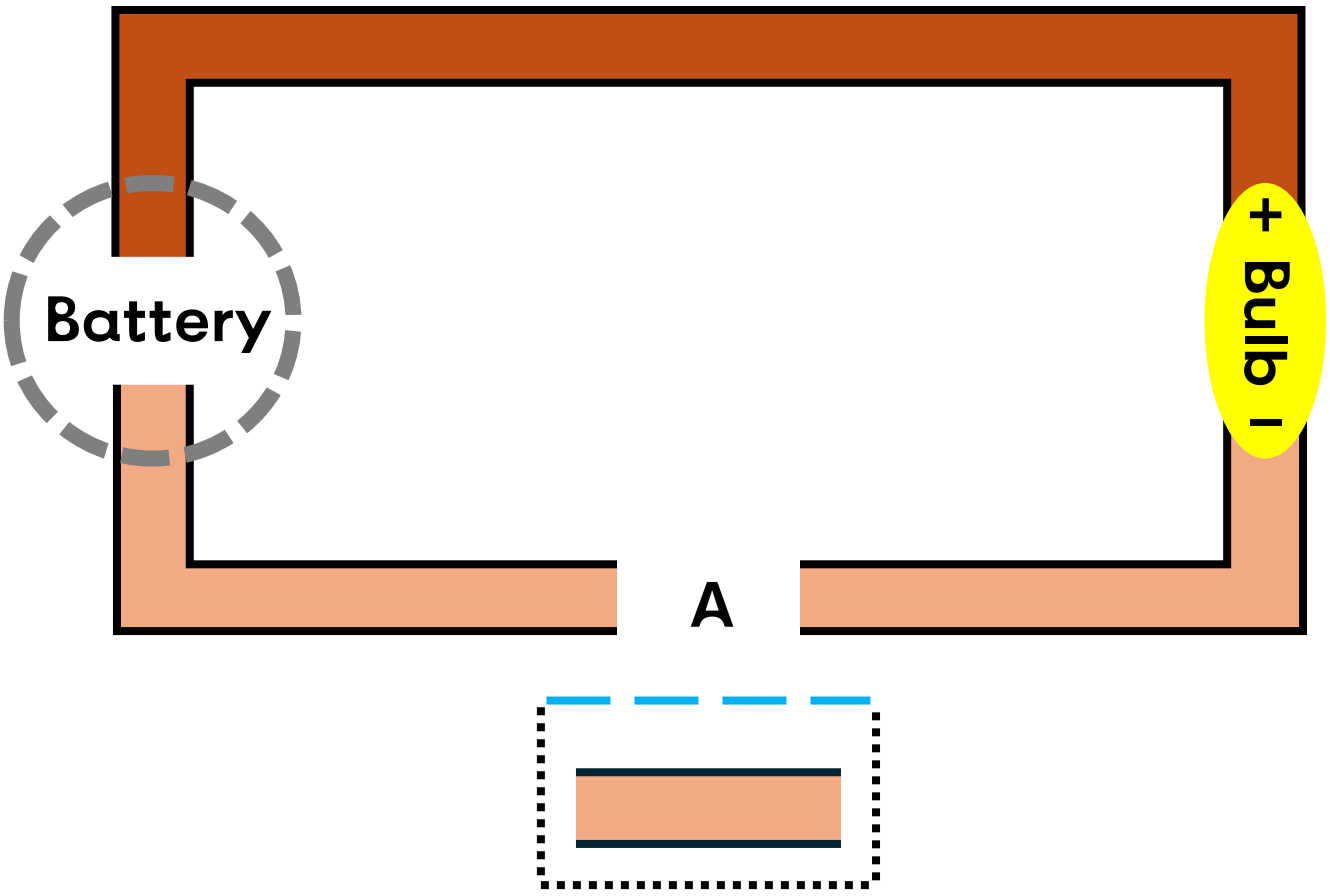
Circuit Instructions

Follow these steps for each template to build your circuits!

1. Grab your lightbulb and extend both legs outwards.
2. Place your lightbulb on top of the yellow oval marked "Bulb." Make sure:
   - The longer positive (+) leg is on top of the + sign and pointing upwards.
   - The shorter negative (–) leg is on top of the – sign and pointing downwards.
3. Place copper tape that starts on top of the lightbulb's positive leg and ends on top of the dark orange region.
4. Place copper tape on top of the rest of the dark orange region, completely covering it with no gaps.
5. Grab your battery and orient it so that the positive (+) side is facing upwards, and the negative (–) side pointing downwards.
6. Place the battery on top of the gray-outlined region labeled "Battery." Make sure it is lying on top of some of the tape you put down in Step 4.
7. Place a strip of copper tape that starts on top of the battery and ends on top of the leftmost light orange region.
8. Place a strip of copper tape that starts on top of the lightbulb's negative leg and ends on top of the rightmost light orange region.
9. Place copper tape on top of all of the light orange regions, completely covering them. There should be one, two, or three gaps marked with a letter (A, B, or C).
10. Take your scissors and cut along all the dotted black lines. You should now have one, two, or three small paper "switches."
11. Fold each switch upwards along the dashed blue line, forming a crease for each.
12. Now, you should be able to complete the circuit and cause the lightbulb to light up by folding one or more switches upwards to lie directly on top of the paper. Experiment with different combinations, and record your results in the corresponding truth table!

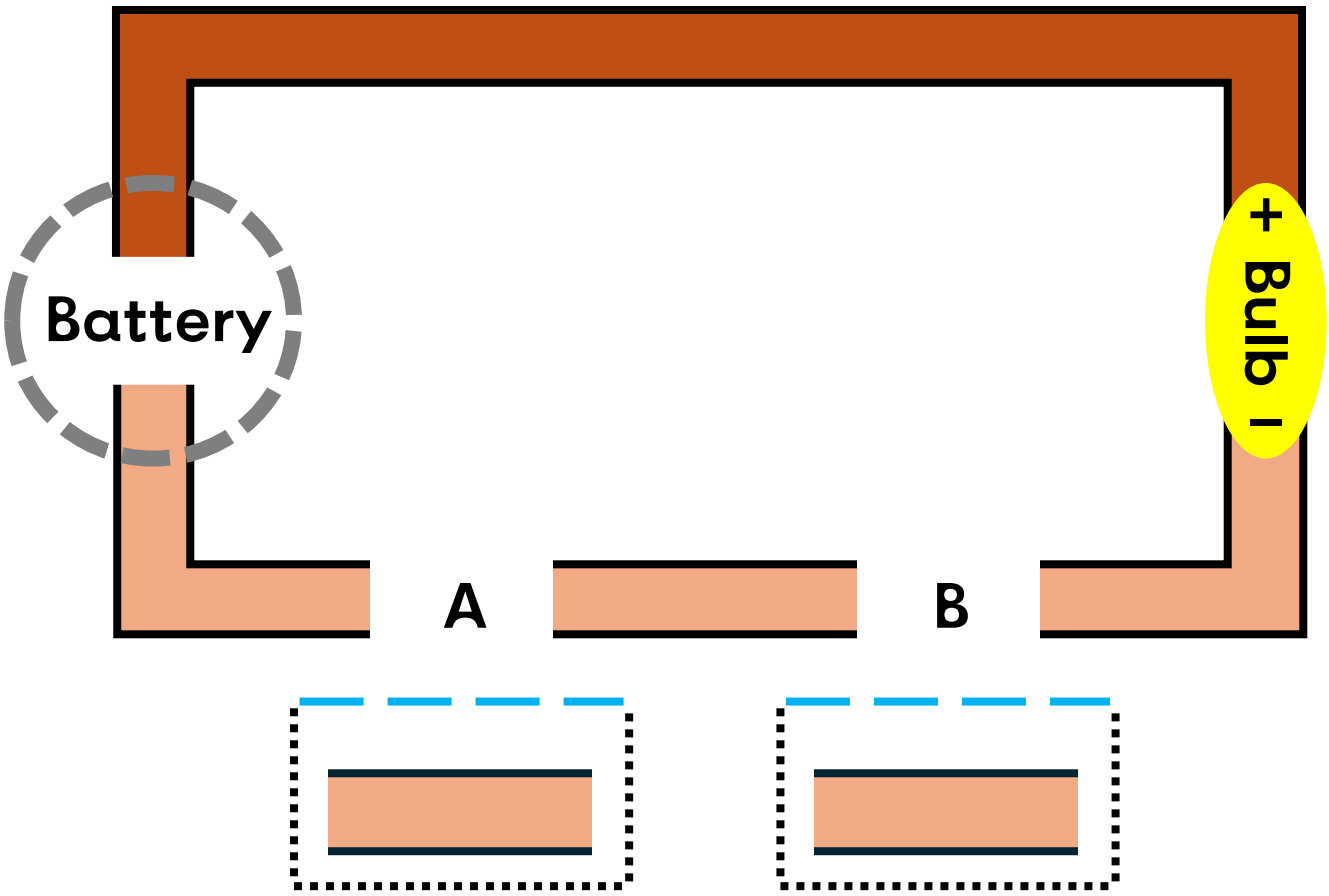
Simple Circuit



Legend

- Yellow oval: Lightbulb
- Dashed gray circle: Battery
- Dotted black lines: Cut along
- Dashed blue lines: Fold along
- Dark orange regions & light orange regions: Copper tape

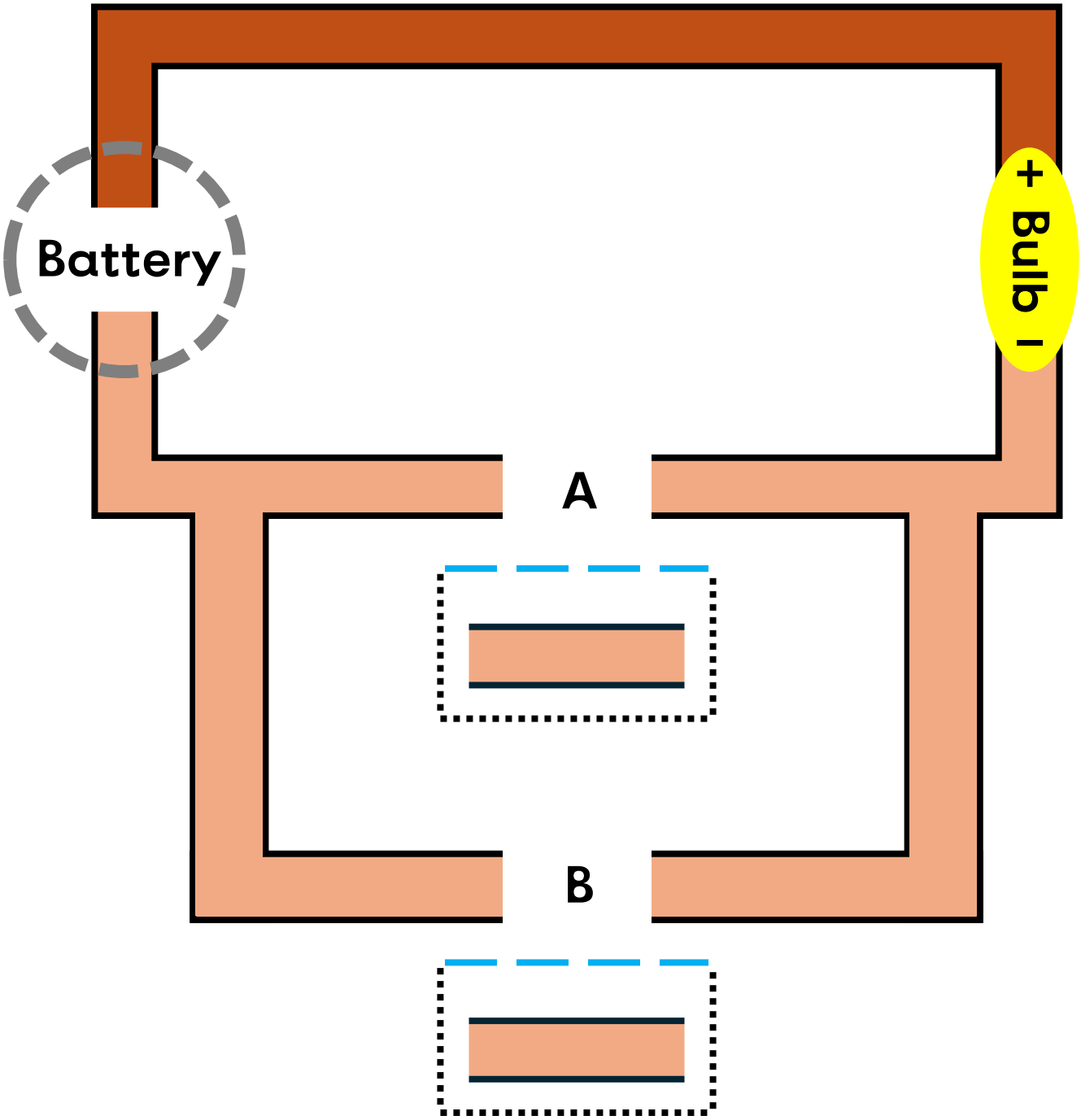
Series Circuit (AND)



Legend

- Yellow oval: Lightbulb
- Dashed gray circle: Battery
- Dotted black lines: Cut along
- Dashed blue lines: Fold along
- Dark orange regions & light orange regions: Copper tape

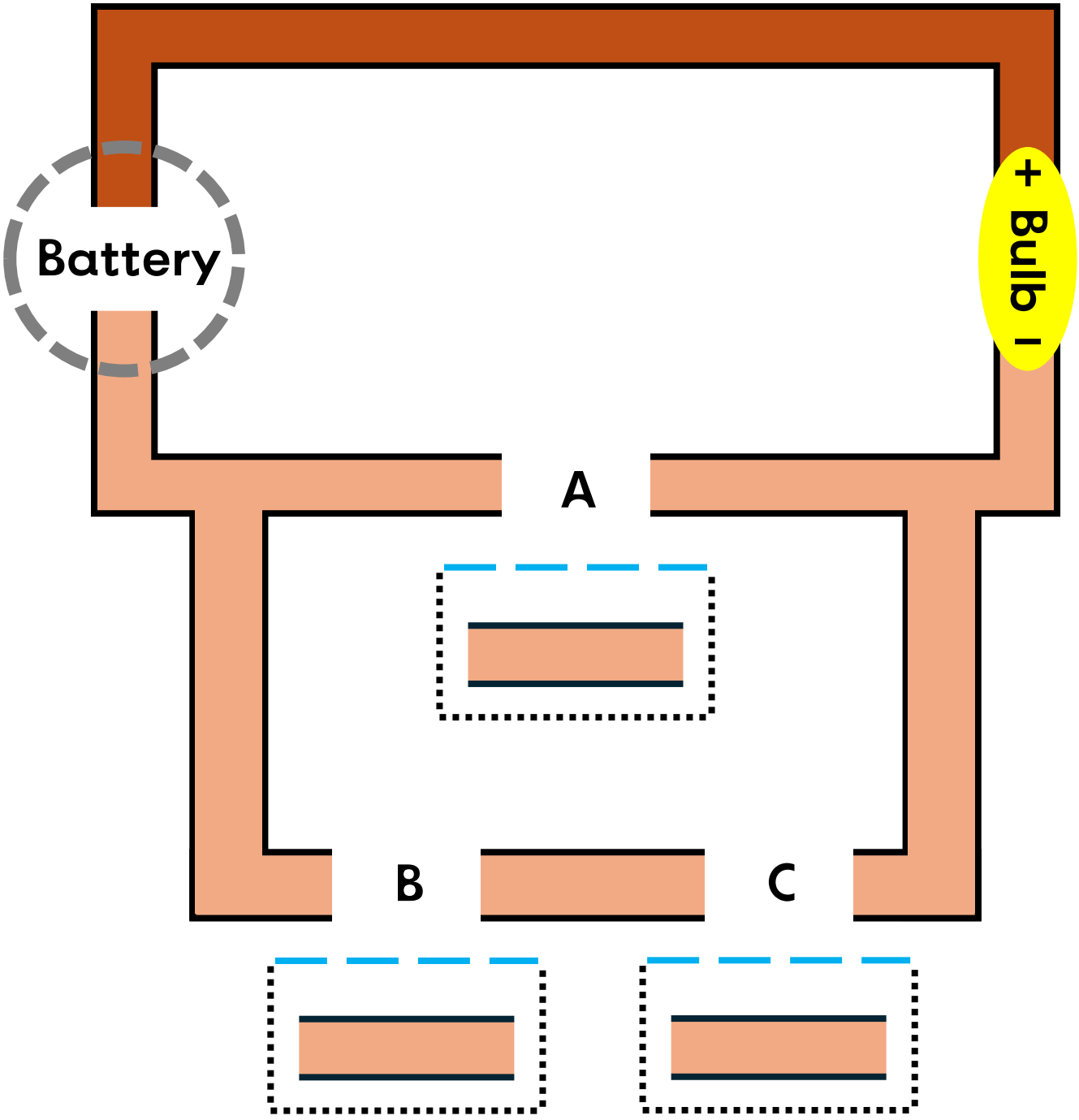
Parallel Circuit (OR)



Legend

- Yellow oval: Lightbulb
- Dashed gray circle: Battery
- Dotted black lines: Cut along
- Dashed blue lines: Fold along
- Dark orange regions & light orange regions: Copper tape

Combination Circuit



Legend

- Yellow oval: Lightbulb
- Dashed gray circle: Battery
- Dotted black lines: Cut along
- Dashed blue lines: Fold along
- Dark orange regions & light orange regions: Copper tape

Truth Table:
Simple Circuit

Switch A	Did the lightbulb light up?
Disconnected	Y / N (circle one)
Connected	Y / N (circle one)

How to fill out this truth table:

1. Use the Simple Circuit template and the Circuit Instructions to build a simple circuit. You should have one "switch" under the letter A, which can be left unfolded (**disconnected**) or folded up (**connected**).
    - This truth table will help you record how your circuit works, and which switch position(s) will complete the circuit and cause the lightbulb to light up.
2. First, leave switch A unfolded, in the **disconnected** position. Observe whether the lightbulb lights up or not. Circle either **Y** (yes) or **N** (no) in the first row based on what you see.
3. Now, fold switch A upwards into the **connected** position, so that it lies flat on top of the letter "A". Observe whether the lightbulb lights up or not. Circle either **Y** (yes) or **N** (no) in the second row based on what you see.
4. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your simple circuit.
    - Hint: for a simple circuit, you should end up circling Y for one row, and N for the other row.

Truth Table:
Series Circuit = A AND B

Switch A	Switch B	Did the lightbulb light up?
Disconnected	Disconnected	Y / N
Disconnected	Connected	Y / N
Connected	Disconnected	Y / N
Connected	Connected	Y / N

How to fill out this truth table:

1. Use the Series Circuit template and the Circuit Instructions to build a series circuit. You should have two "switches" under the letters A and B, each of which can be left unfolded (**disconnected**) or folded up (**connected**).
    - Since each switch has two positions, there are four (2 x 2) possible combinations of switch positions. You'll be testing each combination to see if it causes the lightbulb to light up, and recording your results in this truth table.
2. Start at the first row. Put your switches into the specified combination (for the first row, both disconnected). Observe whether the lightbulb lights up, then circle either **Y** (yes) or **N** (no) in the third column of that row.
3. Repeat Step 3 for each of the remaining three rows.
4. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your series circuit.
    - Hint: for a series circuit, you should end up circling Y for at least one row.

Truth Table:
Parallel Circuit = A OR B

Switch A	Switch B	Did the lightbulb light up?
0	0	1 / 0
0	1	1 / 0
1	0	1 / 0
1	1	1 / 0

How to fill out this truth table:

1. Use the Parallel Circuit template and the Circuit Instructions to build a parallel circuit. You should have two "switches" under the letters A and B, each of which can be left unfolded/disconnected or folded up/connected.
   - Since each switch has two positions, there are four (2 x 2) possible combinations of switch positions. You'll be testing each combination to see if it causes the lightbulb to light up, and recording your results in this truth table.
2. Now we'll be filling out this truth table in binary, the language of computers! Use this key to help you translate your results to binary:
   - **0** = a **disconnected** switch OR an **unlit** lightbulb
   - **1** = a **connected** switch OR a **lit** lightbulb
3. Start at the first row. Put your switches into the specified combination (for the first row, both 0's = both disconnected). Observe whether the lightbulb lights up, then circle either **1** (yes) or **0** (no) in the third column of that row.
4. Repeat Step 3 for each of the remaining three rows.
5. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your parallel circuit.

Truth Table:

Combination Circuit = A OR (B AND C)

Switch A	Switch B	Switch C	Did the lightbulb light up?
0	0	0	1 / 0
0	0	1	1 / 0
0	1	0	1 / 0
0	1	1	1 / 0
1	0	0	1 / 0
1	0	1	1 / 0
1	1	0	1 / 0
1	1	1	1 / 0

How to fill out this truth table:

1. Use the Combination Circuit template and the Circuit Instructions to build a combination circuit. You should have three "switches" under the letters A, B, and C, each of which can be left unfolded/disconnected or folded up/connected.
   - Since each switch has two positions, there are eight (2 x 2 x 2) possible combinations of switch positions. You'll be testing each combination to see if it causes the lightbulb to light up, and recording your results in this truth table.
2. We'll be filling out this truth table in binary, the language of computers! Use this key to help you translate your results to binary:
   - **0** = a **disconnected** switch OR an **unlit** lightbulb
   - **1** = a **connected** switch OR a **lit** lightbulb
3. Start at the first row. Put your switches into the specified combination (for the first row, all three 0's = all three disconnected). Observe whether the lightbulb lights up, then circle either **1** (yes) or **0** (no) in the third column of that row.
4. Repeat Step 3 for each of the remaining seven rows.
5. Your truth table is now complete! Make sure your circled responses match the results you observed; feel free to double-check using your combination circuit.