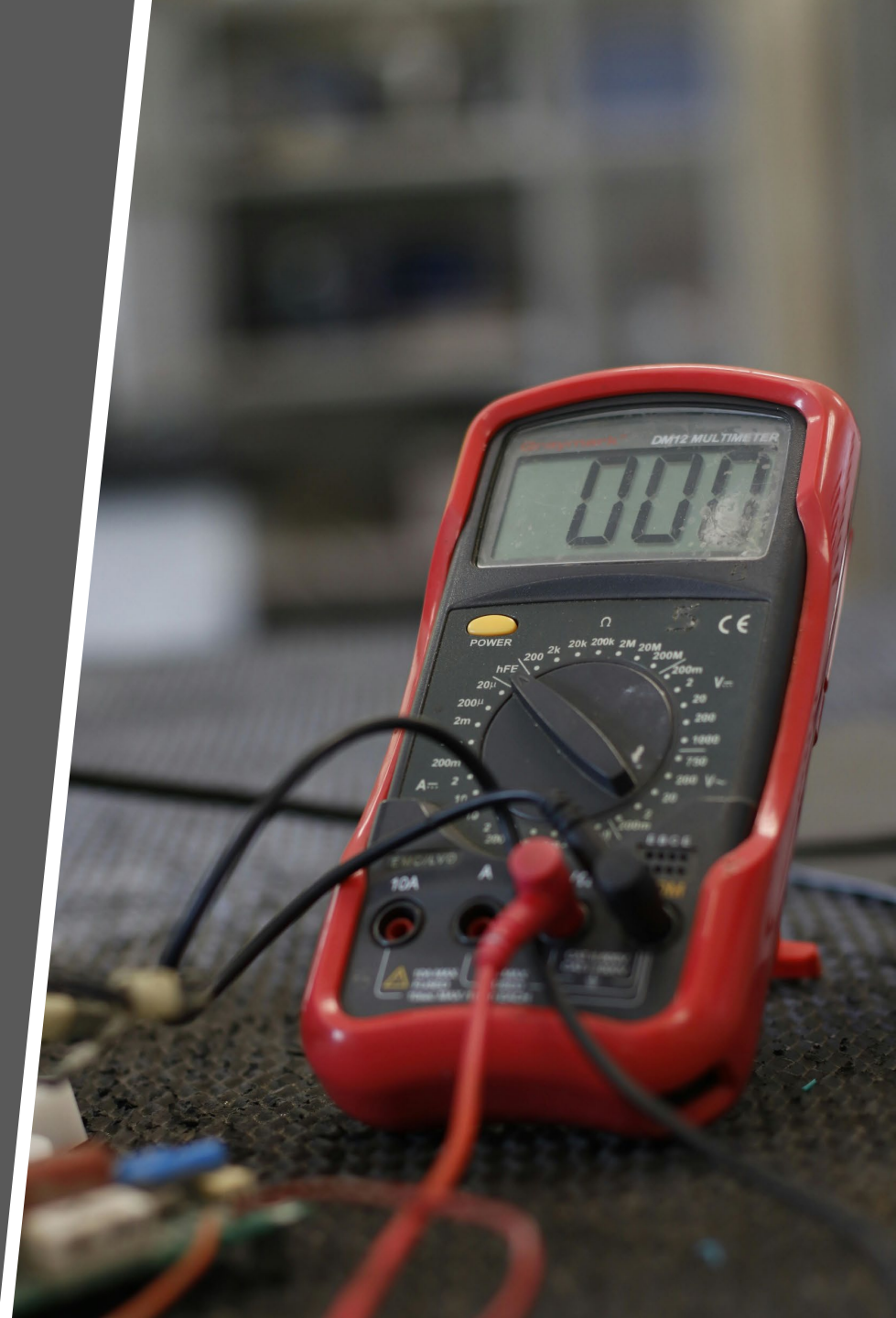




Lesson 4: Testing with a Multimeter and Auto Light Tester

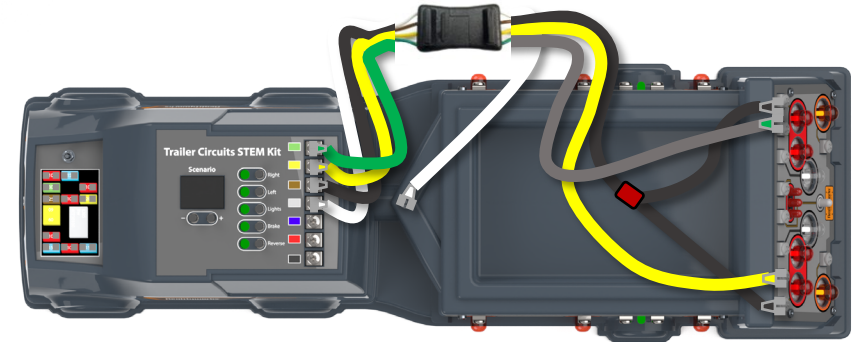
Trailer Circuits STEM Kit Curriculum

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You Will Need These Items

1. Multimeter
2. Auto light tester
3. Trailer Circuits Trucks with 4-way flat harness installed and tested



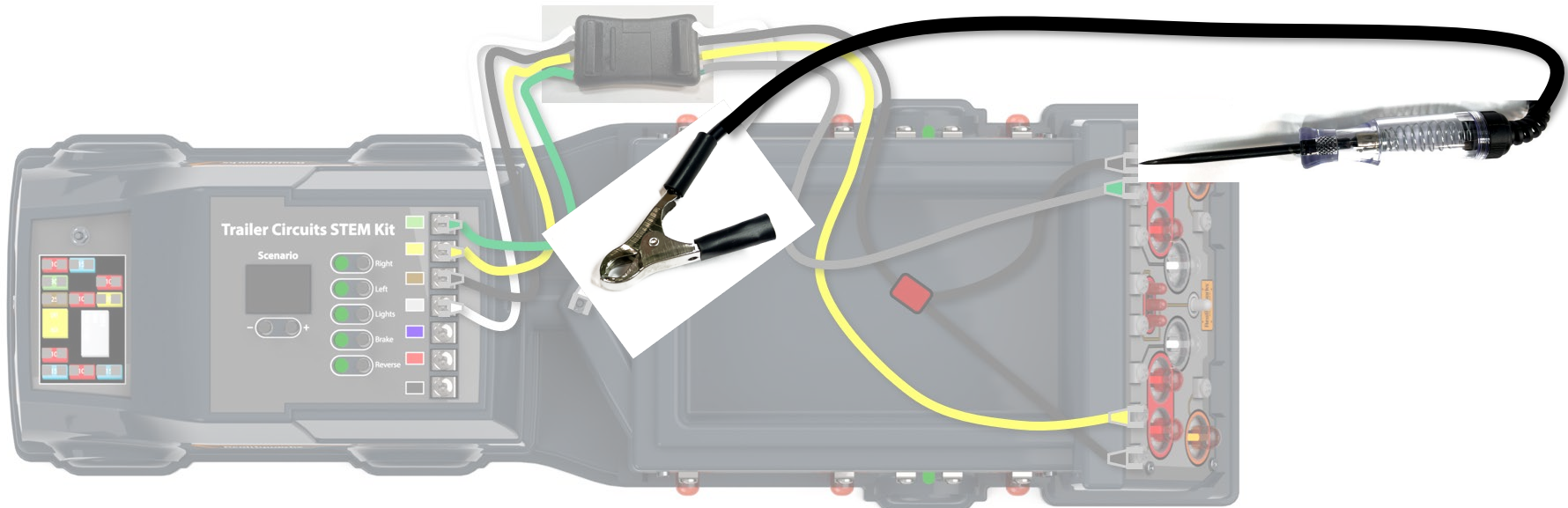
Auto Light Tester

- This tool is a quick and easy way to see if power is present in a circuit
- When power is present in the circuit, the light in the handle turns on
 - Bright light = high voltage present
 - Dim light = low voltage present
 - **No light** = no electricity or a very tiny amount



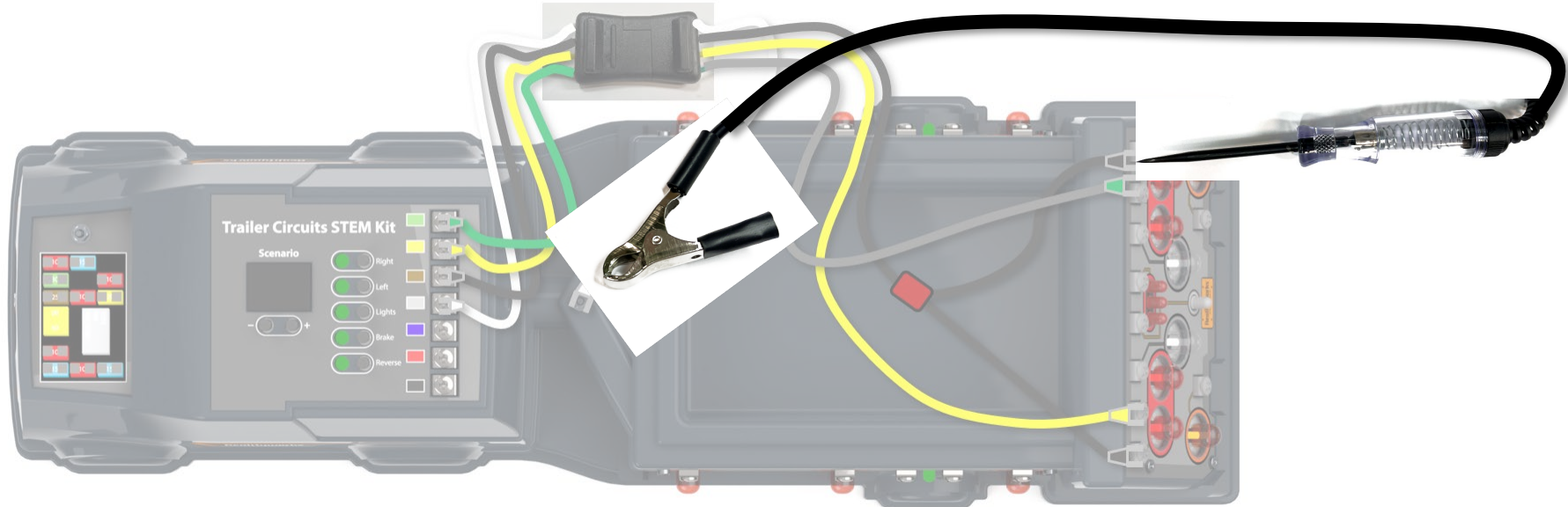
Auto Light Tester: Try It 1

1. Turn on the Trailer Circuits Truck with the 4-way flat harness installed.
2. Turn on the taillights by gently pushing the Lights button on the control panel.
3. With the taillights on, place the:
 - Grounding clip on the ground post of the trailer
 - Touch the probe to the left taillight terminal
4. **What happened?** The light in the probe handle should **glow**, telling you that there is power flowing between these 2 points.



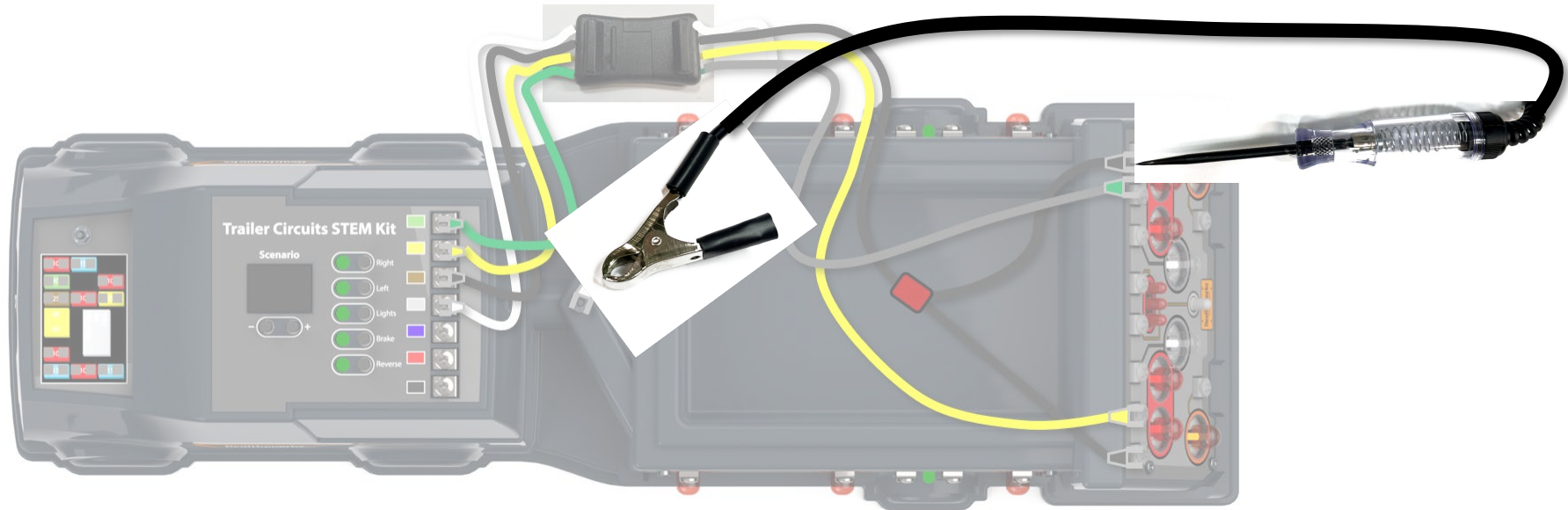
Auto Light Tester: Try It 2

1. Turn the lights off by pushing the button on the control panel.
2. When you test this circuit now, does the test light glow?
 - It should not! Because no current should be flowing in the circuit since you turned it off



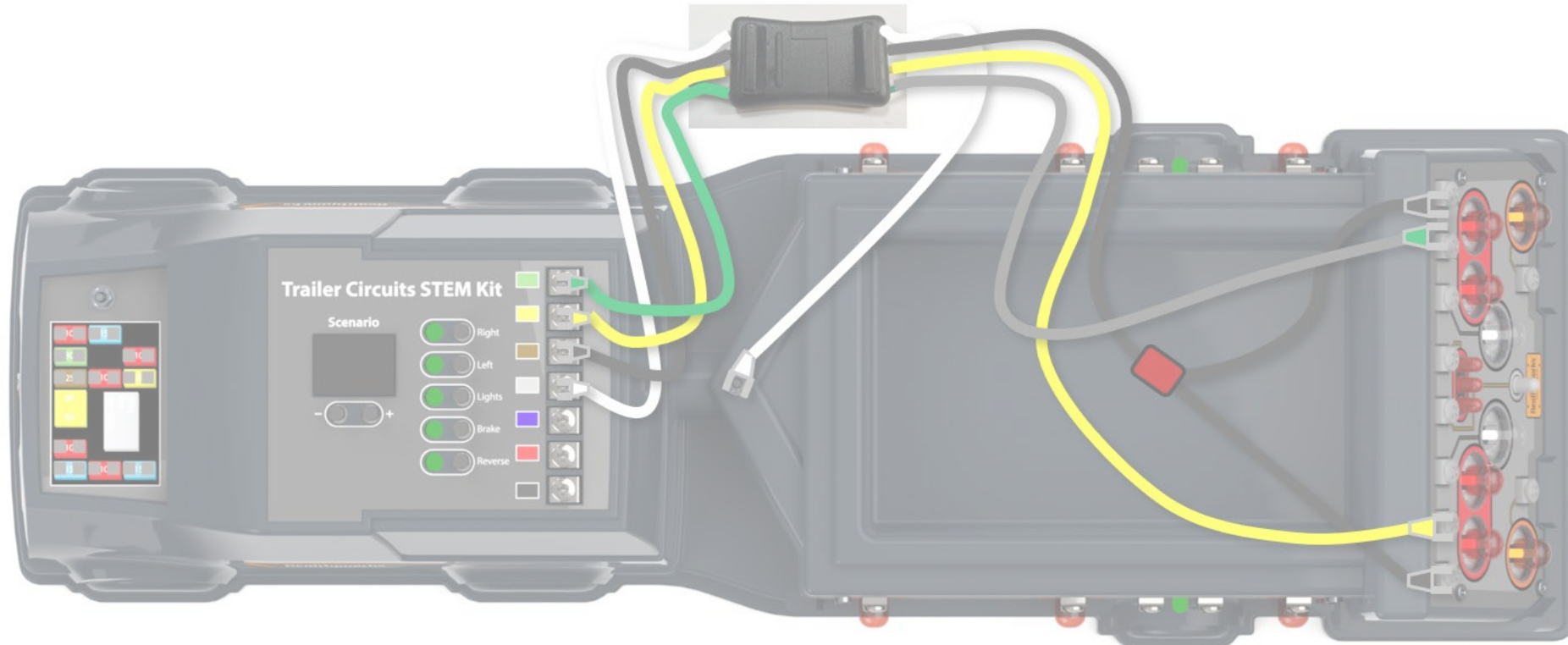
Auto Light Tester: Try It 3

Follow the instructions in your student workbook to practice testing different connections with the auto light tester.



Using the Multimeter: Measuring Voltage

Turn off the Trailer Circuits Trucks before moving on.



A more powerful tool...

The multimeter.

You will learn how to measure/check:

- Continuity
- Voltage
- Current



Understanding the Multimeter

- Used to measure properties of electrical circuits
- 2 types
 - We will use a digital multimeter

Analog

Has a dial with a needle that moves to show measurement.



Image Source:
<https://openverse.org/image/b04ca005-5fb9-43d6-a814-563906ef01fc?q=multimeter>

Digital

Has an LCD screen that shows measurement.



Multimeter Safety

- Multimeters are used on **live** circuits, with current flowing
- This means you must use them properly to prevent:
 - Dangerous short circuits
 - Causing damage to the meter
 - Causing damage to the circuit
 - Blowing the fuse in the meter
 - Shocking yourself
- Only place the metal test leads where instructed



Multimeter Safety

Test Leads:

- Placement matters because the multimeter measures polarity
- **BLACK LEAD** = plug into COM
- **RED LEAD** = plug into right port for working on the Trailer Circuits Truck
- The 10A port on the left is for when you are measuring high current circuits, such as in a household circuit



Using the Multimeter Dial

Multi = can measure many things; use the dial to select what you want to measure



Using the Multimeter Dial

Turn the dial as shown, set to check **continuity**.

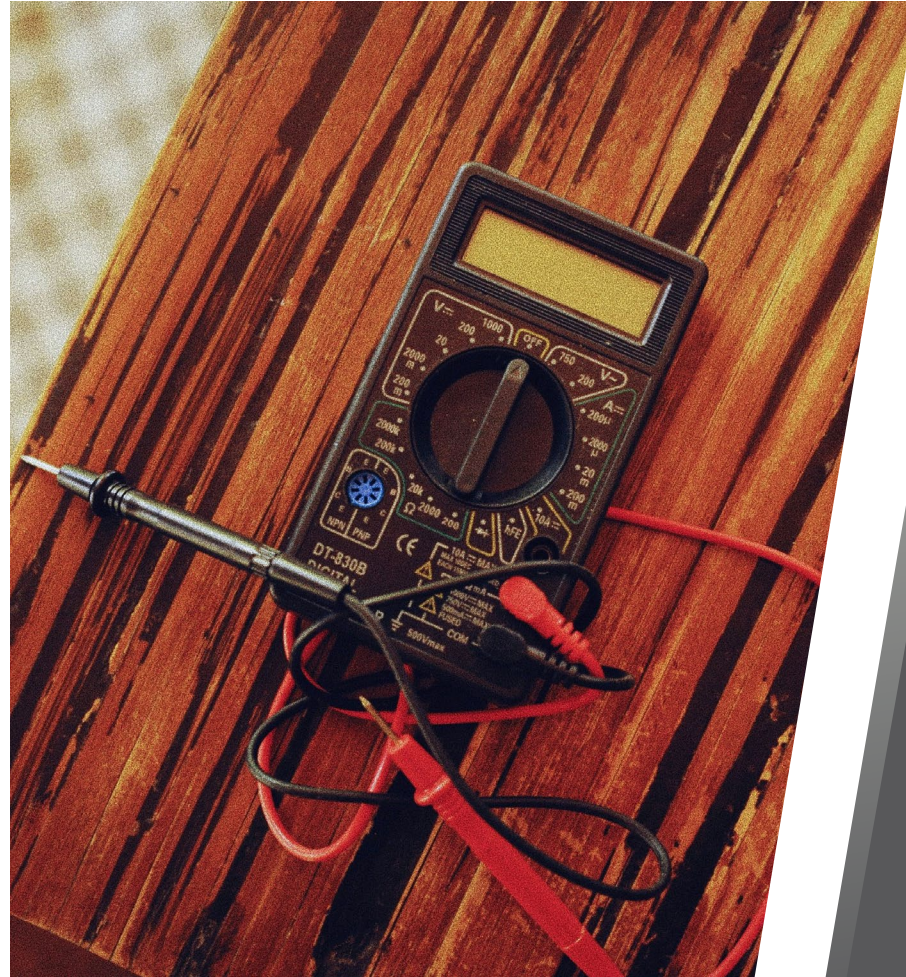
This symbol is telling 2 things:

1. This setting will check a circuit for continuity.
2. It will make a sound if continuity exists.
3. **Bonus:** This multimeter also has an indicator light that turns on if there is continuity.
4. **Try It!** Touch the 2 probes together and listen/look for the signal.



Continuity: What Is It?

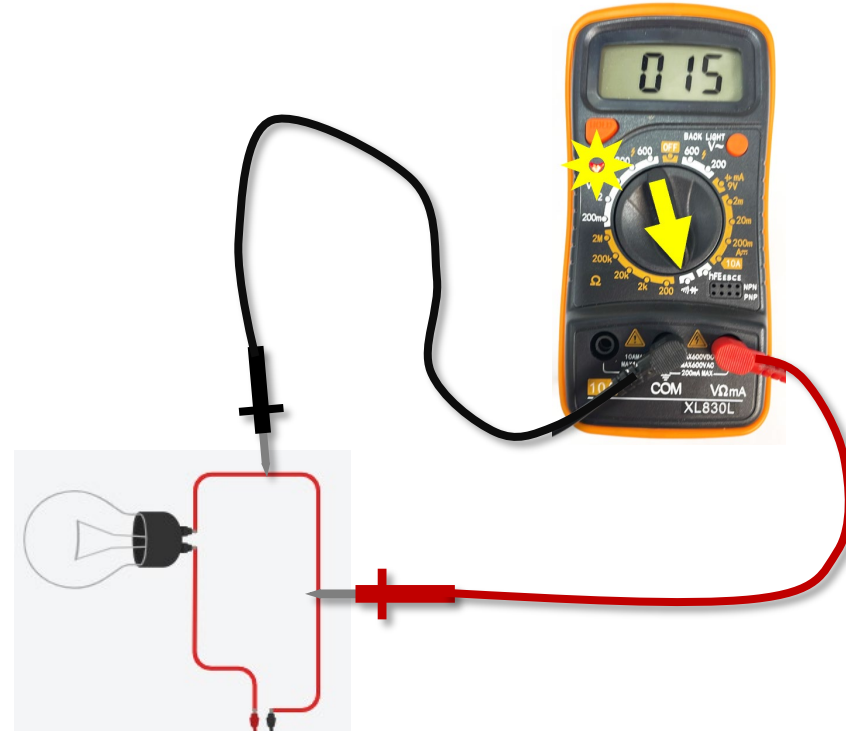
- The first check of a system, helpful when troubleshooting
- Continuity tells you if a complete electrical path exists between the 2 points you touch with the red and black probes
- If continuity does **not** exist, there is a break somewhere in the path between the 2 probes
- ***MAKE SURE THE CIRCUIT IS OFF = NO LIVE POWER!***



Continuity: Need to Know 1

CORRECT Continuity Check:

- **Always make sure the circuit is off and there is no power**
- Place the probes on the section of the circuit you want to test
- If the circuit is complete between these 2 points, the meter will beep/flash and show a number
- The lower the number, the better
- A higher number indicates resistance between the 2 points

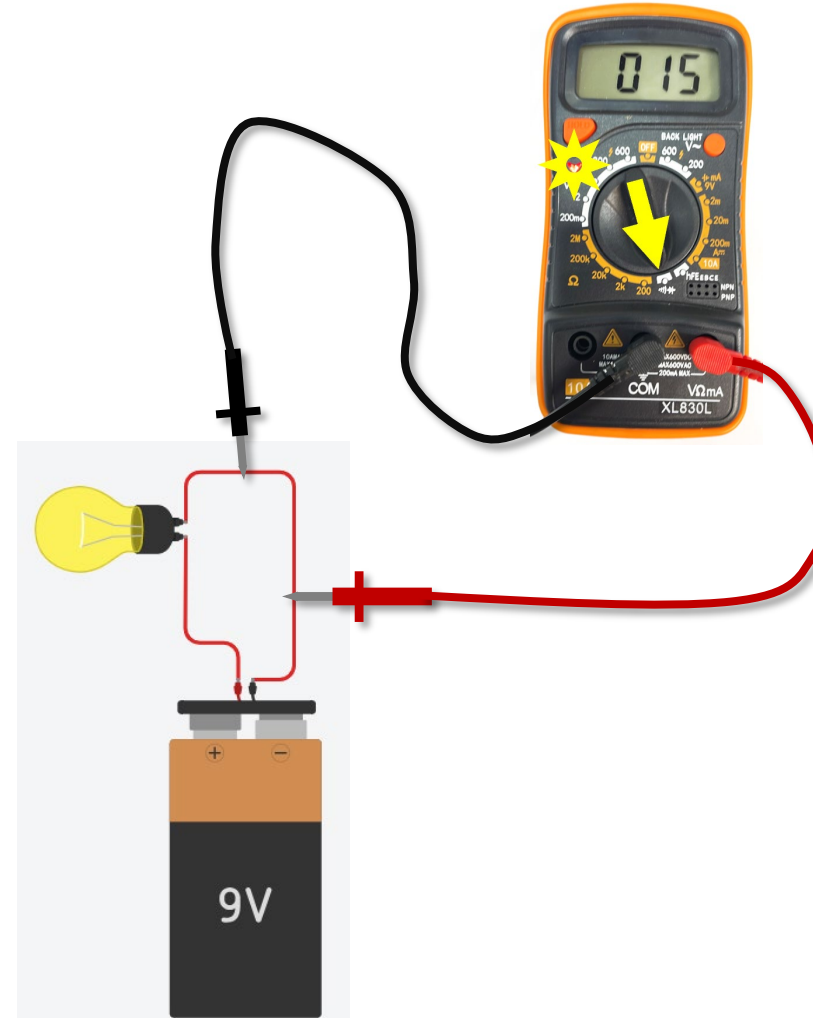


No battery/power.
Must have an off circuit
when testing for
continuity.

Continuity: Need to Know 2

INCORRECT Continuity Check:

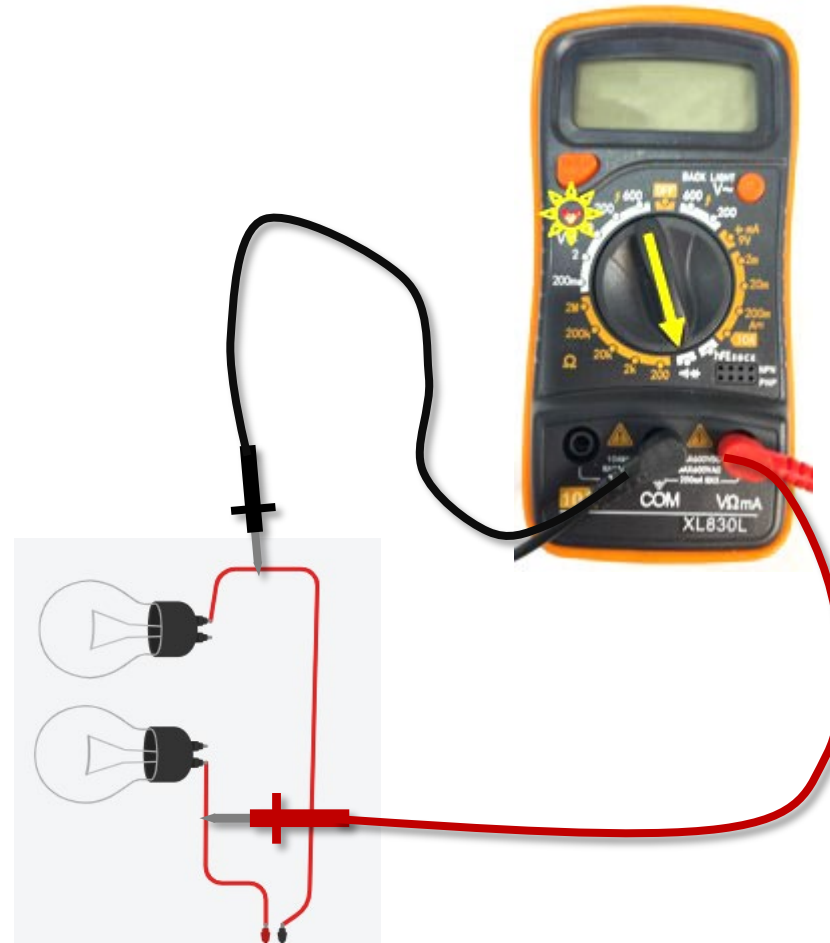
- **Why is this incorrect?**
- **The circuit is live!**
- **Incorrect measurements will occur**



Continuity: Need to Know 3

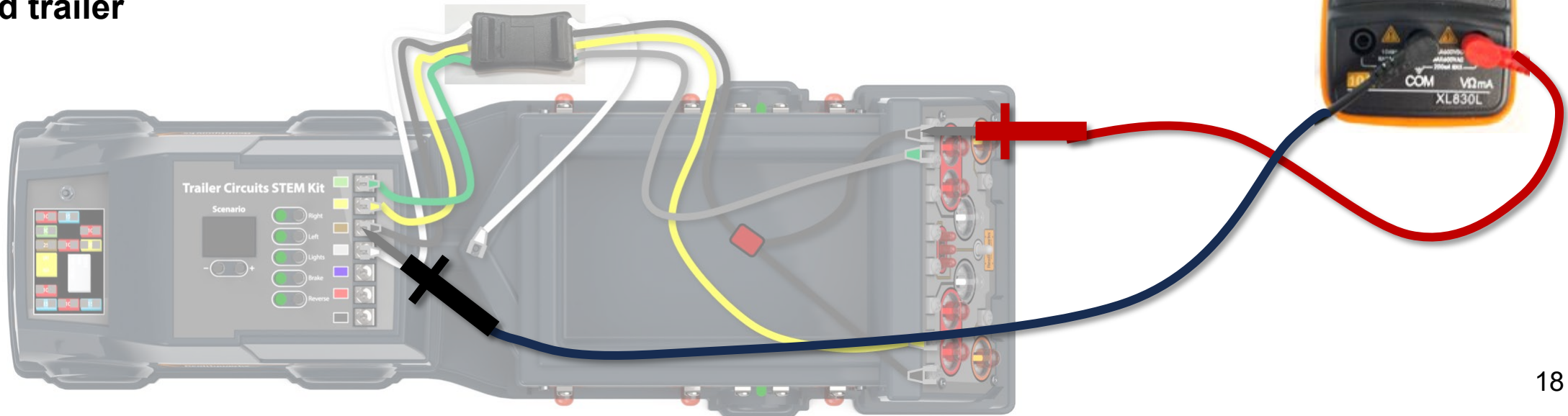
CORRECT Continuity Check:

- **This is the correct way to test, but...**
 - Why does the meter **not** beep/flash to indicate continuity?
 - *Between the probes, there is a missing or broken wire, so the circuit is not complete... aka no continuity.*



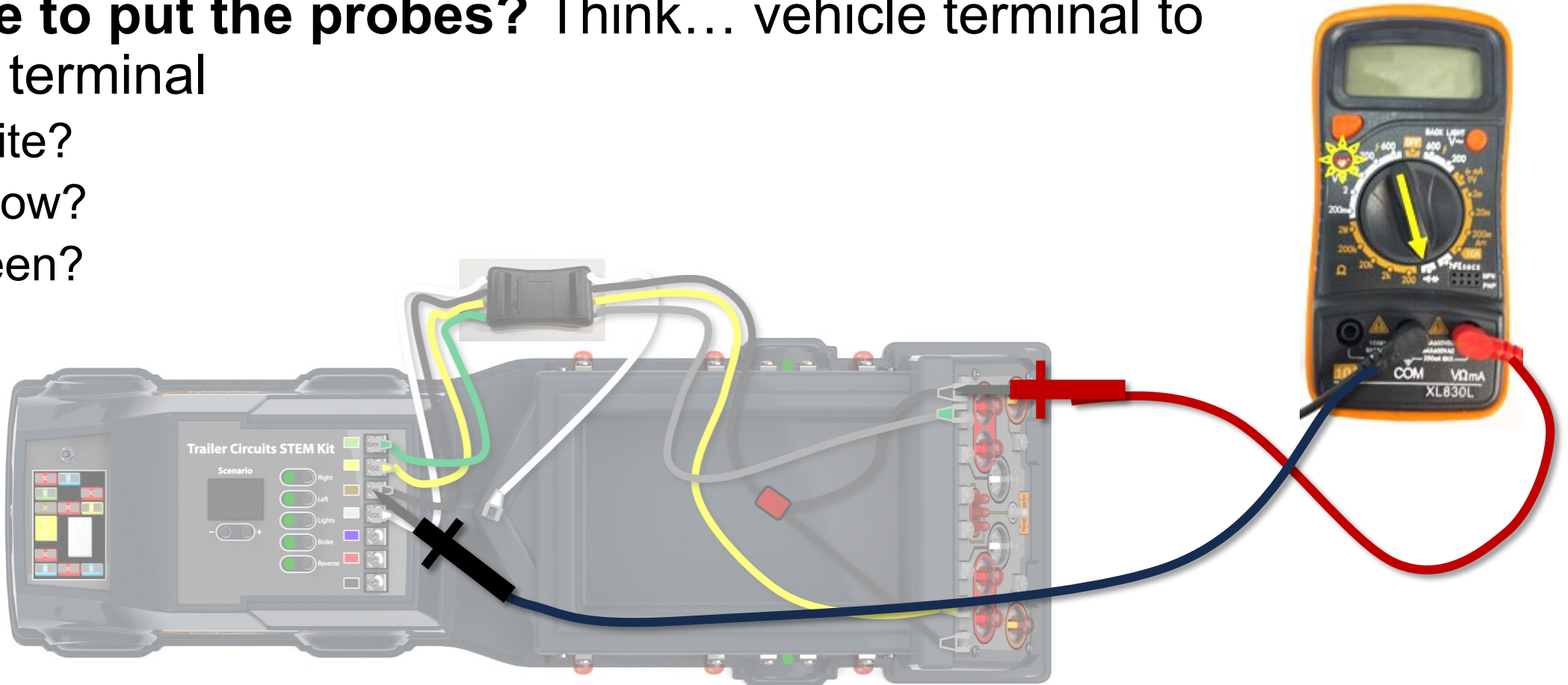
Measuring Continuity: Try it 1

1. Make sure the Trailer Circuits Truck with the 4-way flat harness installed is **powered off**.
2. Place the multimeter probes as shown:
 - **Red Probe:** Right taillight terminal (brown wire)
 - **Black Probe:** Brown wire terminal on truck control panel
3. The multimeter should **indicate that continuity exists**.
 - This means that between these 2 points a path exists for current to flow; in this case, that means your wiring harness is successfully connecting the vehicle and trailer



Measuring Continuity: Try it 2

- Use the multimeter to test **all** the 4-way flat trailer connections for continuity
- **Where to put the probes?** Think... vehicle terminal to trailer terminal
 - White?
 - Yellow?
 - Green?



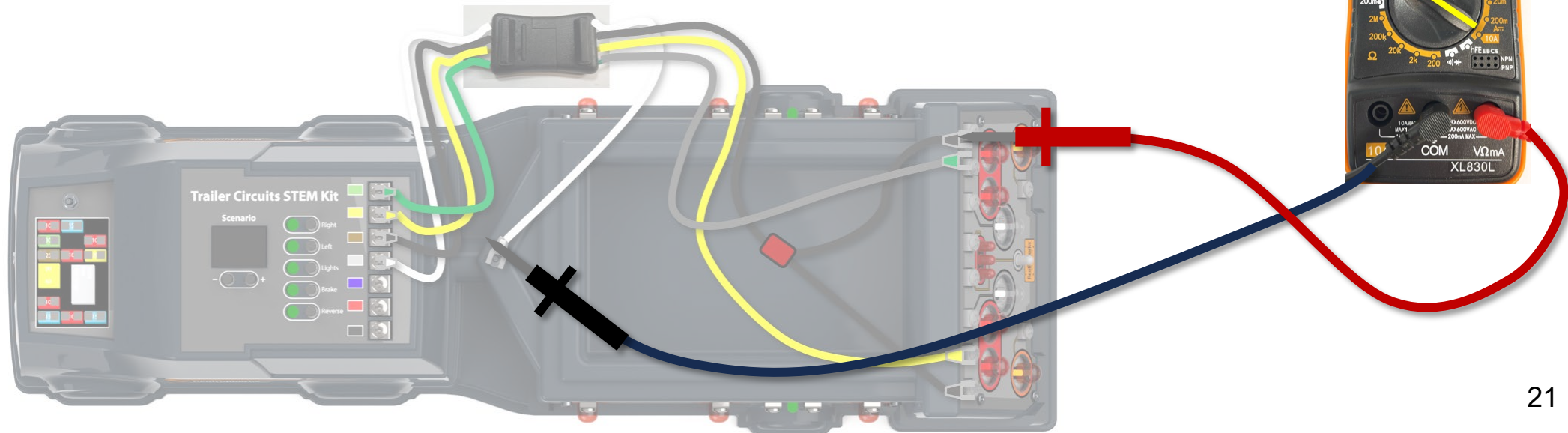
Next... Voltage

- Turn the dial as shown, set to 20-V DC
- This means the meter can measure DC voltage in a circuit that ranges from 0-20 V



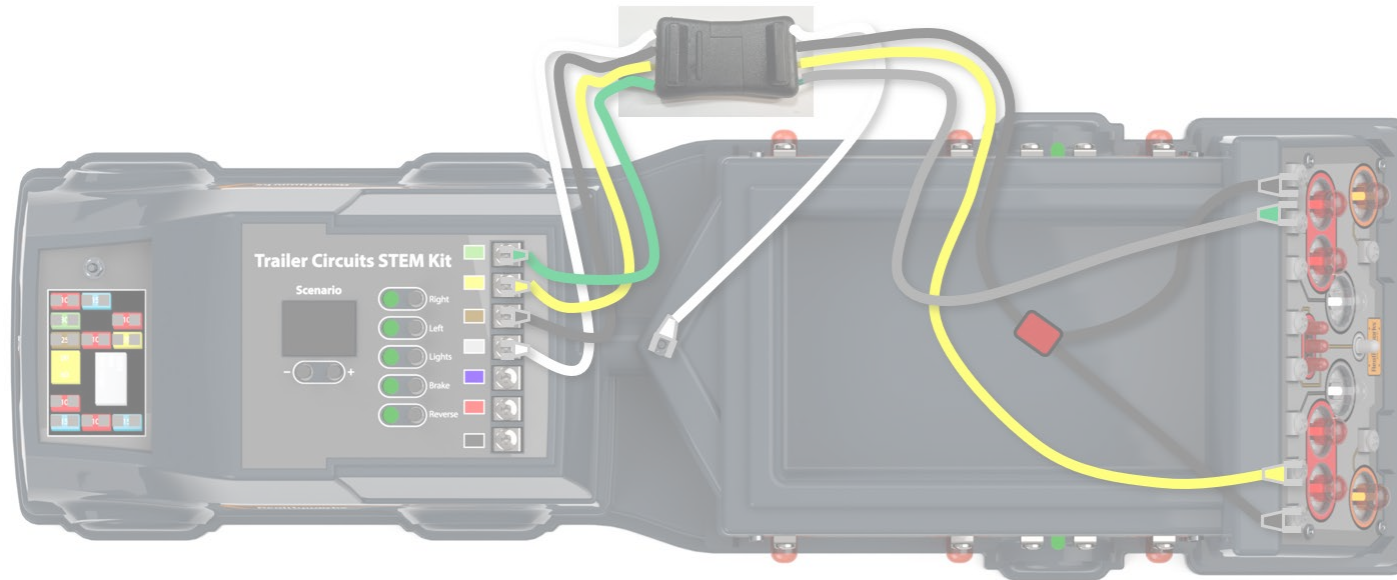
Measuring Voltage: Try it!

1. Turn on the Trailer Circuits Trucks with the 4-way flat harness installed.
2. Turn on the taillights by gently pushing the Lights button on the control panel.
3. With the taillights on, place the multimeters probes as shown:
 - **Red Probe:** Right taillight terminal (brown wire)
 - **Black Probe:** Trailer ground post
4. The multimeter should read **12 V**. *This means there is a potential difference of 12 V between these 2 points on the circuit.*



Measuring Voltage: Try it!

Turn off the simulator before moving on.



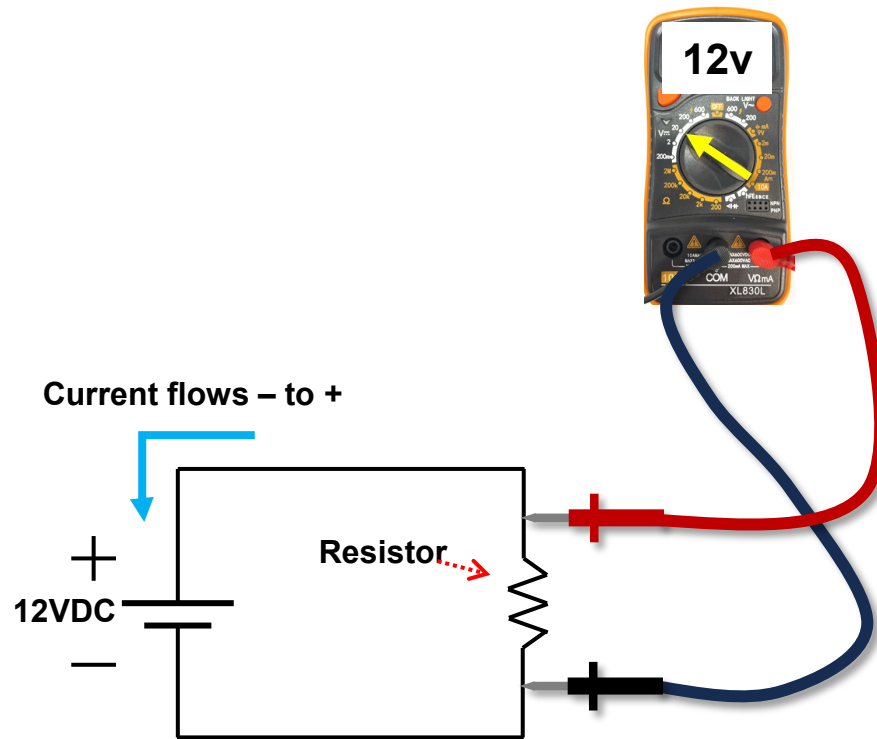
Measuring Voltage: Need To Know 1

CORRECT VOLTAGE TEST: Single Component

- Always measure voltage across a component as shown
- When the probes are placed like this, it is telling you that this resistor is using 12 V

Polarity is important:

- **Red probe always** goes on the positive side of the circuit
- **Black probe always** goes on the negative/grounded side of the circuit



Measuring Voltage: Need To Know 2

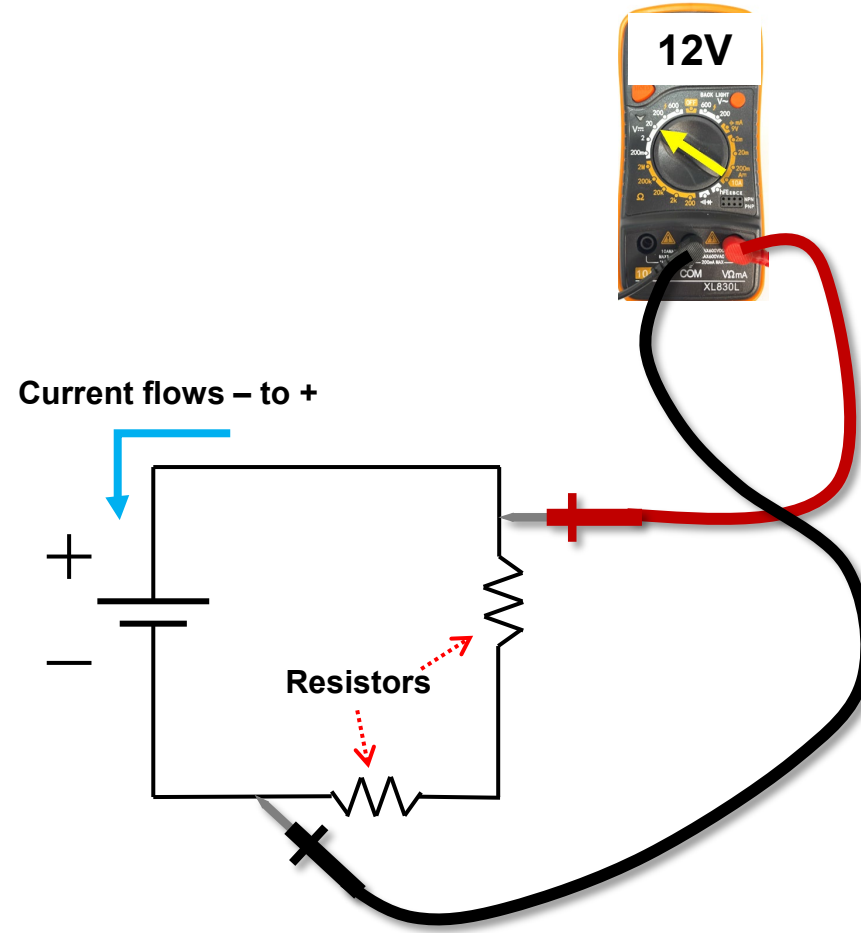
CORRECT VOLTAGE TEST:

Multiple Components

- Always measure voltage across a components, like shown
- When the probes are placed like this, it is telling you that these resistors *together* are using 12 V

Polarity is important:

- **Red probe always** goes on the positive side of the circuit
- **Black probe always** goes on the negative/grounded side of the circuit

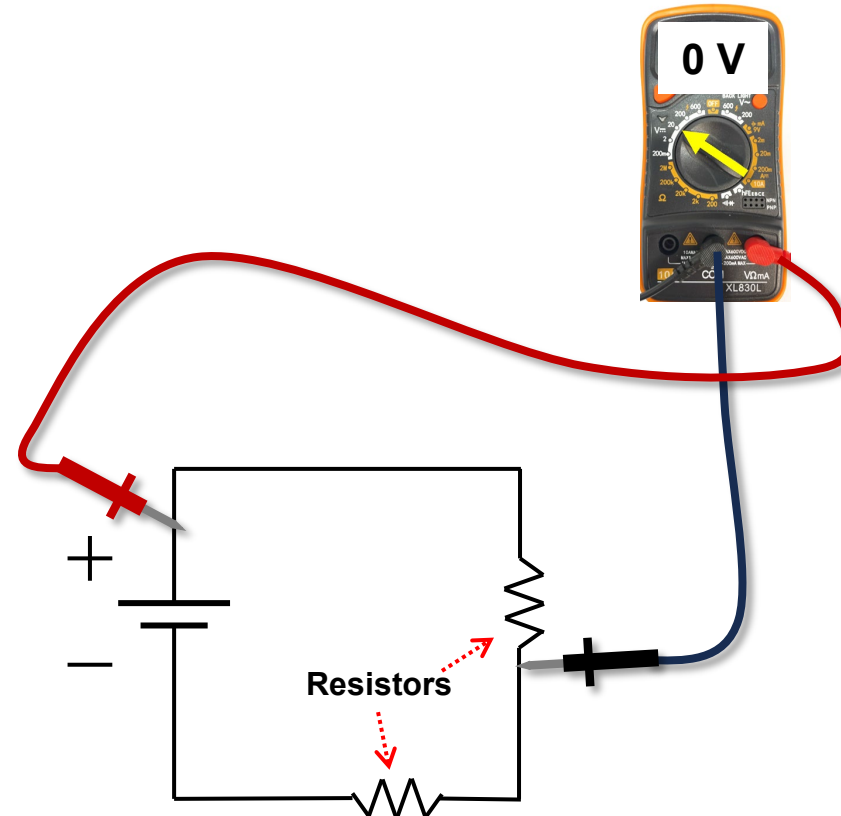


Measuring Voltage: Need To Know 3

CORRECT VOLTAGE TEST:

Circuit Section

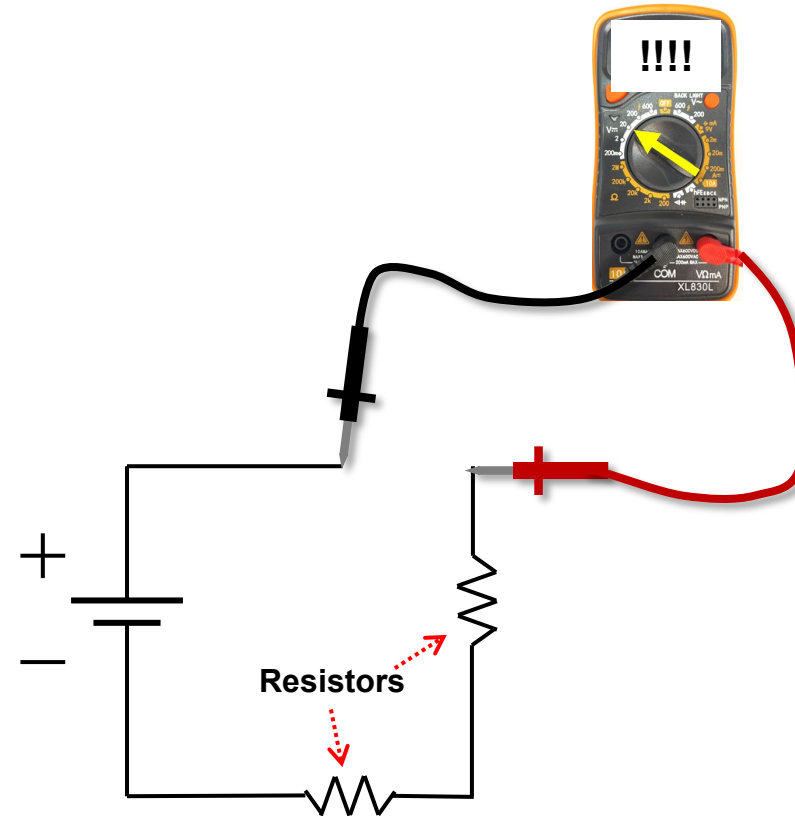
- This testing arrangement is reading 0 V... this means that there is no voltage (electrical energy) flowing through the circuit between the 2 probes (highlighted in yellow)
- This means the circuit is **broken**
- **Why could this be?**
 - The resistor is fried, so current no longer can flow in a complete circuit
 - The wire is broken
 - There is a bad connection



Measuring Voltage: Need To Know 4

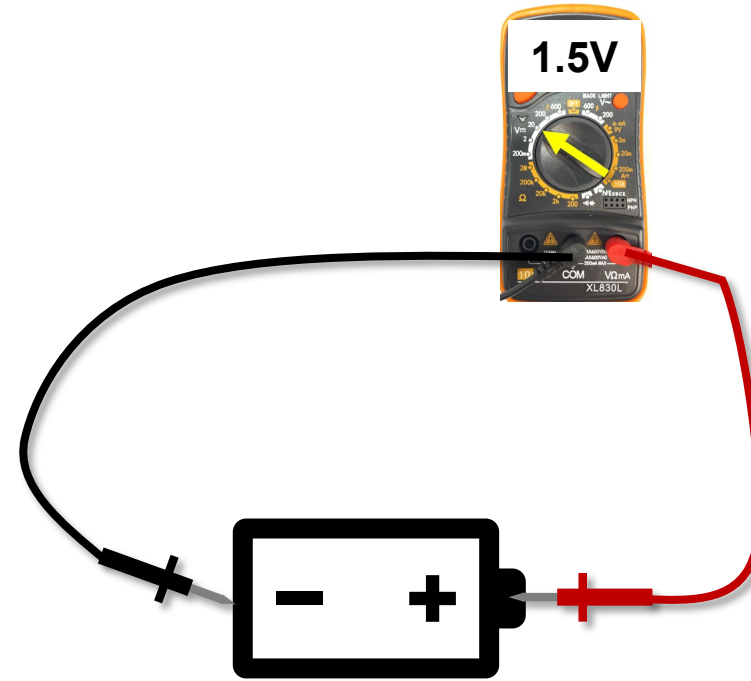
IMPROPER VOLTAGE TEST:

- Meter is incorrectly connected in series with the circuit
- This allows current to flow ***through*** the meter
- Do not do this!
- This can blow the internal fuse
- Also... notice that the polarity is wrong!
 - The black probe is on the + side of the circuit
 - The red probe is on the – side



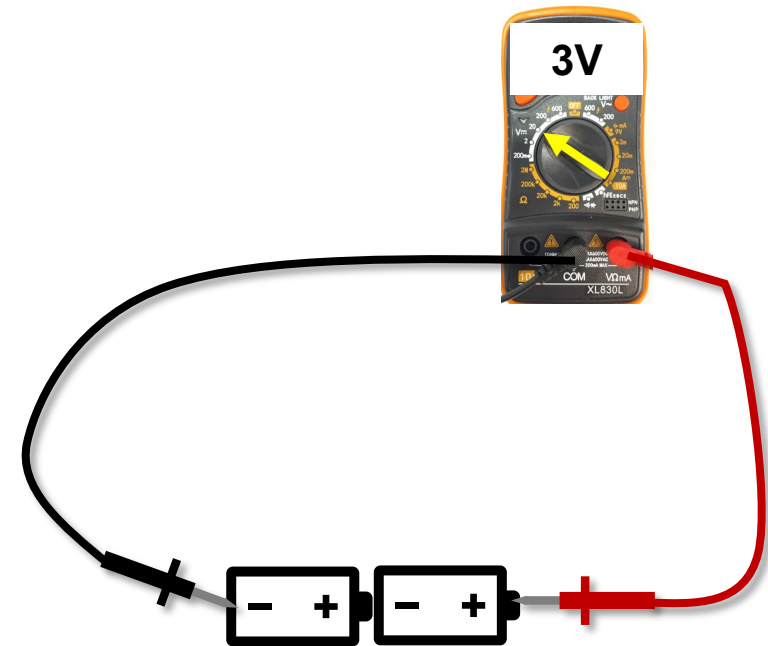
Measuring Voltage: Try This 5

1. Make sure the Trailer Circuits Truck is off.
2. Remove 2 of the AA batteries from the underside.
3. Use the multimeter to measure the voltage across the battery by placing the black probe on the – and the red on the +.
4. What voltage do you measure?
 - **A brand-new alkaline AA battery will measure at 1.5 V**



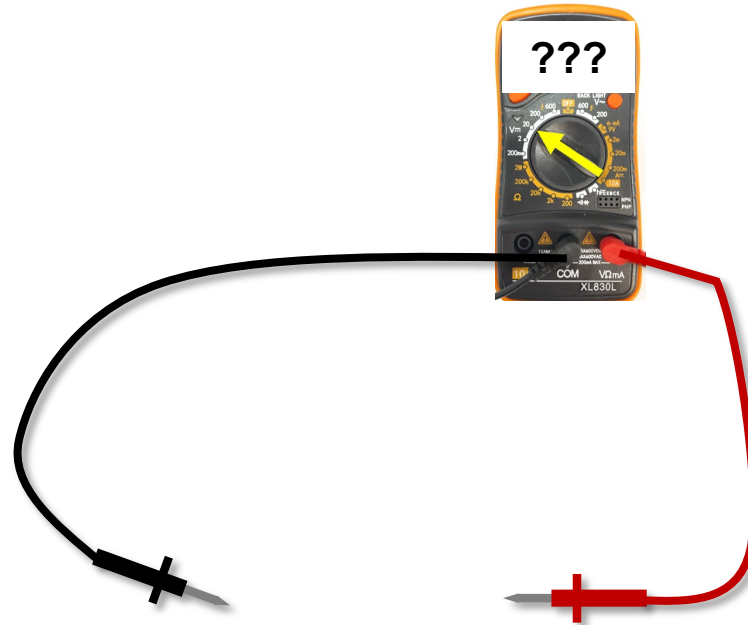
Measuring Voltage: Try This 6

1. Arrange 2 AA batteries end-to-end in a series connection as shown.
2. Make sure you connect + to – where the batteries connect.
3. Use the multimeter to measure the voltage across the 2 batteries, by placing the black probe on the – and the red on the +.
- 4. What voltage do you measure?**
 - Remember... in series Voltages add up!



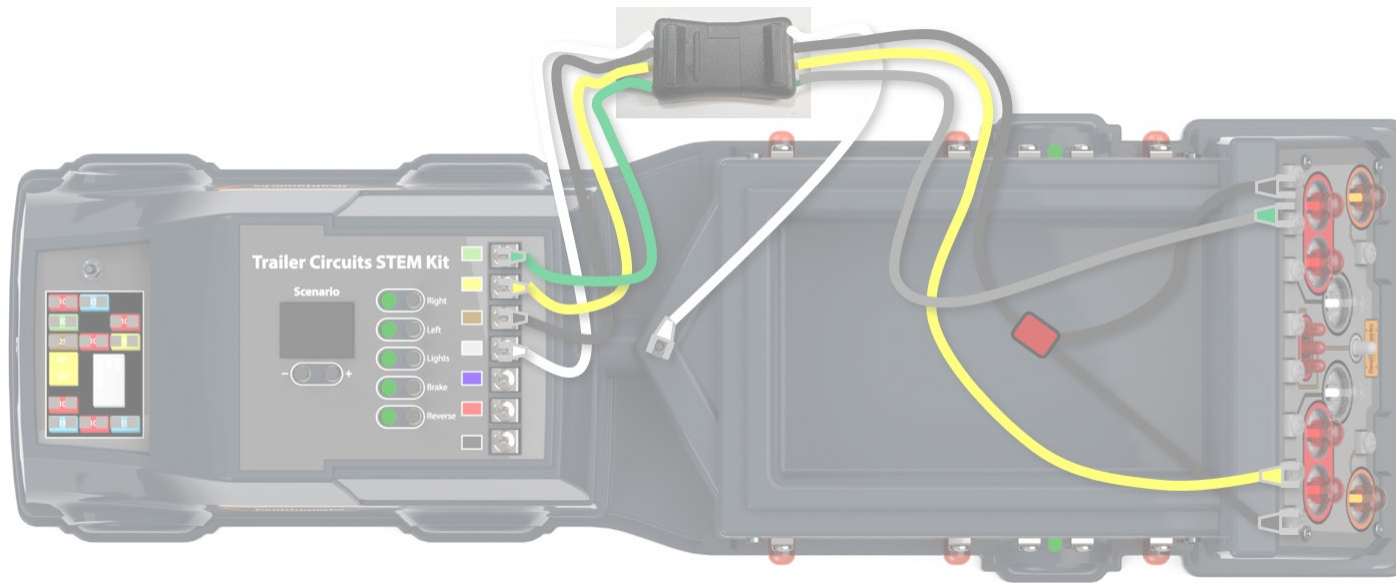
Measuring Voltage: Check the Trailer Circuits Truck

Follow the instructions in your student workbook to practice testing different connections with the multimeter.



Measuring Voltage: Try it!

Turn off the simulator before moving on.



Measuring Current: Need To Know 1

How to Test for Current

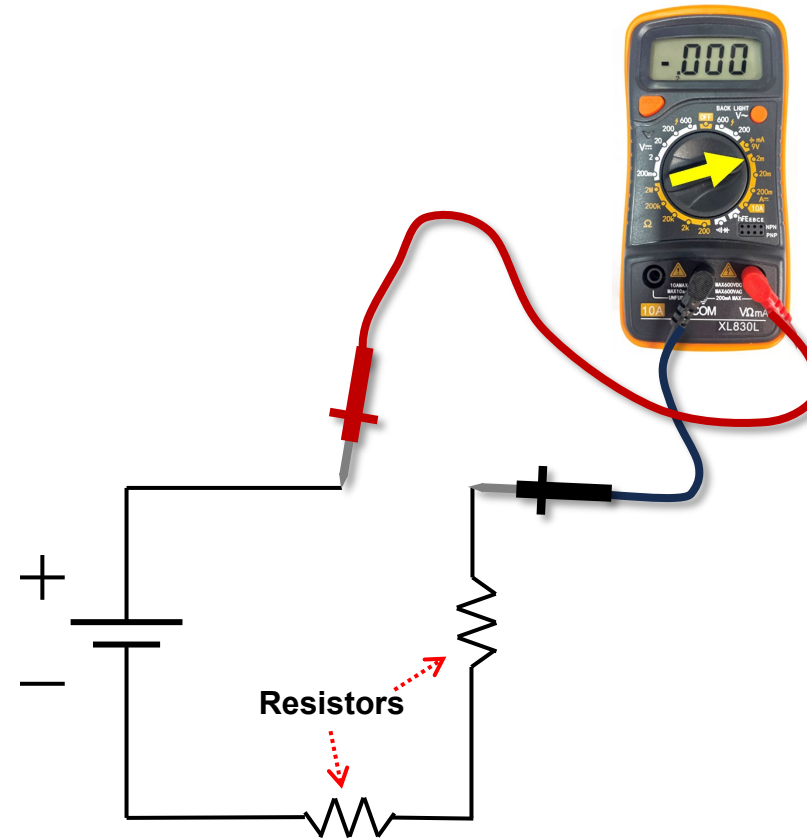
- Turn the dial to 2mA as shown in the picture
- This setting allows us to measure up to 2mA (milliAmps) of current
- The probes can stay in the same ports:
 - Black in the center COM port
 - Red on the right port



Measuring Current: Need To Know 2

How to Test for Current:

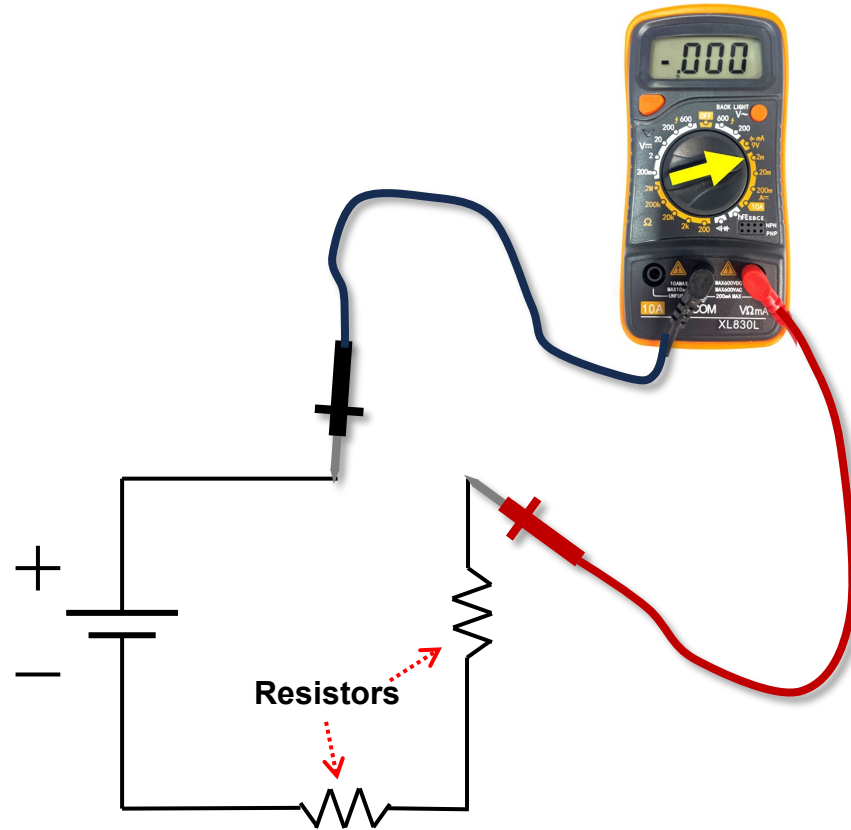
- When measuring current, we **want** the charges to flow through the device
- To do this, we break the circuit and use the test probes to create a path for the charges to flow through the meter as shown
- This will tell us how many amps are flowing through the circuit



Measuring Current: Need To Know 3

What is wrong with this?

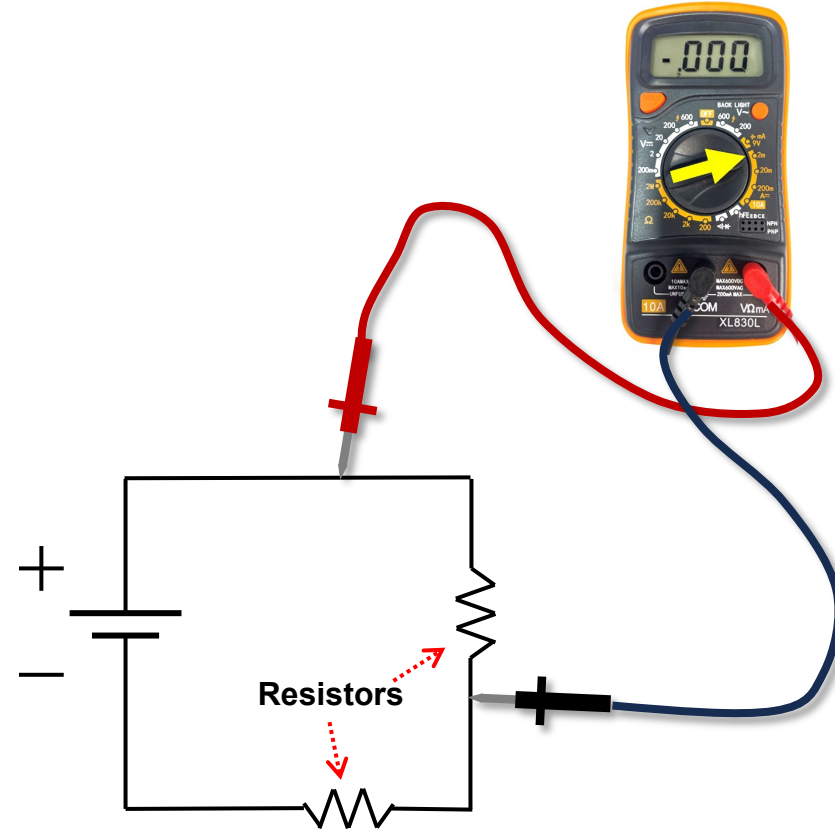
- Can you see it?
 - Wrong polarity
 - Red and black probes are switched!
 - Polarity matters!



Measuring Current: Need To Know 4

What is wrong with this?

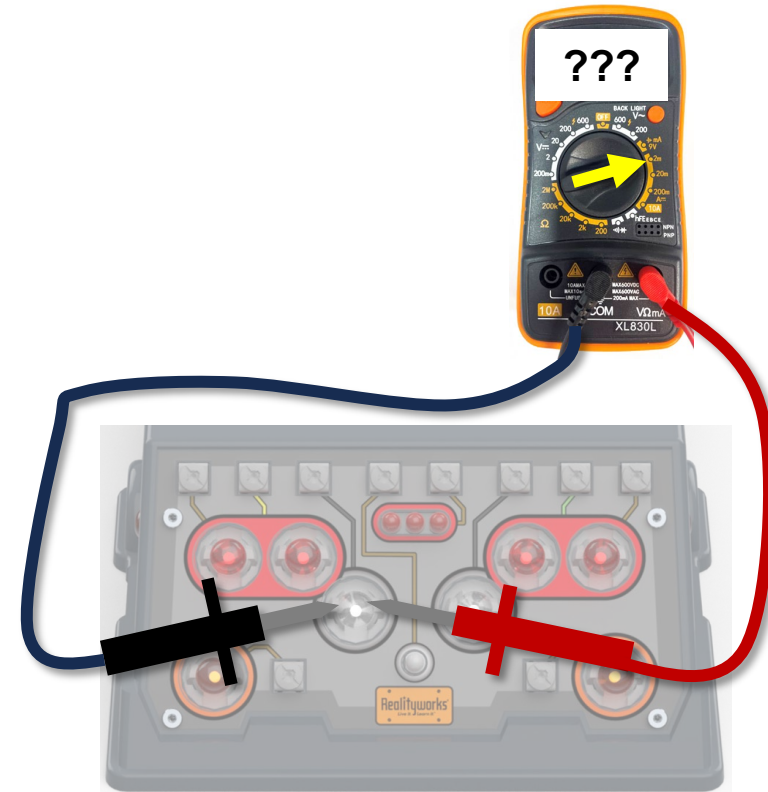
- Can you see it?
 - You are creating a short circuit
 - How?
 - Instead of current flowing through the resistor, it can now skip the resistor by flowing through the meter
- **Dangerous!**
 - This short reduces the overall resistance of the circuit, potentially creating high amperage current that can cause damage



Measuring Current: Check the Trailer Circuits Truck

Let's try checking the current flowing through the left taillight socket.

1. Using your fingers, gently pull the left taillight out of its socket.
2. Identify the 2 metal terminals in the socket.
3. Touch the probes to the metal terminals in the socket.
4. With the probes in place, activate the taillights by gently pushing down on the correct control panel button. The right taillight should turn on when you do so.
5. You should see the multimeter display a current every time you activate the taillights.
6. Finish this lesson by completing the remaining steps in your student workbook.



Congratulations!

You can now test circuits with:

- Auto light tester
- Multimeter

You know how to:

- Check for continuity
- Measure voltage and current



**Done with the Student Workbook for
Lesson 4?**

**See your teacher to check the key and/or
turn in.**

For more information, please contact Realityworks, Inc.
through email at information@realityworks.com
or call toll free at 800.830.1416



www.realityworks.com