Self-Training Activity 2:

LED Series Circuit Analysis and Fault Visualization

This activity is designed for students to visually and mathematically confirm the behaviour of **Series Circuit Connections**, focusing on the single current path.

1. Pre-Activity Theoretical Planning and Calculation (Analysis)

Component	Value	Role in Circuit
Source Voltage (VT)	9	V (Standard battery)
LED 1	≈2V to 3V forward voltage	Visual Load
LED 2	≈2V to 3V forward voltage	Visual Load
Current-Limiting Resistor (RS)	330	Ω (Used to protect the LEDs)

Tasks (Show all working):

1. **Estimate Total Forward Voltage** (VF): Assume VLED=2V for each LED.

   VF=VLED1+VLED2

2. **Calculate Resistor Voltage** (VR): This is the voltage that must drop across the current-limiting resistor (RS).

   VR=VT−VF

3. **Calculate Expected Total Current** (IT): Use Ohm's Law with the resistor's voltage and value.

   IT=RSVR

4. **Prediction:** Based on the properties of a series circuit, will the current through LED 1 be the same as the current through LED 2? (**Yes/No**)

Quantity	Calculated/Estimated Value	Unit
VF (Estimated)		V
VR (Calculated)		V
IT (Expected)		mA

2. Hands-On/Virtual Construction and Measurement (Application)

Use a physical breadboard and components (if available) or a reliable circuit simulation tool (e.g., PhET or Tinkercad).

Tasks:

1. **Construct the Circuit:** Connect the 9V source, the 330Ω resistor (RS), LED 1, and LED 2 **all in series** in a single path. Ensure the LEDs are connected with the correct polarity.
2. **Observation A: Closed Circuit:**
    - **Result:** Observe the LEDs. Are both LEDs lit? Record the brightness.

3. **Measurement:** Use a virtual or real multimeter to measure the following:
    - Measure the **Current** at any point in the circuit (Im,T).
    - Measure the **Voltage Drop** across the current-limiting resistor (Vm,R).
    - Measure the **Voltage Drop** across LED 1 (Vm,LED1) and LED 2 (Vm,LED2).

Observation/Measurement	Value	Unit	Compare to Calculated (IT, VR)
LED Brightness			
Measured Im,T		mA	
Vm,R		V	
Vm,LED1+Vm,LED2		V	

Reflection: Explain the relationship between your measured total voltage drops (Vm,R +Vm,LED1+Vm,LED2) and the source voltage (VT). Which fundamental law does this verify?

3. Visual Fault Analysis (Series Open Circuit Principle)

Tasks:

1. **Fault Simulation: Single Component Break (Open Circuit):**
    - **Action:** Disconnect the wire leading immediately after **LED 1**, simulating a physical break in the path.
    - **Observation:** What happens to **LED 2**?

2. **Fault Simulation: Component Polarity Error (Diode Open Circuit):**
    - **Action:** Restore the connection. Now, **reverse the polarity** of **only LED 2**.
    - **Observation:** What happens to **LED 1** and **LED 2**?

3. **Fault Analysis:** Fill in the table below.

Fault Condition	Observation (What happened to ALL lights?)	Core Principle Demonstrated
Fault A: Physical Break		
Fault B: LED 2 Reversed		

Conclusion: In a series circuit, any interruption (a break, a failed component, or a reversed diode blocking current) immediately stops the flow of current **to every single component** because there is **only one path**. Therefore, if one LED goes out, **all LEDs** in the series connection go out.

Tips

1. Led will light if the current flows.

2. Led will off if the there is no current flows.