts.

You have 5 minutes to present.



Reflection and Learnings :

- 1) Write down some new things you have learned about your community. Share your experience with the class or use the space below.
- 2) Coming to identifying problems in the community, we know it is never easy to find a solution but were you able to make a meaningful impact through your project?
- 3) What were some hiccups you faced during the solution finding process - did it help that you worked as a team?
- 4) What were the ideas that the team came up with and which was the final idea? What was the feedback they received for the prototype from the customers? Were you able to try out their idea and what happened because of it?

Use the space below to draw or write your reflections and learnings