Lesson 3: Wire, Wiring Skills, and the 4-Way Flat Harness

Trailer Circuits STEM Kit Curriculum

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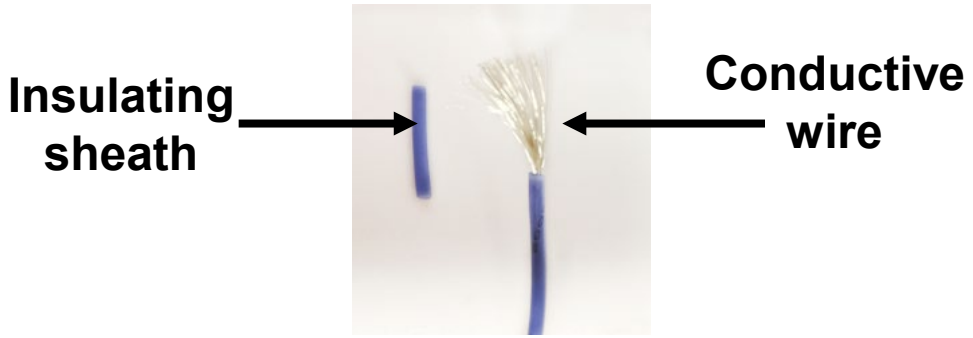
Today’s Automobiles

- Today’s automobiles are advanced electrical machines
- Knowing some basics will help you troubleshoot problems

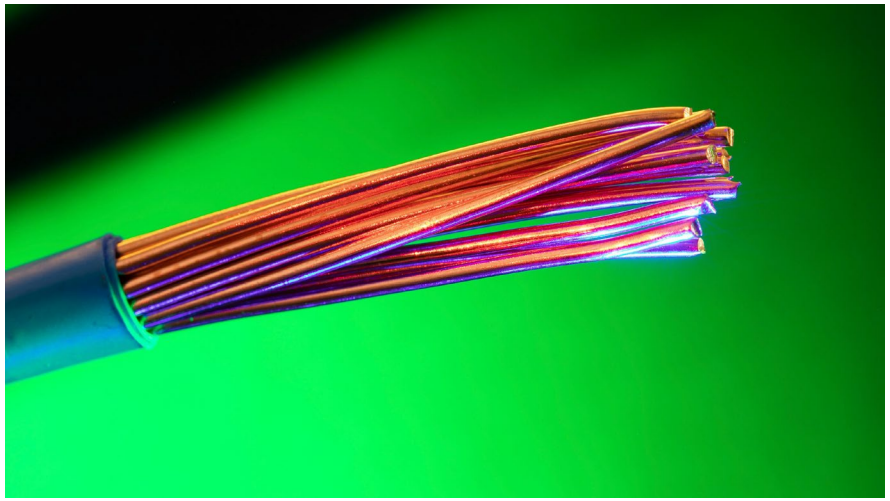
Resistance, Insulators, and Conductors

- **Resistance** is the tendency of a material to impede (prevent) the flow of electrons
- **Conductors**, such as copper, gold, or aluminum, are materials through which electrons flow easily; these have low resistance
- **Insulators**, such as rubber, glass, and plastic, have a high resistance and can control where electricity flows; these have high resistance
  - We choose rubber and plastic type polymers for various wire sheaths (coating)

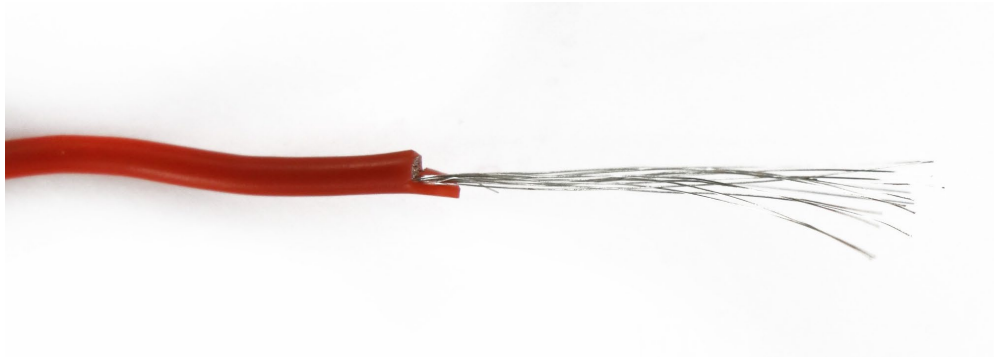


Conductors: Copper and Aluminum

Copper is the most common conductor used. It is the best conductor for an economical price.



Aluminum is a close second in terms of conductive properties and less expensive.

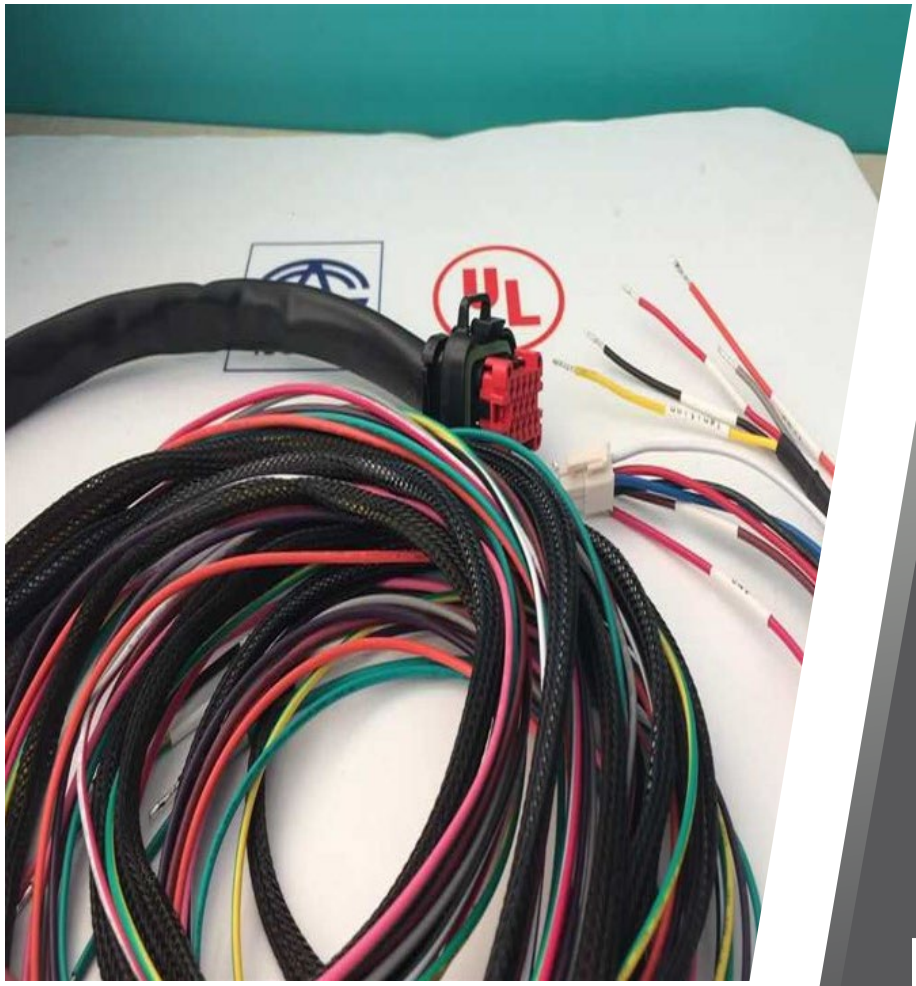


Commonly Used Vehicle Wire Types

Various wire type and sizes are used throughout a vehicle.

Properties of Vehicle and Trailer Wires:

- Multi-stranded
- Flexible insulation
- Usually rated to 80C (176F) or higher
- Resistant to grease, oil, acids, water, fungus, and solvents
- Important information is usually printed on the wiring or attached tags



5 Types of Commonly Used Wire in Vehicles

GPT or Primary Wire

- The most common general purpose automotive wire
- Multi-stranded
- Usually rated to 80° C
- Trailer wire is GPT wire

SXL Wire

- Cross-linked poly-jacketed can withstand higher heat, abrasion, aging

Battery Cable

- 6 AWG – thick, can carry high current
- Connects to the vehicle's battery and major electrical system components

Motor wire (1015 or hook-up wire)

- This has finer strands than GPT wire, higher temp rating
- Resistant to grease, oil, acids, solvents

Speaker Wire

- Intended for low voltage and should never carry a large load
- Looks similar to lamp cord

4-Way Harness Wiring

Real-World Trailer Wiring

Time to start wiring.

You will need the following:

- Trailer Circuits Truck
- Wire cutter
- Screwdriver
- Ruler or tape measure
- 3-way red snap connectors
- U-hook crimp terminals
- 4-way flat wiring harness

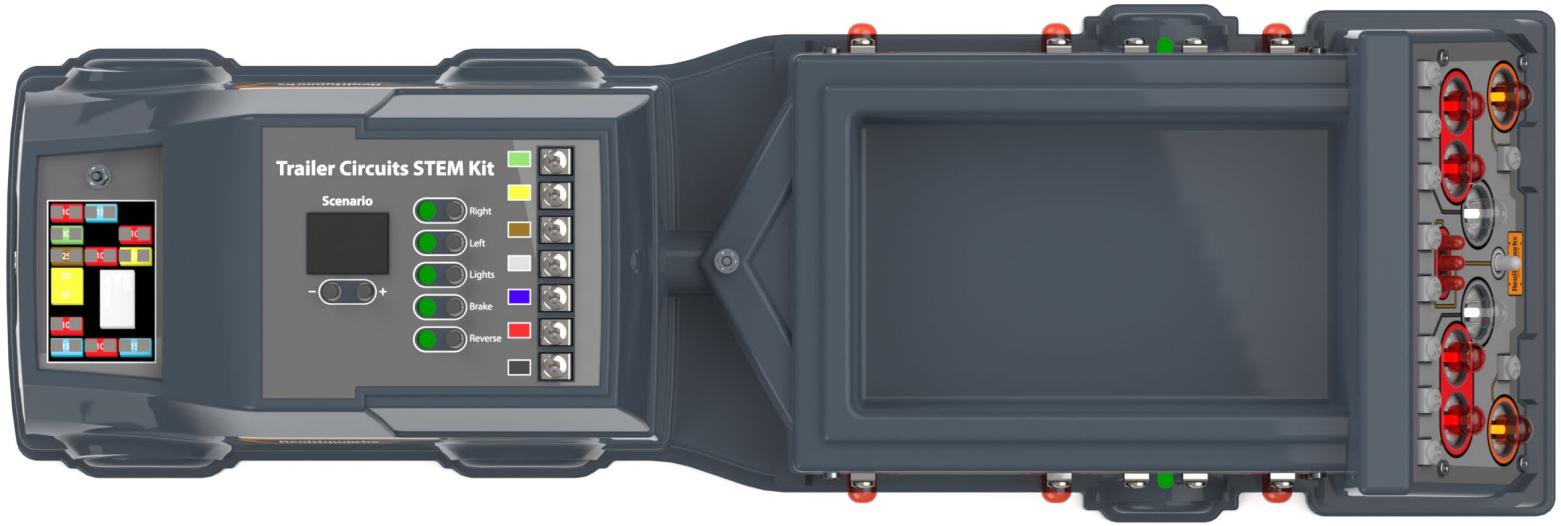
U-hook crimp terminals

3-way red snap connectors

4-way Flat Wiring Harness

We need a ***quick and easy way*** to connect the electrical connections between them. Like on a real trailer, we will use the 4-way flat wiring harness to wire up our trailer.

1. **Confirm that your Trailer Circuits Truck is turned off.**
2. Prepare your simulator for the next step by loosening the terminal screws (lefty loosey) and removing the white and blue wires from the Trailer Circuits Truck.
3. Set the wires aside for later use… you will be able to use them again later.

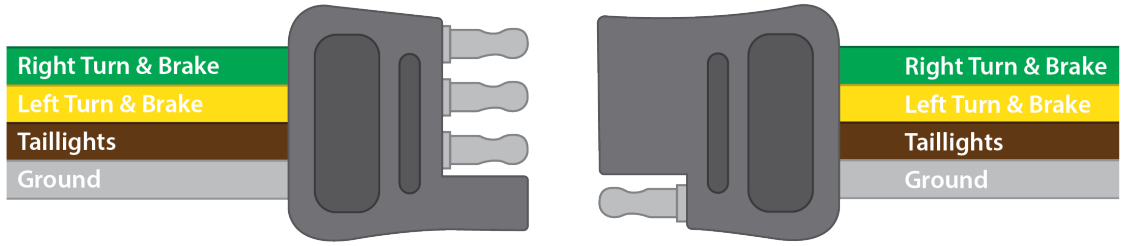


4-Way Flat Wiring Harness

- This type of wiring harness is most common on cars and trucks
- It is used for simple trailers that do not have many electrical needs
- Colors usually mean the same in every vehicle but can be different depending on manufacturer

4-Way Flat
(Trailer side)

4-Way Flat
(Car side)

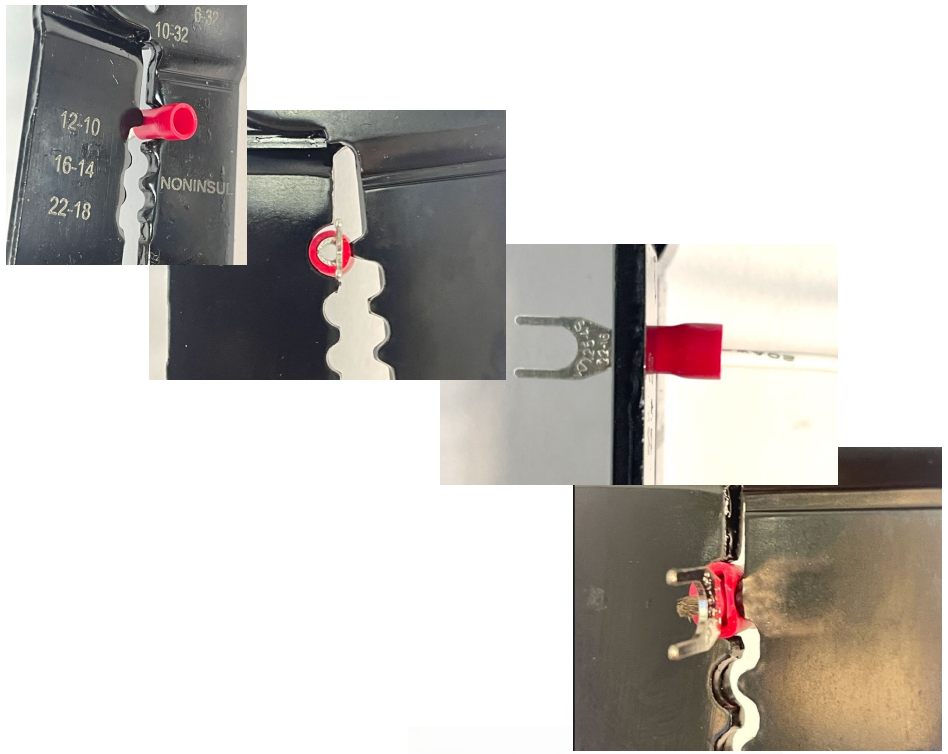


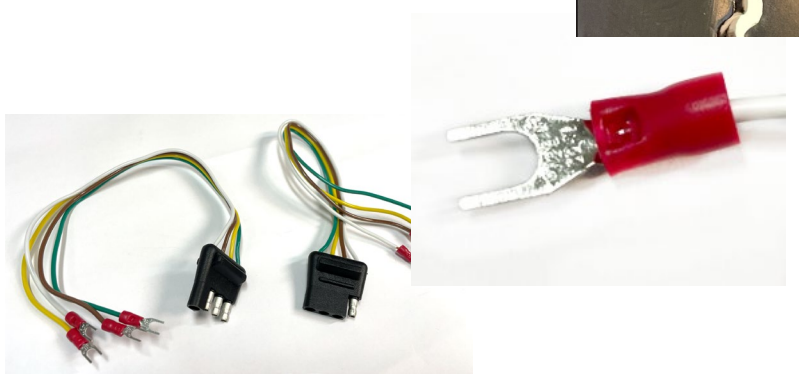
Standard color code:

Green = Right Turn and Brake
Yellow = Left Turn and Brake
Brown = Taillights
White = Ground

Step 1: Prepare the Wire Ends

1. Remove ½” of the sheath from all the wire ends.
2. Instead of J-hooks, we will use U-shaped crimp terminals.
3. Slide a crimp terminal over the end.
4. Crimp (smash) the terminal down using the crimp tool on the wire cutter as shown.
5. This should secure the terminal to the wire.
6. Repeat for all the wire ends, so each wire on both sides ends with a u-shaped crimp terminal.





Step 2: Connect the Vehicle Side

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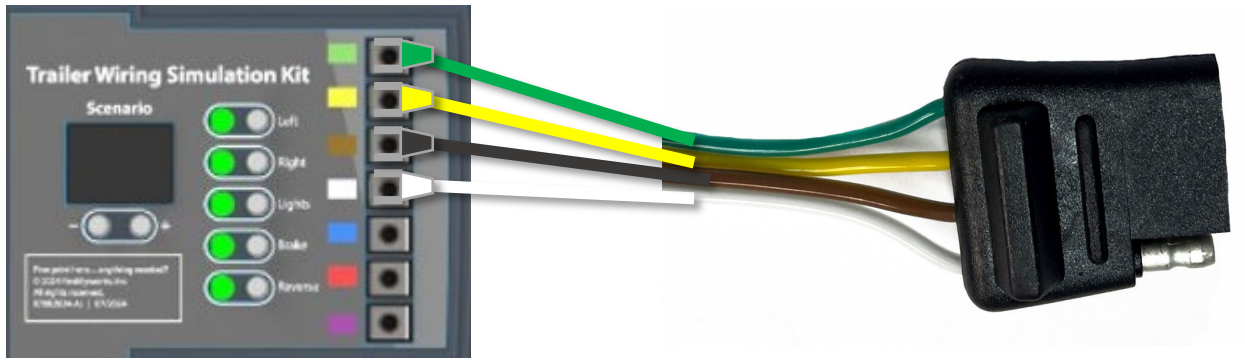
Use the screwdriver to secure the wires to the vehicle's terminals, matching the colors as shown.

Vehicle side of harness has 1 male connector.



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Step 3: Connect the Trailer Side – Ground

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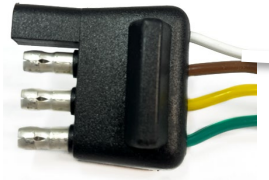
Use your fingers to securely tighten the white wire to the trailer's ground post.

Trailer side of harness has 3 male connectors.



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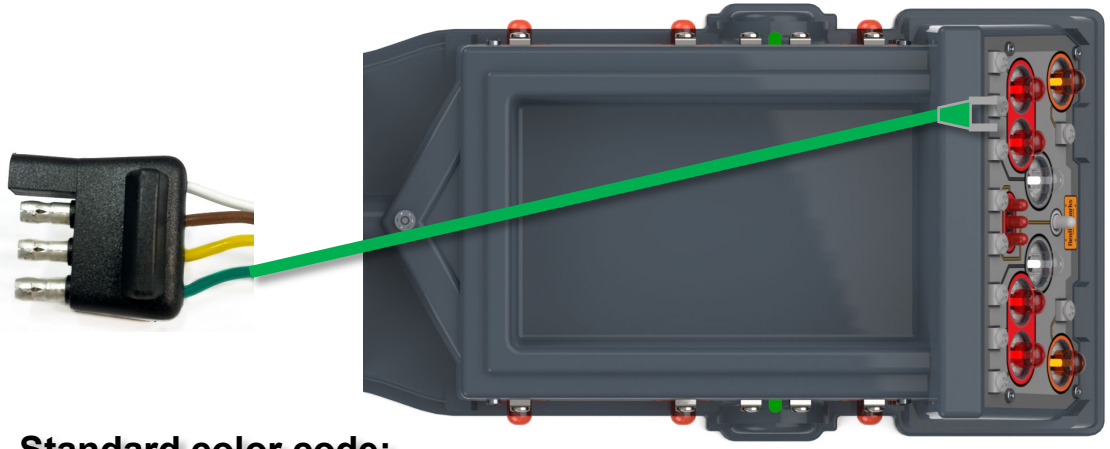
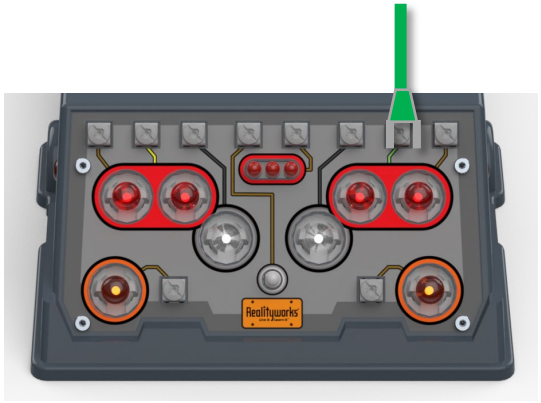
White = Ground

Step 4: Connect the Trailer Side – Right Turn/Brake

Use the screwdriver to securely tighten the green wire to the right light brake terminal.

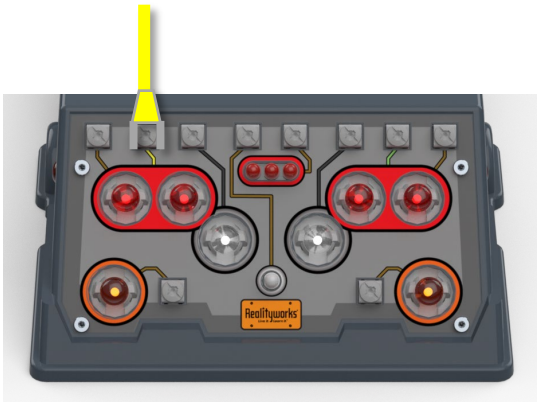




Standard color code:
Green = Right Turn and Brake
Yellow = Left Turn and Brake
Brown = Taillights
White = Ground

Step 5: Connect the Trailer Side – Left Turn/Brake

Use the screwdriver to securely tighten the yellow wire to the right left brake terminal.

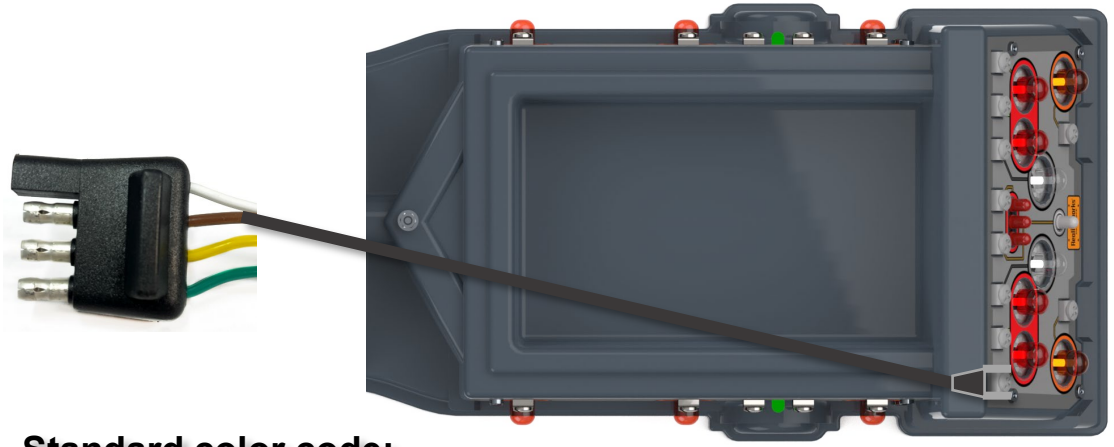


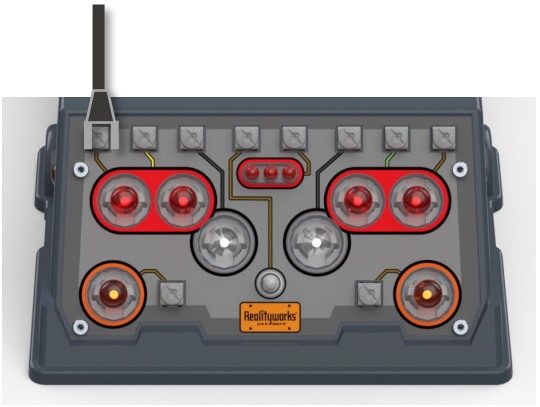
Standard color code:

Green = Right Turn & Brake
Yellow = Left Turn & Brake
Brown = Taillights
White = Ground

Step 6: Connect the Trailer Side – Left Taillights

Use the screwdriver to securely tighten the brown wire to the left taillight terminal.





Standard color code:
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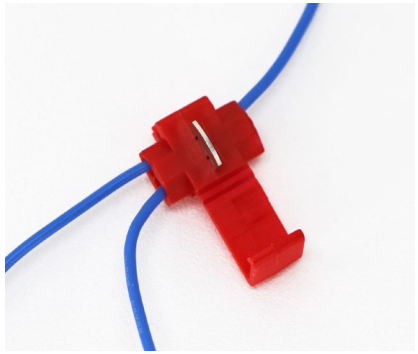
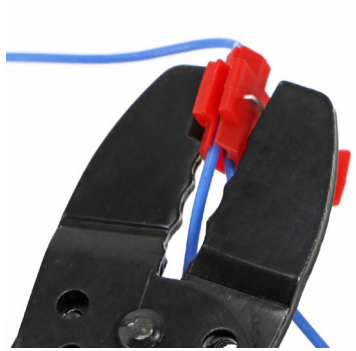
Brown = Taillights
White = Ground

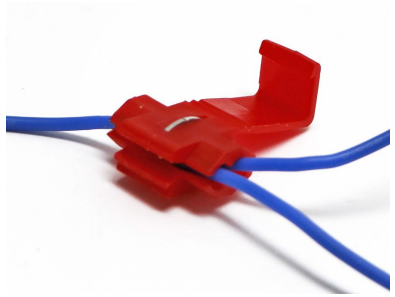
How to Use Red 3-Way Connectors



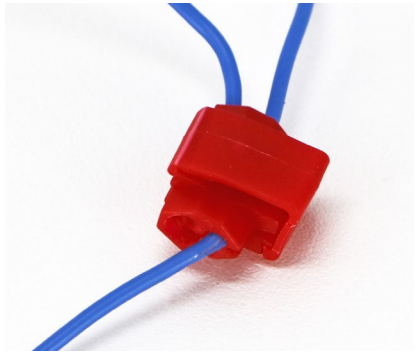
1. Slide red connector onto existing wire and insert new wire you want to connect.



2. Use the wire cutter tool to squeeze the metal bar down as show. This cuts through the wire's coating and electrically connects the 2 wires' conductive cores.



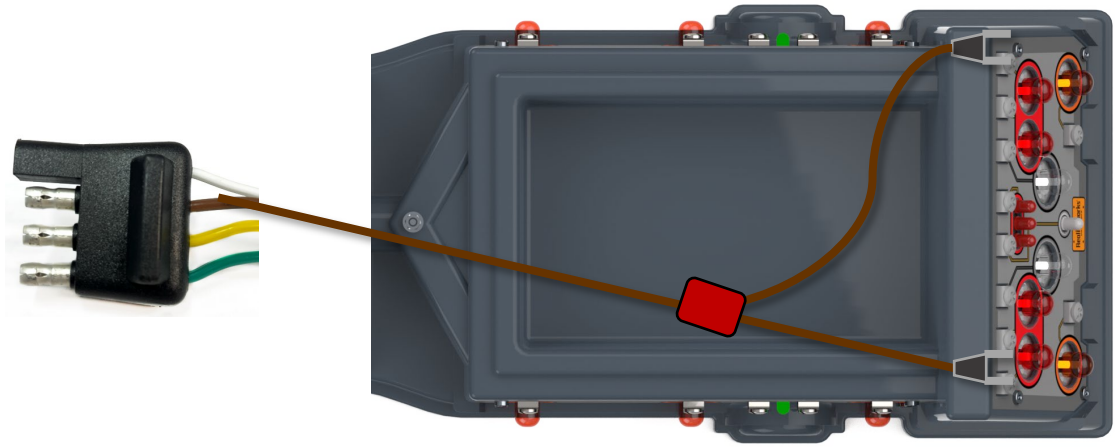
3. Confirm that metal bar is fully squeezed down.

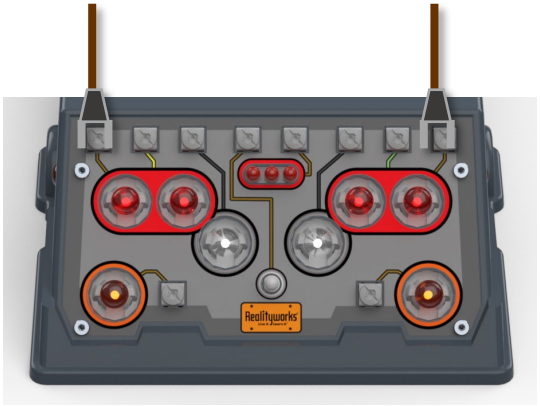


4. Wrap plastic snap over the connector so it snaps shut.

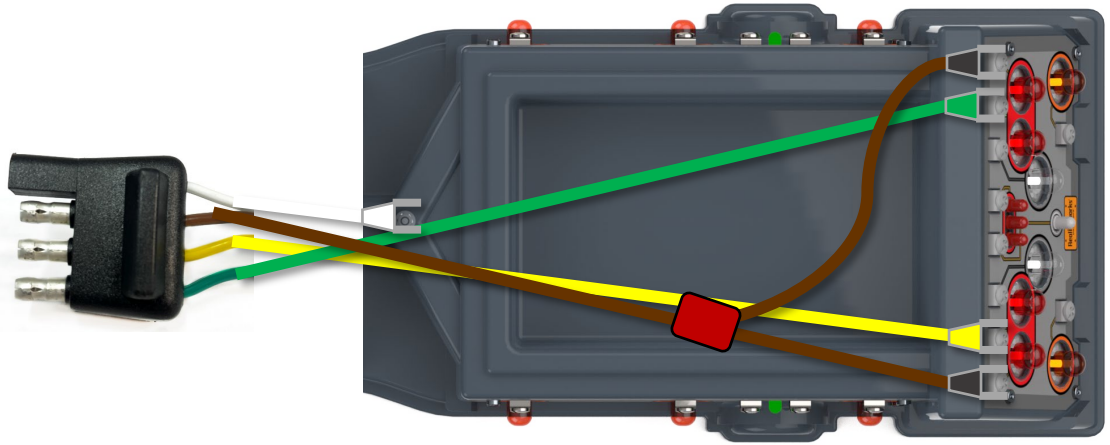
Step 7: Connect the Trailer Side – Right Taillights

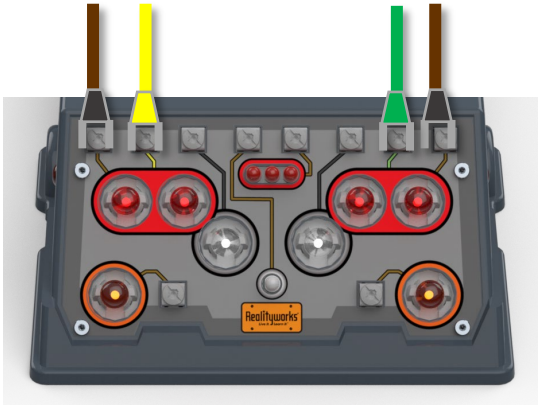
1. Measure and cut an 8” length of brown wire off the spool.
2. Strip ½” off one end of this brown wire and install a U-shaped crimp terminal.
3. Connect this crimp terminal to the right taillight terminal.
4. Use a red 3-way snap connector to connect this new brown wire to the existing brown wire on the trailer, as shown below.





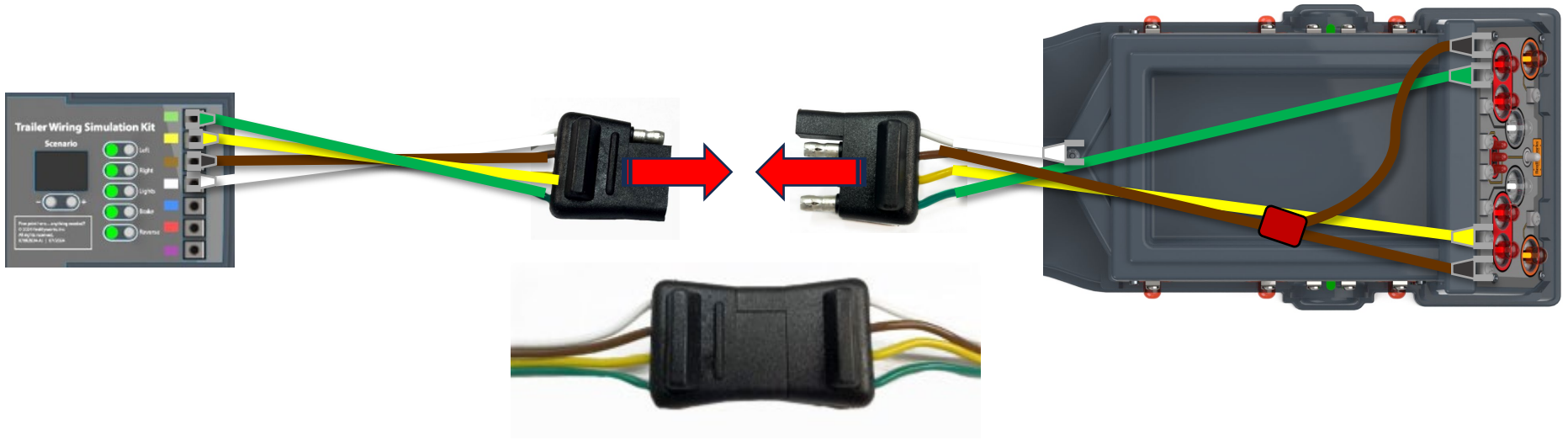
Step 8: Connect the Trailer Side – Confirm Connections





Step 9: Connect the Harness

- Plug the 2 sides into each other, as shown below
- You may need to twist 1 of them, so they line up correctly



Step 10: Confirm and Power On

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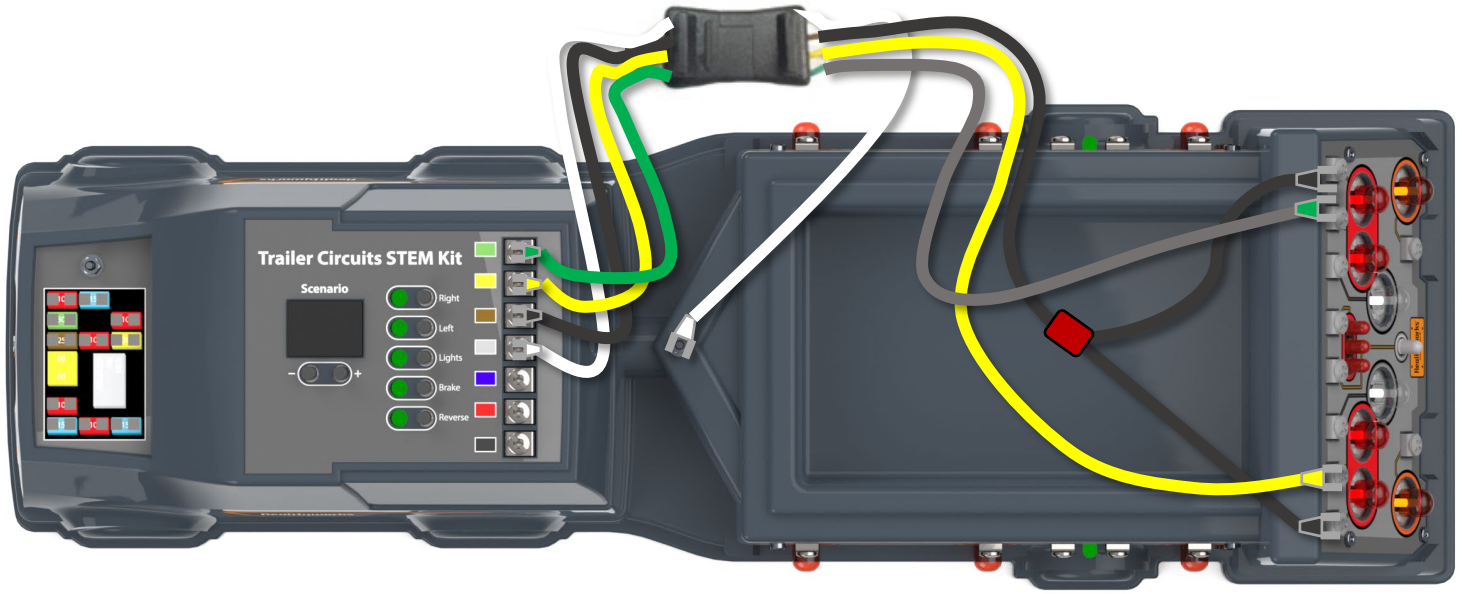
1. Check your complete setup.
2. Turn on the power switch underneath the Trailer Circuits Truck.



Step 10: Test – Taillights

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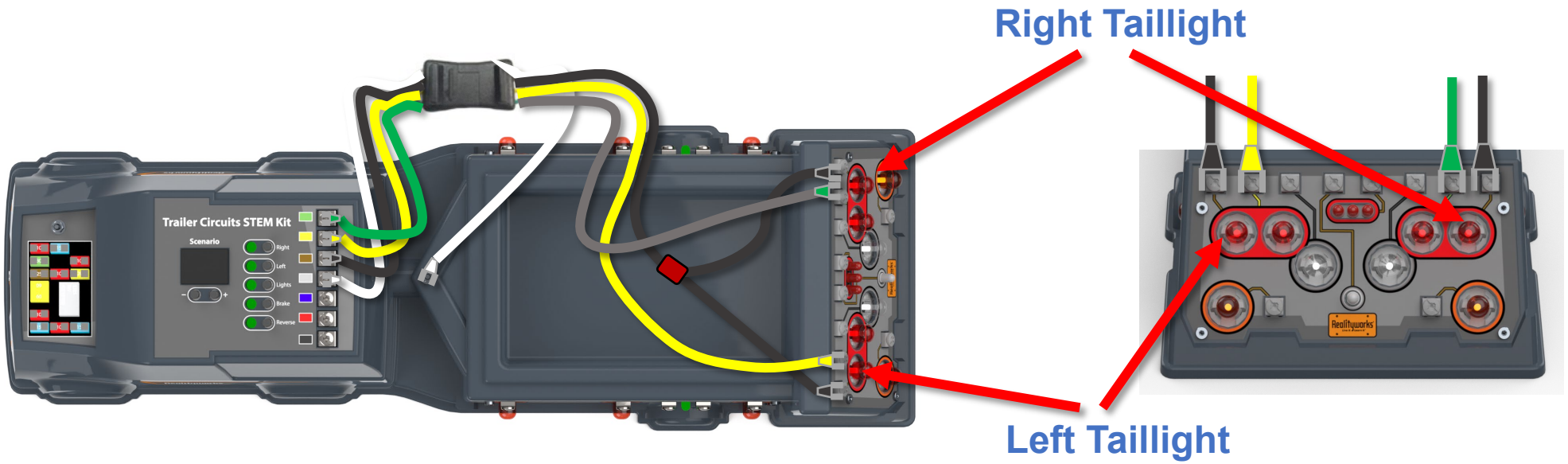
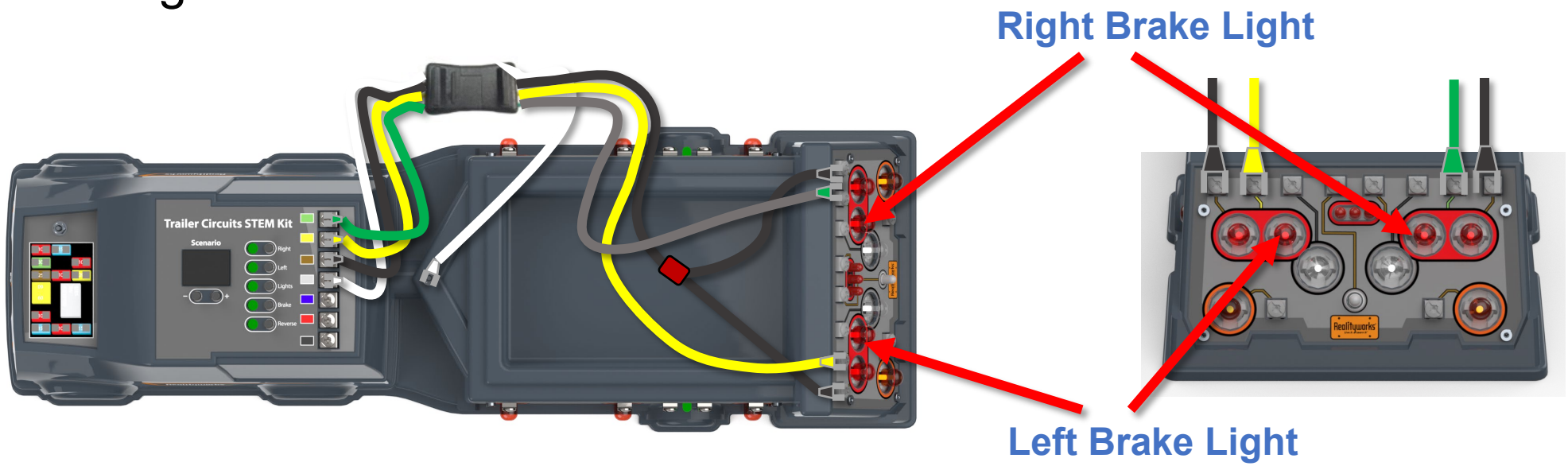
1. You will know the Trailer Circuits Truck is on because the Scenario # screen is lit up and showing a 0. Scenario 0 is for testing.
2. Turn on the taillights by gently pushing the Lights button on the control panel.
3. **Test:** Did the right and left taillights turn on?
   - **Yes:** Nice work! Move on.
   - **No:** Check your connections; something is preventing current from getting to the taillights.



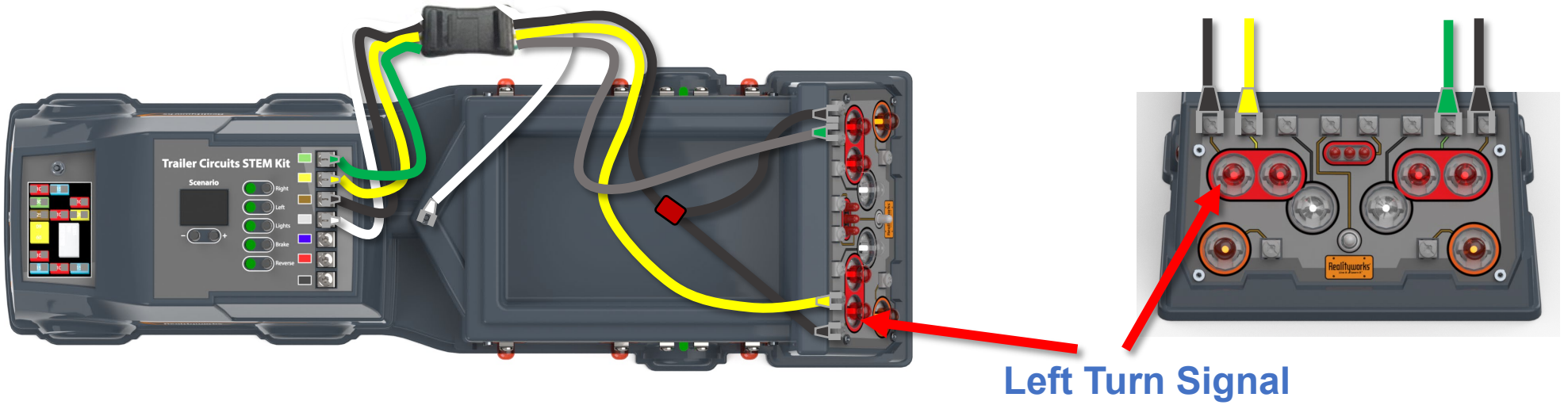
Step 11: Test – Brakes

1. Test the brake lights by gently **holding down** the Brake button on the control panel.
2. **Test:** Did the right and left brake lights turn on?
   - **Yes:** Nice work! Move on.
   - **No:** Check your connections; something is preventing current from getting to the taillights.



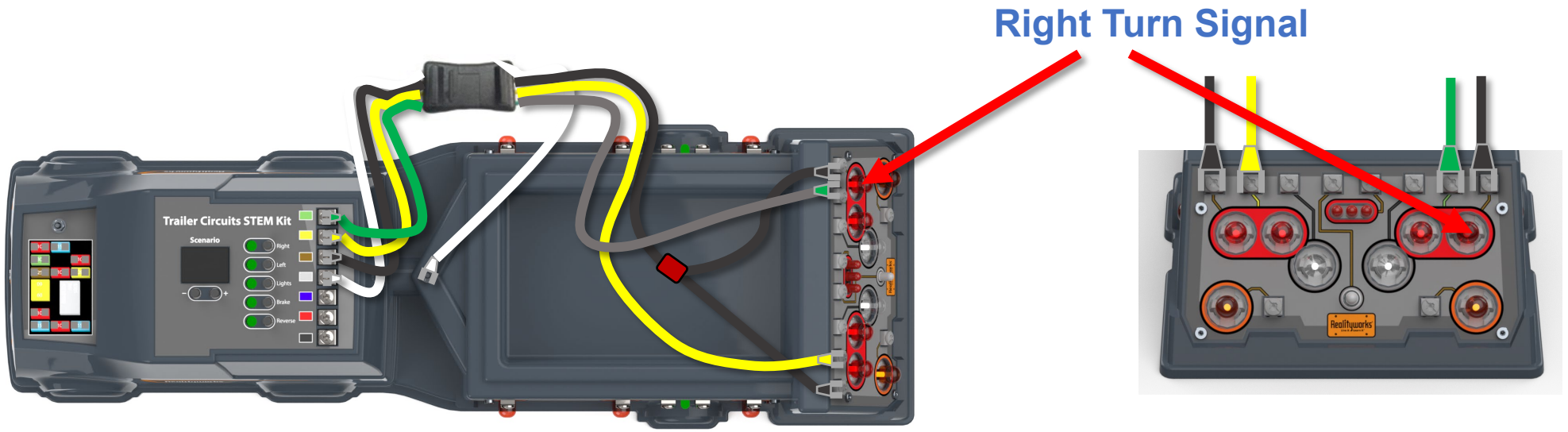
Step 12: Test – Left Turn Signal

1. Test the left turn signal by gently pushing the Left button on the control panel.
2. **Test:** Did left turn signal start to flash?
   - **Yes:** Nice work! Move on.
   - **No:** Check your connections; something is preventing current from getting to the taillights.



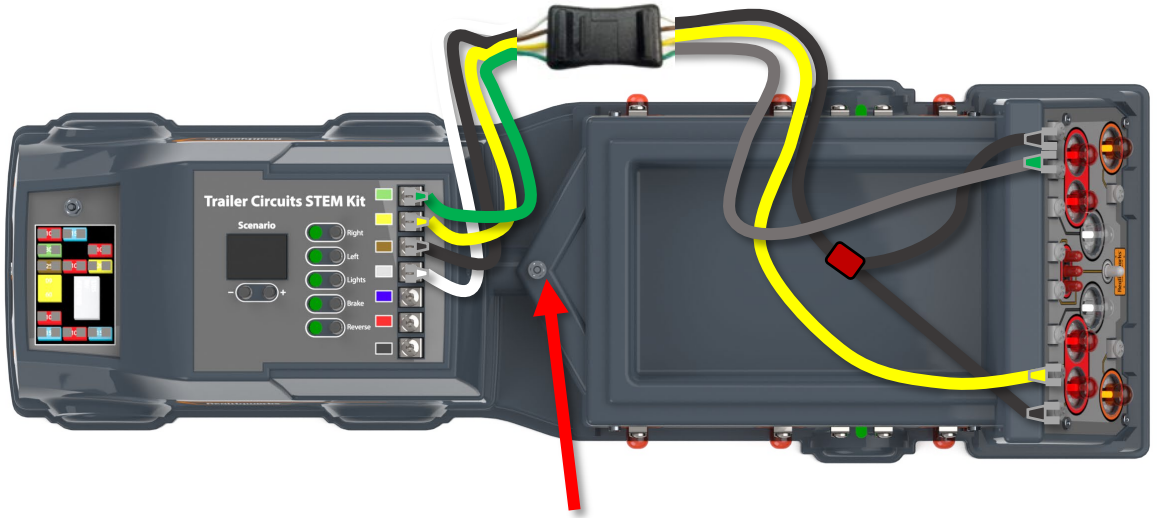
Step 13: Test – Right Turn Signal

1. Test the right turn signal by gently clicking on the Right button on the control panel.
2. **Test:** Did right turn signal start to flash?
   - **Yes:** Nice work! Move on.
   - **No:** Check your connections; something is preventing current from getting to the taillights.



Try This: No ground?

1. Use the control panel to deactivate all the lights on the Trailer Circuits Trucks. Nothing should be lit up on the trailer.
2. Disconnect the white wire on the trailer's ground post.
3. Securely hold the end of the white wire so it does not touch any other metal and create a short circuit.
4. Try testing the lights of the trailer using the buttons on the control panel.
5. Answer questions in the Student Workbook.



Congratulations! You have successfully constructed and tested a working vehicle/trailer electrical connection using a 4-way flat wiring harness!

Done with the Student Workbook for Lesson 3?

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

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