Topic	VISUAL SIGNALS	
Class Description	**Students will be introduced to the basic concepts and components of electronic systems - current, voltage, resistors, LEDs, and basic electrical circuits.**	
Class	**PRO C242**	
Class time	**45 mins**	
Goal	• Learn about the basics of electronic systems • Introduction to Tinkercad • Circuit design • Controlling LED through a switch	
Resources Required	• Teacher Resources: ○ Laptop with internet connectivity ○ Earphones with mic ○ Notebook and pen ○ Smartphone ○ WHJR IoT kit ○ Components: Breadboard-1, Coin battery -1, Battery socket-1, LED-1, PushButton-1, Male Jumper wires-4,Resistors : 330 ohm-1, 10K-1,1K-1 • Student Resources: ○ Laptop with internet connectivity ○ Earphones with mic ○ Notebook and pen ○ WHJR IoT kit ○ Components: Breadboard-1, Coin battery -1, Battery socket-1,LED-1, PushButton-1, Male Jumper wires- 4, Resistors: -330 ohm-1, 10K-1,1K-1	
Class structure	**Warm-Up** **Teacher-led Activity 1**	**5 mins** **10 mins**

	Student-led Activity 1 **Teacher-led Activity 2** **Student-led Activity 2** **Wrap-Up**	**5 mins** **15 mins** **20 mins** **5 mins**

WARM-UP SESSION - 5 mins	
Teacher Action	**Student Action**
Hey <student's name>. How are you? It's great to see you! Are you excited to learn something new?	**ESR**: Yes, I am excited about it!
In our last class, we discussed IoT simulations. We built a smart home system and an irrigation system to see how Internet-enabled devices work.	
Do you have any queries about our last session? *The teacher will clarify if students have any doubt.*	**ESR** Varied!
Do you like fun activities? Having fun before class will make the class more enjoyable.	
Try this tongue twister: *"IF A DOG CHEWS SHOES, WHOSE SHOES DOES HE CHOOSE?"* Isn't it fun?	**ESR** Yes!
You can try this with your friends too!	
WARM-UP QUIZ Click on In-Class Quiz	

Activity Details

Following are the session deliverables:

- Appreciate the student.
- Narrate the story by using hand gestures and voice modulation methods to make the students feel more interested.

Teacher Initiates Screen Share

ACTIVITY

- **Introduction to current, voltage, resistors, LEDs**
- **Introduction to TinkerCad**

Teacher Action	Student Action
Let's learn something new today. Are you excited?	**ESR** Yes!
What do you understand by visual signals? Visual signals are signs or indicators that are visible to the human eye, and communicate some message. The following are some examples of visual signals used in real life: ● Stadium displays ● Decorative displays ● Destination displays at airports, railway stations, bus stands ● Traffic lights ● Diwali/ Christmas lights ● Message displays ● Router/Modem power indicator	**ESR** Varied!
Have you ever wondered how they work?	

What type of electronic device is used for visual signals?	**ESR** Varied!
LEDs are used for visual signals. In addition to knowing about LEDs, many more things need to be understood when we are discussing visual signals. We must know the basics when dealing with electronic devices, whether it is an IoT device or a simple device. For example, let's consider a bulb. It can be a smart bulb or a simple bulb that we use at home. How do you turn on the bulb?	**ESR** Varied!
Yes, we need to turn on the switch, and the bulb will only light up if electricity is available. ***"Electricity or electric current is the movement of electrons through a wire."*** Now, let us understand how the electricity board measures it and charges us. Just as we have units like kg and gram to measure things, similarly, we have a unit to measure current, that is, **Amperes**, denoted by the letter **A**. Now I have a question for you. Do you really believe it's only the electric current that turns the bulb on?	**ESR** By turning the switch on. **ESR** Varied!

This brings us to the main thing that makes your devices turn on and off. All electronic devices which are connected to electricity must have internal circuits.

- You may be surprised to learn that every electronic device has different circuits.
- Electric circuits use various types of electric components, each having their own unit of measurement and symbol. We shall study them one by one.

Let us now learn the basics of electric circuits.

Electric Circuits

Electric circuits transfer electricity to components (such as light bulbs, fans, motors, etc) that transform electrons into other types of energy (such as light, motion, etc) in order to perform specific tasks.

How does an electric circuit work?

Electric circuits provide a path for the current to flow. This path must start and end at the same point.

Polarity refers to the direction of a **current** (flow of electrons) in a **circuit**. Within the circuit, the electrons (charged particles) move from end to end (poles). Typically, in a battery one pole is negative and one pole is positive. The positive end of a battery is labeled with the **+** sign, and the negative end will be labeled with the **-** sign.

In this case, the current would only flow in one direction, from negative to positive. The electric circuit of any device

ESR
Varied!

works only when its continuous path conducts electrons from the positive (+ve) terminal of a power source, through the input or output, back to the negative (-ve) terminal of the power source.

For any circuit to work you must have following things:

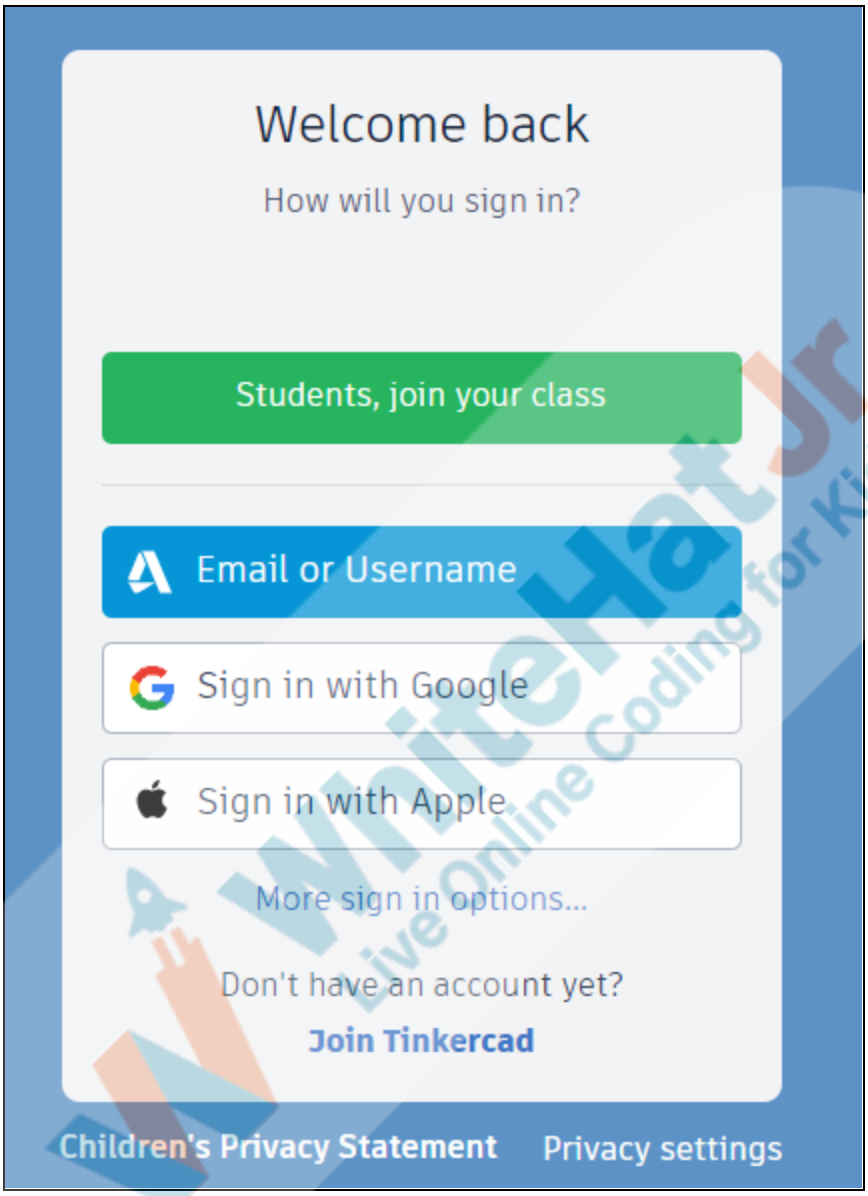
- Battery or Power source or Voltage

Voltage: Voltage is the pressure from a power source (battery) that pushes electrons through a wire. The unit **Volt** (denoted by the letter **V**) is used to measure voltage.

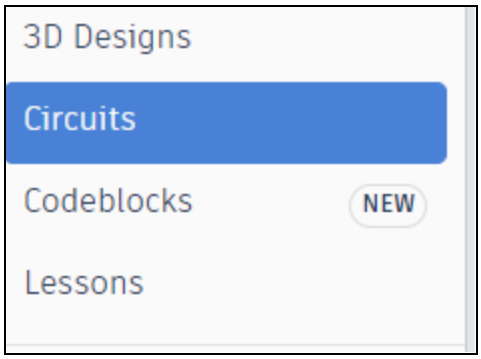
- Connecting wires make a continuous path or loop. Such a continuous path is called a closed circuit. An open circuit will never give any output.
- **Load**, which is the output, which could be an LED bulb, a regular light bulb, an air conditioner, a washing machine, or any other electric appliance.

How Current Flows in a Circuit

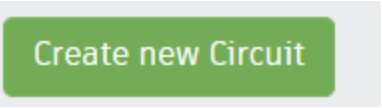
A simplest circuit may include three components: **Battery(V), ConWires,** and an **LED**. The circuit allows current to flow from the battery to the LED, through the LED, then back to the battery using connecting wires. Thus, the circuit forms a closed loop. Let's have a virtual tour of our electric components.	
Click on Teacher Activity 1	*Student clicks on Student Activity 1*
Tinkercad is an online 3D modeling program through which we can make and simulate electrical circuits. Whenever we want to design circuits we will simulate them here first.	
1. Click on Sign in 2. Sign up with Google or Apple or Email or username.	Student observers the teacher



- Click on **Circuits** at the left corner.



- Click on **Create new Circuit**.



Let's design a circuit. Select the components from the Right corner

- **Select Battery**

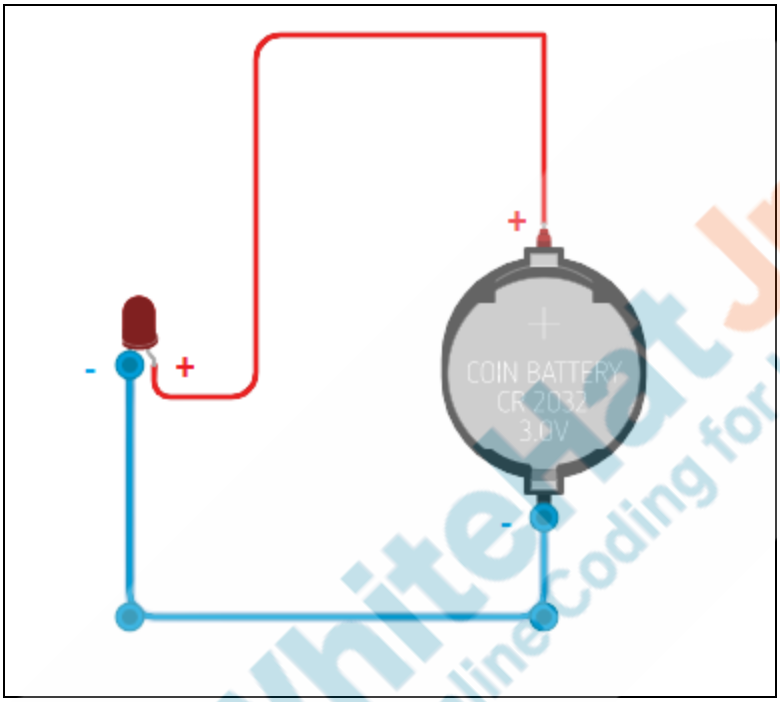
The battery has two ends, one positive (anode) and one negative (cathode).

- **Select LED (Light Emitting Diode)**

LED stands for **Light Emitting Diode**. Light-emitting diode (LED) is a device that produces light from electricity.

LEDs are used as indicators or as visual signals. You must have seen many LEDs in your daily life. An LED has two legs, one longer and one shorter.

• The longer leg is +ve and known as **anode**. • The shorter leg is -ve and known as **cathode**.	
Circuit Diagram We know about components, but how do we connect them? Can we connect them randomly? To understand circuits, we need to understand how to establish connections between electric components. And in order to understand more about electric components, we must know how to draw circuit diagrams. We can use actual components while designing circuits or we have electric symbols for each circuit component. ***Note:*** *Teacher will open the symbols reference link and show it to the student.*	**ESR** Varied!
Teacher clicks on Teacher Activity 2	*Student clicks on Student Activity 2*
Connections for Circuit Diagram Always use a color scheme for circuits. **Color Scheme:** • For **positive (+ve)** use red color. • For **negative (-ve)** use black/blue color. 1. Connect the **positive** terminal of the battery with the **LED's +ve** terminal (anode). Click on the positive part of the battery and drag it to the positive part of the LED. 2. Connect the negative terminal of the battery with	

LED's -ve terminal (cathode). Click on the negative part of the battery and drag it to the negative part of the LED.	
	
Click on the simulation and see the output. The LED will turn on and off when you click on the simulation button *In the field of electronics, it is important to take care of our safety and the safety of the products as well. It is therefore important to be careful while designing a circuit. Simulating circuits will help us design them correctly.* So, we designed our first circuit using an LED bulb, a battery, and connecting wires. So do you think it's a complete circuit? Yes, it's complete but not a safe circuit.	**ESR** Varied!

Now it's your turn to design circuits on Tinkercad and then we will learn about safe circuits.	
Teacher Stops Screen Share	
So now it's your turn. Please share your screen with me.	
Teacher Starts Slideshow  **Slide 10 to 13** <**Note**: Only Applicable for Classes with VA> Refer to speaker notes and follow the instructions on each slide.	
We have one more class challenge for you. Can you solve it? Let's try. I will guide you through it.	
STUDENT-LED ACTIVITY - 20 mins	
• **Ask the student to press the ESC key to come back to the panel.** • **Guide the student to start Screen Share.** • **The teacher gets into Fullscreen.**	
ACTIVITY • **Introduction to resistors.** • **Circuit simulation on tinker.**	
Teacher Action	**Student Action**
So let us discuss safe circuits. If you see any electric device at your home like air conditioning circuit, **LED** lights, or suppose you are probably working with any other electric circuits **Resistors can be found in almost every electrical circuit.**	

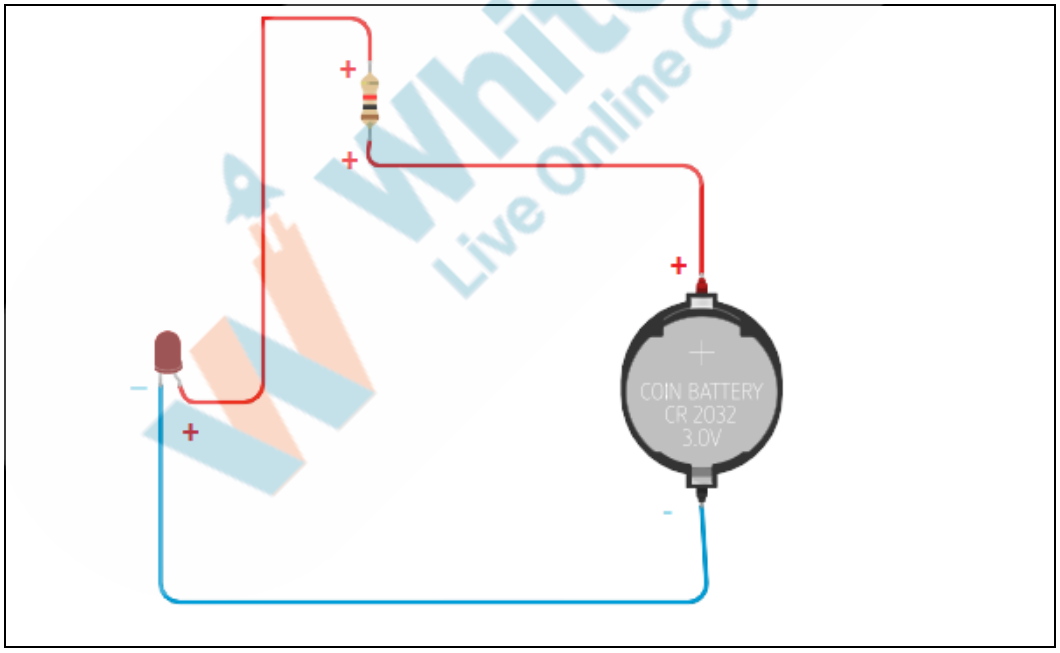
So, what do resistors really do and why are they so important to the electrical circuits that we use every day? A resistor **controls the flow** of current within a circuit. They act as a **breaker** for the current, or, we can say that they provide resistance to the flow of the current. The unit for resistance is **ohm.** Every electronic component has a specific voltage/current requirement, and resistors will protect the circuit if the voltage is too high. Basically, it protects the circuit from unwanted voltage spikes. Based on the requirements we may have different values of resistors, **330 ohms, 1k ohm**, and many more. Let's add a resistor in a circuit to make it a safe.	
Note: The teacher will guide the student to complete the activity; this time we need to add a resistor too.	
1. Select LED, Battery, Resistor  **2. Select Resistor** Resistors don't have specific positive or negative terminals. When current flows through a resistor, the terminal through which the current enters the resistor will be considered as the positive terminal and the one through which the current goes out will be considered the negative terminal.	Student makes the circuit on Tinkercad
Color Scheme:	

- For **positive (+ve)** use red color.
- For **negative (-ve)** use black/blue color.

1. Connect the **positive** terminal of the battery with one of the resistor's terminals. Click on the positive part of the battery and drag it to the resistor terminal.

2. Connect **another resistor terminal** to the **+ve** (anode or longer leg) of the LED. Click on the resistor another terminal and drag it to the +ve (anode or longer leg) of the LED

3. Connect the **negative terminal** of the battery with LEDs **-ve** (cathode) terminal. Click on the negative part of the battery and drag it to the negative part of the LED.



TEACHER-LED ACTIVITY - 10 mins

<table>
<tr><th colspan="2">Teacher Initiates Screen Share</th></tr>
<tr><td colspan="2"><u>ACTIVITY</u>

• Introduction to breadboards.
• Circuit design on a breadboard.</td></tr>
<tr><th>Teacher Action</th><th>Student Action</th></tr>
<tr><td>We've only seen the simulation until now. Let us see how we can make such connections using the real components

To perform the same activity with real components, we need a breadboard.

Do you know what breadboards are?

A breadboard is used to make up temporary circuits for testing or to try out an idea. It is easy to change connections and replace components. A breadboard has many mounting holes.

The teacher will take her breadboard and the student will take his/her breadboard.</td><td>ESR
Varied!</td></tr>
<tr><td>If we see a breadboard for the first time, then we may feel it is a very difficult task to connect the circuit as it consists of several holes which can be somewhat confusing.

But with a little practice and learning, it can become easy to understand.

Component Rails: Breadboards have numbers and letters marked on various rows and columns. Letters on the breadboard are printed at the top & bottom that range from A to J and run horizontally. They are connected to each other internally.
Middle Divider: The line between abcde and fghij is called the middle divider which is used to mount four-leg components like push buttons.</td><td></td></tr>
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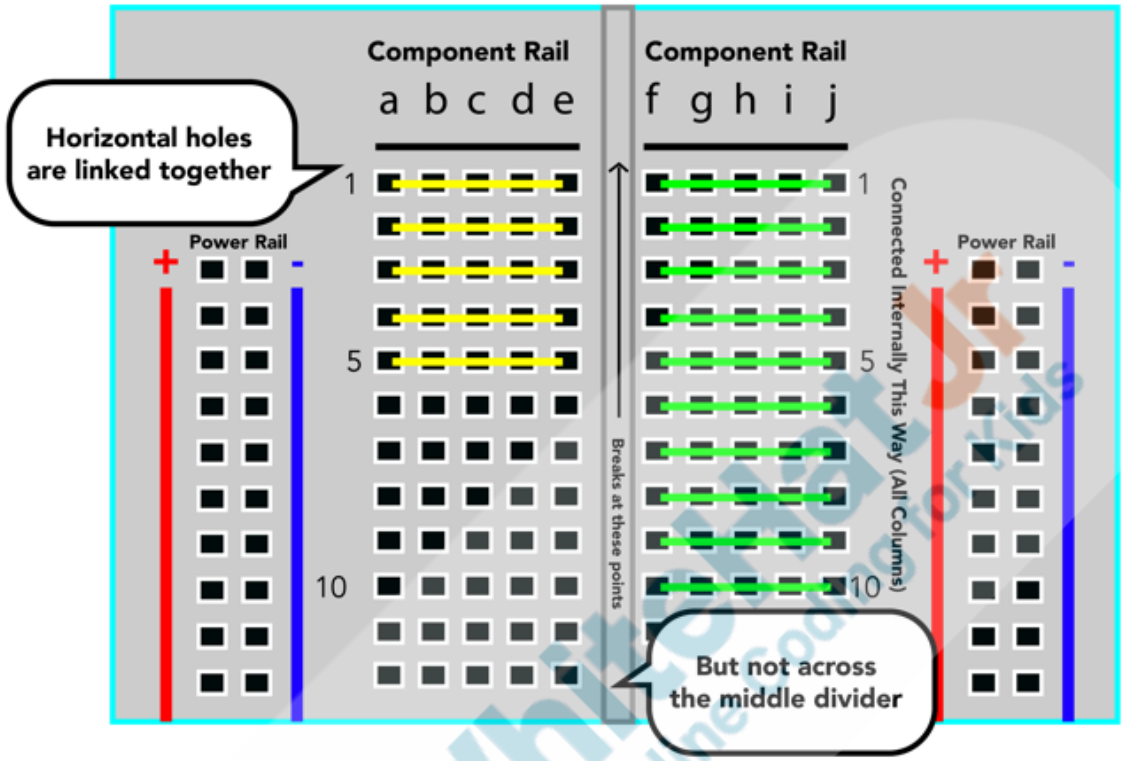
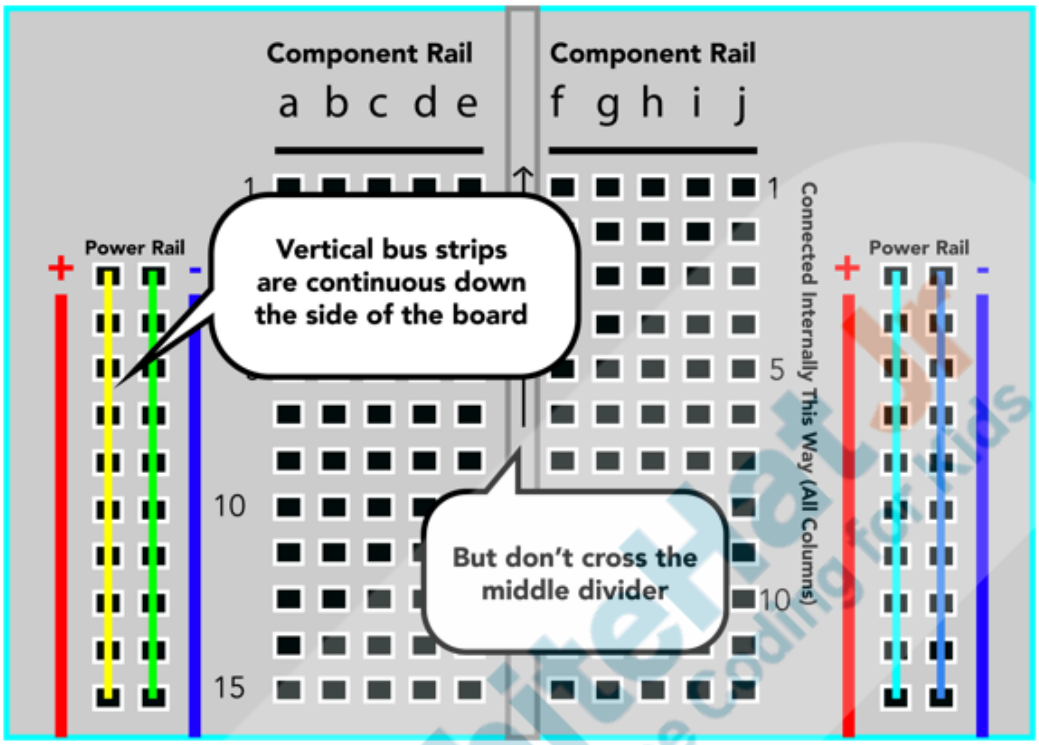


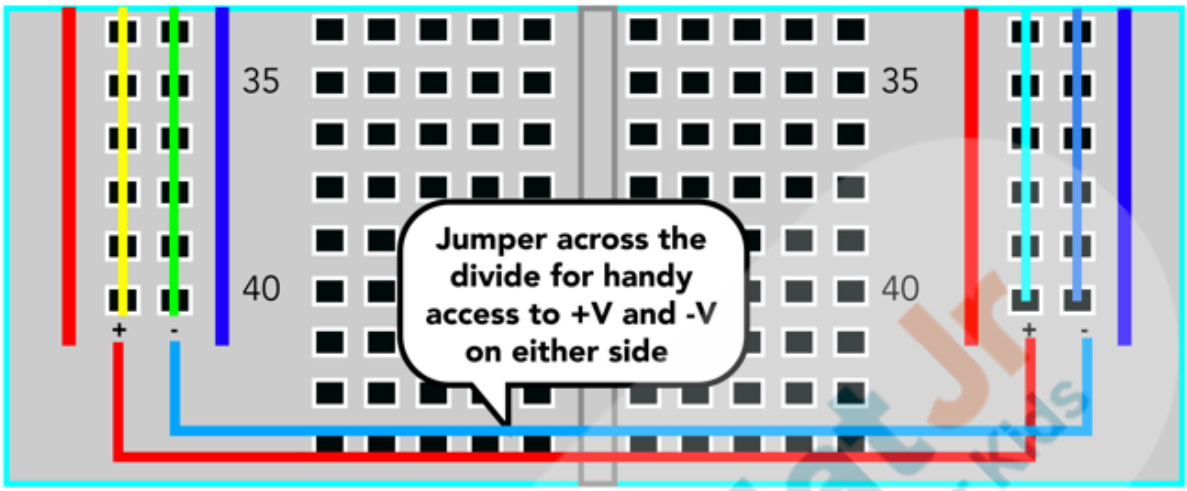
Power Rails: The **red VCC (+ve)** and **blue GND (-ve)** are called power rails that are used to provide supply to the breadboard. They are not connected to each other.



Jumper Wires

Jumper wires are simply wires with connector pins at each end, allowing them to be connected with electronic components like resistor, LED, etc.

Jumper wires are typically used with breadboards to access +ve and -ve on both sides (not necessarily used, just for ease).

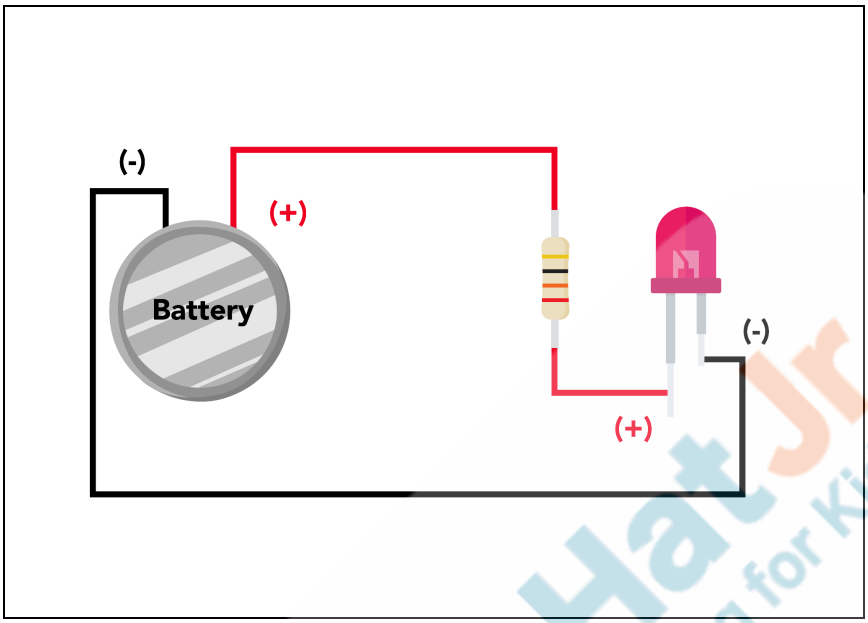


To understand the breadboard better, let's make a circuit diagram on a breadboard.

Let's have a blinking LED bulb on the breadboard:

First, gather the following materials:

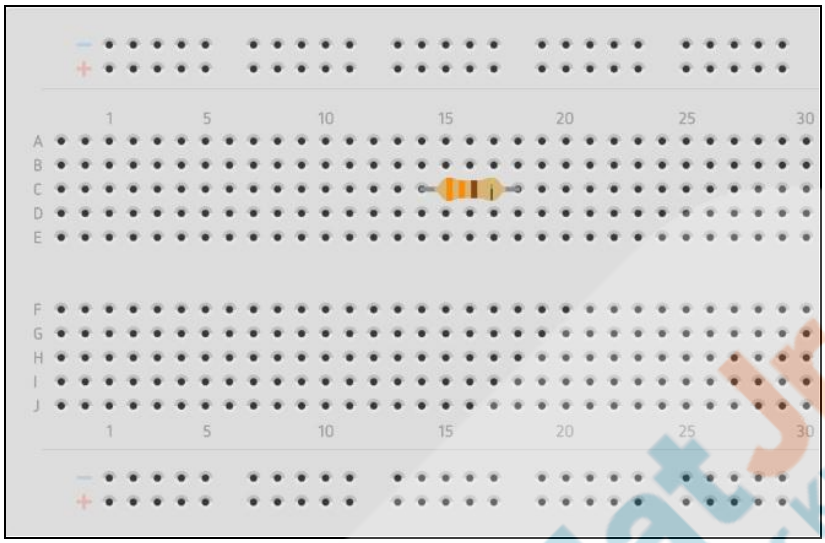
- 1 x Breadboard
- 1 x Resistor
- 1 x LED
- 1 x battery along with battery socket
- 3 x Jumper Wires: Use jumper wires to jump from the breadboard to other components.



Look at the circuit diagram and follow the same on a breadboard.

1. Insert the Resistor into the Breadboard

Connect one of the resistors ends directly with a **positive supply** of the top power rail. Another resistor terminal should go into a hole below the middle breaker of the breadboard. The resistor is not polarized so it does not matter in which direction you insert it.

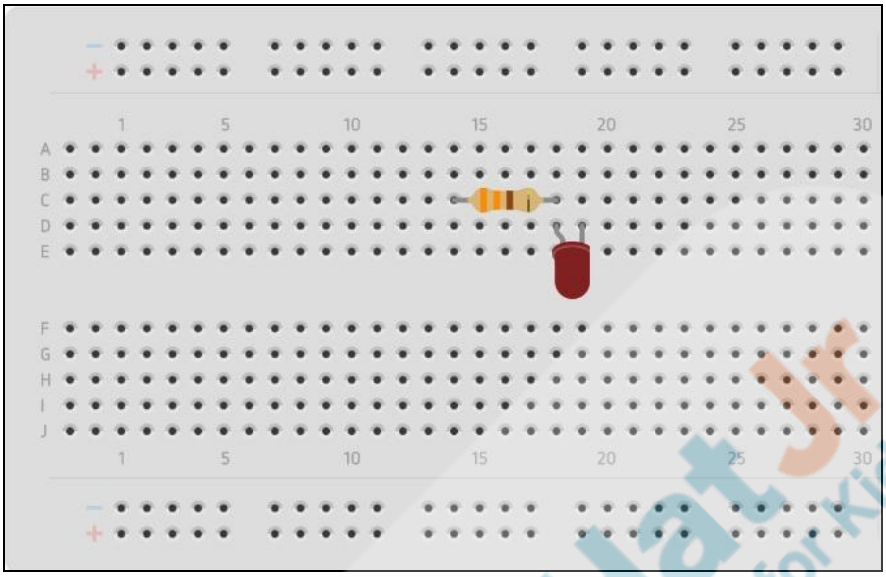


2. Insert the LED into the Breadboard

Make sure that the **longer leg (anode) of the LED** is **connected to just the bottom of the resistor** (because they are internally connected so the same +ve supply will flow) and the other end of the LED is connected to another column to connect with the -ve supply to make the circuit complete.

Note: *Students and teachers can follow any pattern. By viewing the circuit diagram and keeping track of the +ve and -ve supply voltages any combination can be made on the breadboard.*

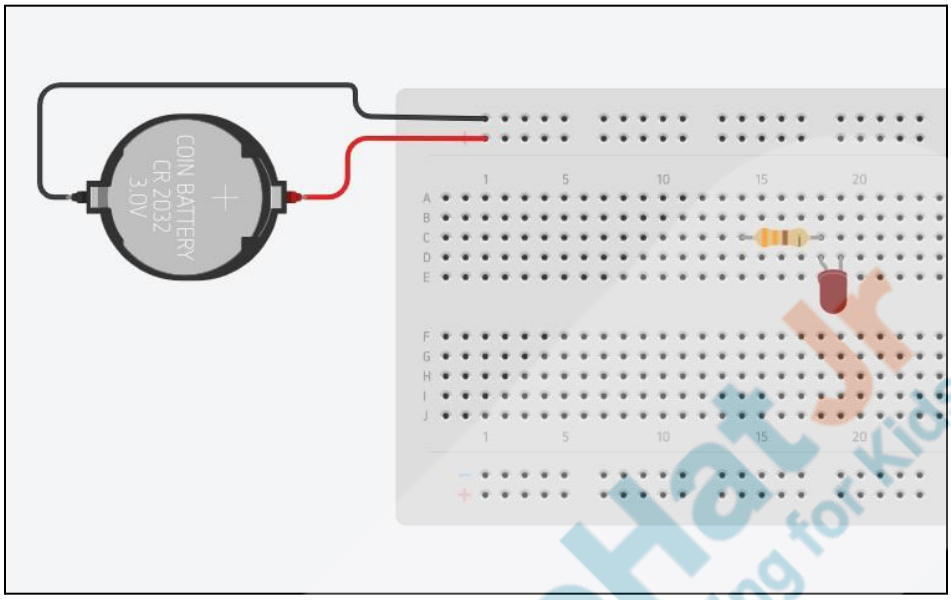
The same can be designed on Tinkercad first.



3. Insert the Battery into the Breadboard

Plug the red (**positive) wire of the battery clip** into the **+ve power rail of the breadboard**. Plug the **black (negative) wire** of the battery clip into the -ve power rail of the breadboard.

Now our breadboard has a power supply. We just need to add components to make a complete circuit.

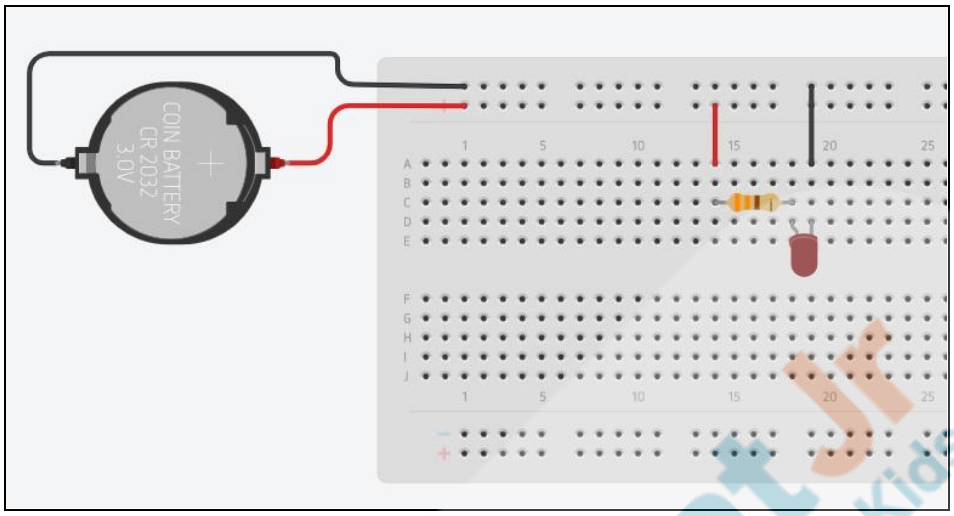


4. Insert the Jumper wire

Now let's power up our electronic components. Insert a jumper wire connector into a hole directly above the resistor terminal and extend it to the +ve supply of power rail.

Insert a jumper wire connector into a hole directly above the LED (short leg or cathode) terminal and extend it to the +ve supply of power rail.

This will make the circuit complete.



So our LED is working properly now. Our LED is switched on, but can we change its intensity? The intensity here refers to whether the LEDs are dim or very bright. And yes, we can change the intensity. Now, it's your turn to make the LED blink and turn the LED light low or high.	**ESR** Varied!

Teacher Stops Screen Share

STUDENT-LED ACTIVITY - 10 mins

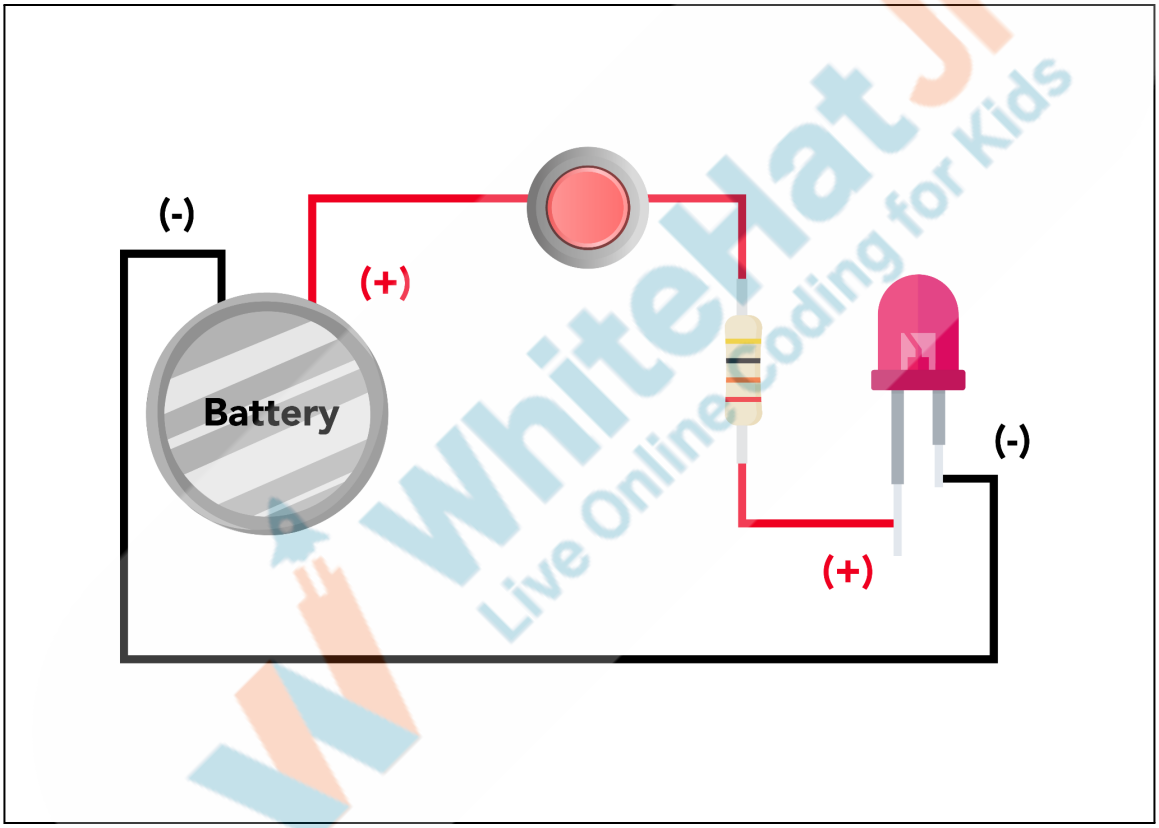
- **Ask the student to press the ESC key to come back to the panel.**
- **Guide the student to start Screen Share.**
- **The teacher gets into Fullscreen.**

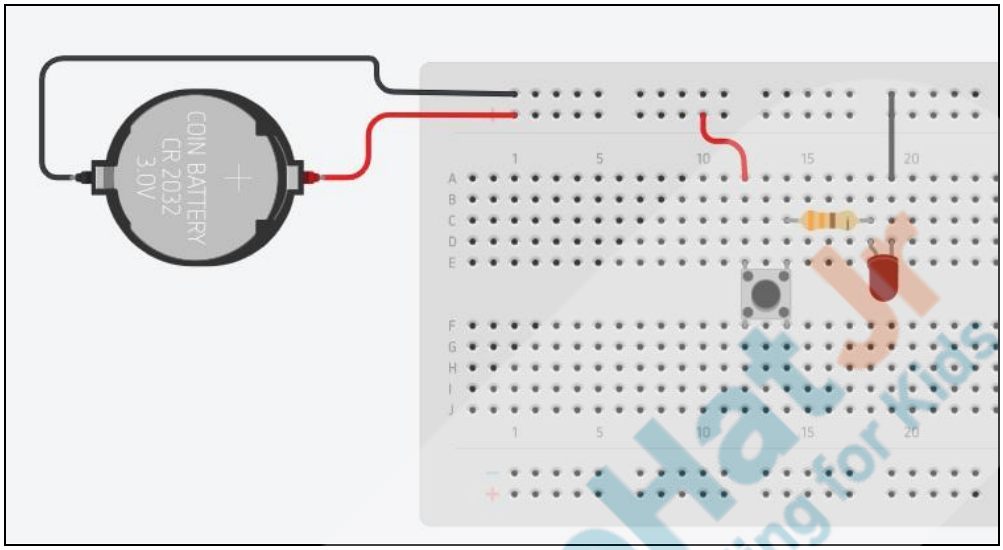
ACTIVITY

- **Make the LED blink.**
- **Turn the Intensity of the LED light low or high.**

Teacher Action	Student Action

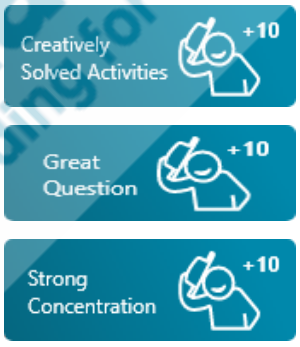
The brightness of an LED bulb changes depending on the amount of current flowing through it. We know it's the resistance that acts as a breaker for the current. Now if you check your WHJR IoT kit, you will see resistors of different types. You will be surprised to know that while comparing a **330Ω** resistor to a **10kΩ** resistor: ● More current flows through the 330Ω resistor with the smaller resistance, which causes the LED to light up more brightly. ● Less current flows through 1 kΩ with the higher resistance, which causes the LED light to dim.	
During the activity, the teacher will guide the student. Perform all steps as mentioned in TA Activity to make the LED light blink. *Note: While changing any component, remove one of the battery ends from the breadboard* When the LED starts blinking, tell the students to change the resistance and check how resistance helps to control the current.	The student performs the activity
After checking the resistor's role, you might wonder if there should be a button to control the LED. Right! For that, let's use a push button in the circuit. I am sure you know what a switch is used for. A Push Button is a type of switch that works on a simple	**ESR** Yes! **ESR** To turn on and off!

mechanism called “Push-to-make”. Initially, it remains in an **off state or normally open state** but when it is pressed, it allows the current to pass through it or we can say **it closes the circuit when pressed.** We need to do a little bit of change in a circuit	
	
Take a push-button switch. Now mount the push button. The push button has four legs, so mount two on one side and the other two on the other side of the middle breaker. Connect **one end** of the push button to the **+ve** supply of	

the battery and another end of push-button to the terminal of the resistor.	
	
Press the button and check the circuit. When the button is pressed it conducts current through it and makes the complete closed circuit. As the button is released it breaks the circuit and stops the flow of current.	
Teacher Guides Student to Stop Screen Share	
WRAP-UP SESSION - 05 mins	
Activity details **Following are the WRAP-UP session deliverables:** • Appreciate the student. • Revise the current class activities. • Discuss the quizzes.	
WRAP-UP QUIZ Click on In-Class Quiz	
Activity Details	

Following are the session deliverables:

- Explain the facts and trivia
- Next class challenge
- Project for the day
- Additional Activity (Optional)

Teacher Action	Student Action
You get hats-off for your excellent work! In the next class, _____	*Make sure you have given at least 2 hats-off during the class for:* 
PROJECT OVERVIEW DISCUSSION Refer the document below in Activity Links Sections	
Teacher Clicks ✖ End Class	
ADDITIONAL ACTIVITIES	
Additional Activities(Optional)	

ACTIVITY LINKS		
Activity Name	**Description**	**Link**
Teacher Activity 1	TinkerCad	https://www.tinkercad.com/
Teacher Activity 2	Component & Symbols Reference sheet	https://s3-whjr-curriculum-uploads.whjr.online/2949124c-ab3a-4d98-ae3d-96ba76e84ec4.docx

Teacher Reference 1	Project	https://s3-whjr-curriculum-uploads.whjr.online/0f434bbe-1721-49d6-8cb8-855daaee53232.docx
Teacher Reference 2	Project Solution	NA
Teacher Reference 3	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/e16668ac-4713-4a07-bd93-b93cf9d6db1f.docx
Student Activity 1	TinkerCad	https://www.tinkercad.com/
Student Activity 2	Component & Symbols Reference sheet	https://s3-whjr-curriculum-uploads.whjr.online/2949124c-ab3a-4d98-ae3d-96ba76e84ec4.docx
In-Class Quiz	In-Class Quiz	https://s3-whjr-curriculum-uploads.whjr.online/e16668ac-4713-4a07-bd93-b93cf9d6db1f.docx