ThinkFun

CIRCUIT MAZE™

ELECTRIC CURRENT LOGIC GAME

**AGES
8 to adult
single player**

⚠ WARNING ⚠

Avoid creating "short circuits" when building circuits in Circuit Maze™. Doing so can cause the batteries to overheat and damage the game's components.

A "short circuit" occurs when there is no resistance, or very little resistance, between the two ends of the Power Supply. In Circuit Maze, this occurs any time there is a direct path of metal strips from the Start (+) end of the Power Supply token to the Finish (−) end with no LED Beacons in between. Pages 10 & 11 give more information on short circuits.

Example 1	Example 2	Example 3
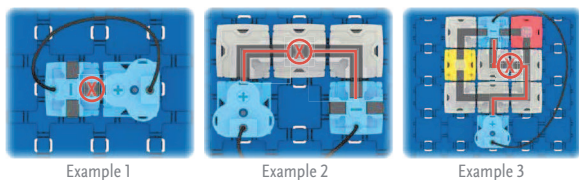
Make sure to avoid creating "short circuits" such as those shown above, where the current can move completely through the circuit without passing through an LED. **Always remove the Power Supply tokens from the grid when Circuit Maze is not in use.**

Before starting to play Circuit Maze, always check your batteries first. Try this simple test setup. If the LED doesn't light up, your batteries may be dead, if so, you will need to replace them with fresh batteries.
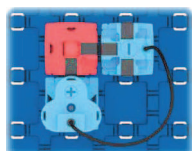
CIRCUIT MAZE™

**Circuit Maze™ is an electricity puzzle game. To play, you build a circuit pathway across the Game Grid from Start to Finish. When you complete your circuit and light up the designated Beacons, YOU WIN!**

Circuit Maze is challenging and fun. Plus, hands-on circuit building teaches you how electricity really works. You'll develop a good mental model for how current flows through an electrical circuit as you play.

INCLUDES:

5x5 Game Grid
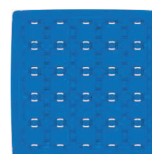
60 Challenge Cards with Solutions and 2 Legend Cards

CHALLENGE

BEGINNER
INTERMEDIATE
ADVANCED
EXPERT

START Token (+) and **FINISH Token (−)**, connected by wire.

Start Token

Finish Token

3 AAA Batteries

Finish Token has metal contact strips on three sides

Together, these are the Power Supply

90° Left

90° Right

Straight

3 Beacon Tokens (1 red, 1 yellow, 1 green) – Each Beacon contains a resistor to limit the current flow and an LED (Light Emitting Diode) that lights up when current flows through it in the proper direction.

1 Switch Token – This token causes the metal strip pathway to turn 90 degrees to the right, to go straight, or to turn 90 degrees to the left, depending on how you set the switch.

2 Straight Tokens – These carry the metal strip straight across the token from one side to the other.

5 Corner Tokens – These carry the metal strip 90 degrees around a corner.

2 T Tokens – These split the metal strip into two pathways.

1 Bridge Token – This houses two metal strips that connect pathways across the token, east-west and north-south, without them touching each other.
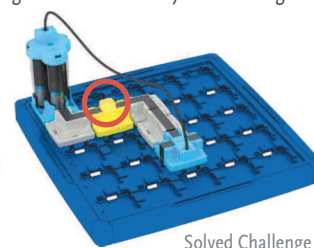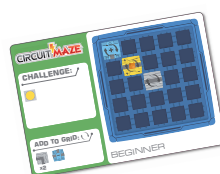
1 Double-Corner Token – This carries two metal strips, each strip comes in and goes out at a 90 degree angle.

1 Blocker Token – This prevents other tokens from being placed in a given grid square.

OBJECT:
For each challenge, build a continuous metal strip pathway from Start to Finish that lights up the designated Beacons on your Challenge Card.

Solved Challenge

THE BEACONS:
Begin each challenge by identifying which Beacons you will use, and whether the Challenge Card designates them to be lit or to stay dark. Every challenge will include at least one illuminated Beacon.
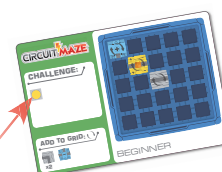
Designated Beacons Sample Configurations

One lit Beacon

Two lit Beacons

Two lit Beacons, one dark Beacon

BEACONS AND SWITCH TOKEN:
For challenges that include the 3-way Switch token, the Challenge Card indicates the Beacon configuration goal for each switch position.

**Designated Beacons for switch challenge Sample Configuration**

Switch in left position

Switch in center position

Switch in right position
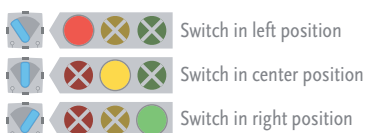
SETUP:

1. Select a Challenge Card.

2. Set up the tokens on your game grid to match the symbols illustrated on the Challenge Card.

   a. NOTE: The exact location and orientation of some tokens will be given. If the symbol contains a ROTATE sign ↻, it is up to you to figure out the orientation.

ADD TO GRID: ↻
x2

Place on grid

3. Select the tokens underneath the words "ADD TO GRID" for use in this challenge. **Any remaining tokens will not be used.**

4. Identify the Beacons you must light to solve the challenge.
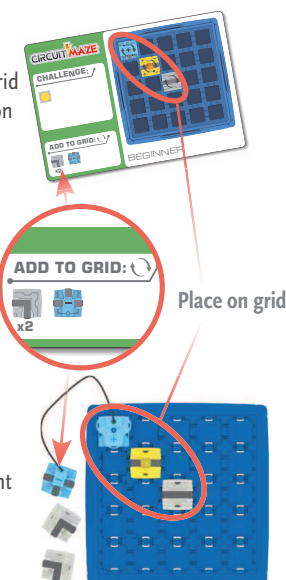
STEPS TO PLAY:

1. Place the designated tokens onto the game grid.

   a. Place and position tokens as specified on Challenge Card.

   b. You must use all the designated tokens, all must be part of the circuit.

2. When the designated Beacons light up, YOU WIN!

Challenge
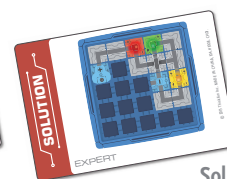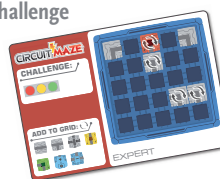
Solution!

CIRCUIT MAZE RULES AND CURRENT FLOW:
The following are the rules and regulations for how the current flows in Circuit Maze. These will be helpful for you to understand as you play. Our rules match the rules for how electrical circuits behave; by playing Circuit Maze you will be learning basic electronics concepts.

ELECTRICAL CIRCUITS:
You solve each challenge by placing your tokens on the game board to create a pathway – that is, a circuit – of metal strips, light Beacons and switches that connect the Start Token (+) to the Finish Token (–). Your solution must include at least one illuminated Beacon (LED/resistor) along the pathway or have an open switch.

You'll notice that the Start and Finish Tokens are connected by a wire, and that the Start Token (+) houses three AAA batteries.
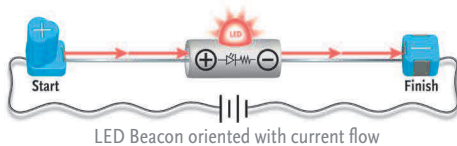
CURRENT FLOW:

As you play, imagine that there is a current that will flow along your circuit, from the Start Token (+) to the Finish Token (–). Your challenge is to channel this current so that it lights up the designated Beacons.


Power Supply
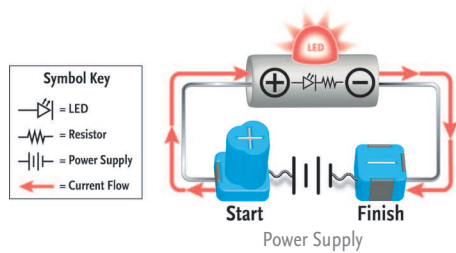
BEACONS:

Each Beacon contains a Light Emitting Diode (LED) that glows when current flows through it in the proper direction. Direction is important: Along with producing light, LEDs are one-way electrical valves, they allow current to flow in one direction but not in the other direction.

As shown in the following diagram: Current flows out of the Start Token (+), into the (+) side of the LED, lights the Beacon and flows out the (–) side of the LED, then on to the Finish Token (–).

LED Beacon oriented with current flow

As shown in the following diagram: If the LED Beacon is reversed so that the (–) side faces the Start Token (+), the LED valve closes and current does not flow through the LED. The Beacon stays dark.

LED Beacon oriented against current flow
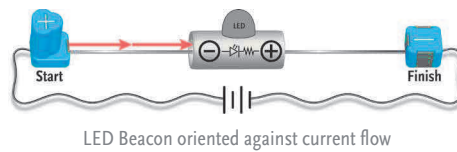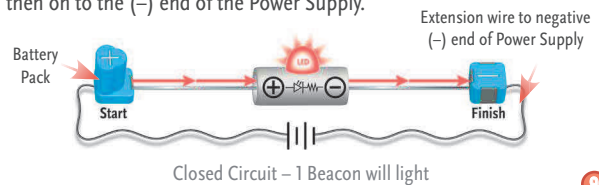
RESISTORS:

Each Beacon also contains a resistor that reduces the flow of current. Resistors are included to protect the LEDs from electrical damage caused by too strong current and also to protect the metal strips from heating up and draining the batteries.

CIRCUITS:

There are several different types of circuits that you will encounter in Circuit Maze. You will want to learn about these to get good at solving our challenges. The descriptions and diagrams that follow show several Circuit Maze elements. With the exception of short circuits, the challenges will have variations and combinations of these elements.

CLOSED CIRCUIT:

This is the simplest circuit – a pathway of metal strips from the (+) end of the Power Supply, through a single Beacon (LED/resistor), then on to the (–) end of the Power Supply.

Battery Pack

Extension wire to negative (–) end of Power Supply


Closed Circuit – 1 Beacon will light

SHORT CIRCUIT (AVOID THIS!):

A short circuit is a pathway of metal strips with an unrestricted connection from the (+) end of the Power Supply directly to the (–) end of the Power Supply, without passing through an LED/resistor. In this situation, too much current will flow and the batteries will get hot. This is bad. Immediately remove one of the tokens to break the circuit. See examples 1 & 2 on page 2.

Short Circuit – there is no beacon to light
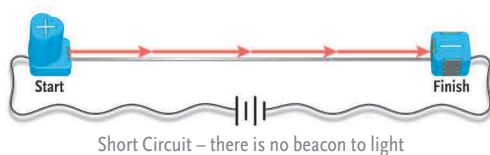
SERIES CIRCUIT:

A series circuit is when two or more Beacons are located on the same pathway, one after another. In the illustration below, current flows through and lights both LEDs.
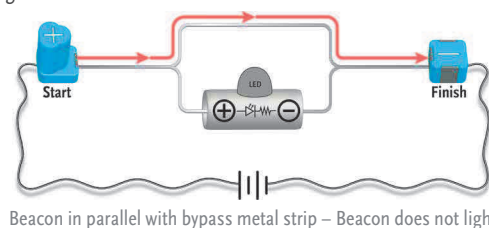

Series Circuit – 2 Beacons will light
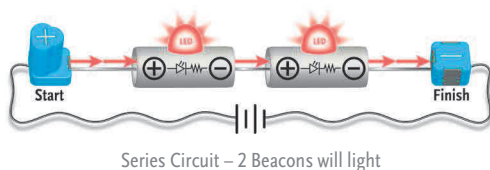
PARALLEL CIRCUIT:

A parallel circuit is when the pathway splits into two or more branches, with a Beacon located on each branch. In the illustration below, current flows through both branches and lights both Beacons.

Parallel Circuit – 2 Beacons will light
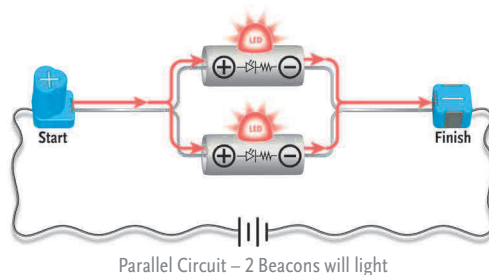
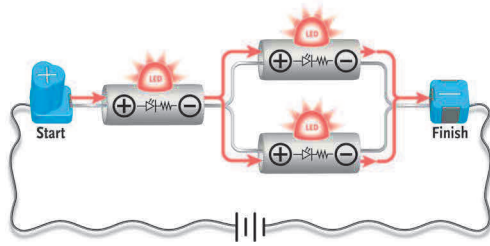## SHORT CIRCUIT BYPASS IN PARALLEL CIRCUIT (AVOID THIS!):

If a Beacon (LED/resistor) is located in one branch of a parallel circuit but not the other branch, the current will bypass the Beacon and flow only in the unrestricted branch of the circuit. This is bad. It creates a short circuit condition that will heat up your batteries. If you create a short circuit, remove one of the power supply tokens. See example 3 on page 2.

Beacon in parallel with bypass metal strip – Beacon does not light

SERIES AND PARALLEL CIRCUIT:

Some challenges include a Beacon on the main pathway, then the pathway splits into two branches each of which also includes a Beacon. In the illustration below, all three Beacons will light.

Beacon in series with 2 paralleled Beacons – All 3 will light

Some challenges include a parallel circuit with one Beacon on one branch and two Beacons in series on the other branch. In the illustration below, all three Beacons will light.
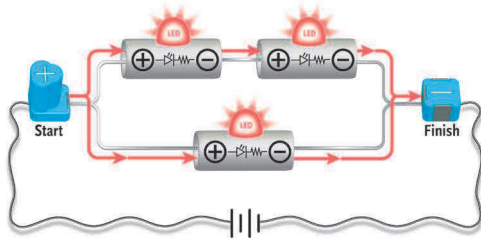

Two Beacons in series, both paralleled with third Beacon – All 3 Beacons will light

## BYPASS IN SERIES AND PARALLEL CIRCUIT:

With some "Parallel Circuit in Series" challenges, we place a Beacon on one branch of the parallel circuit but not the other branch. In these cases, current will bypass the Beacon and flow only through the unrestricted branch. Since the current will flow through the beacon in series, the bypass in parallel is fine (i.e. not a short circuit.)
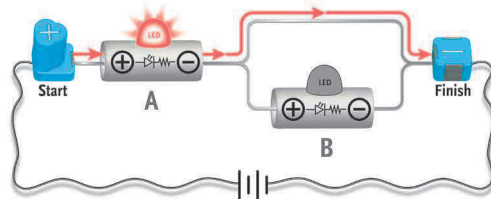
Beacon in parallel with bypass metal strip in series with another Beacon – Beacon A will light, Beacon B will not light

METAL STRIPS IN PARALLEL:

Some challenges have pathway sections that branch and come back together without flowing through any Beacons. Current flows through both branches here. We put these in to be tricky.
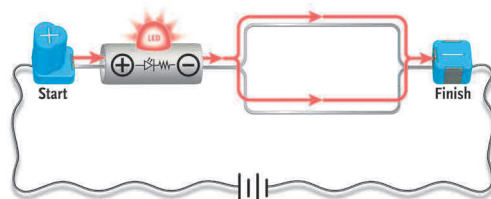

Metal strips in parallel and series – Beacon will light

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METAL STRIP LOOSE ENDS:

The Circuit Maze challenges are designed to have unique solutions and to contain no loose ends… every token will contribute to making the complete circuit. Two of the tokens deserve special comment.

Finish Token: We have designed this token to have metal strip connectors on three sides. Some of the challenges will connect to all 3 sides, some challenges will connect to 2 or 1 side only.

Metal strips on 3 sides
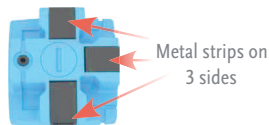
Finish Token – Not all sides must be used for every challenge

Switch Token: The 3-way Switch token lets us create different circuits within the same challenge. For some Switch challenges, one of the Challenge Beacon Settings shows all Beacons to be dark. In these cases, this branch of the circuit stops at the Switch token or loops back on itself, it should not create a short circuit.

ABOUT THE INVENTOR:

David Yakos is driven by creativity and a background in Mechanical Engineering. He develops consumer products as Director of Creativity, and Co-Owner of a product design firm called Salient Technologies Inc. He spends nearly every day of his life inventing unique solutions for everyday problems. Named on dozens of patents, he has helped develop hundreds of products for startups and leading brands.
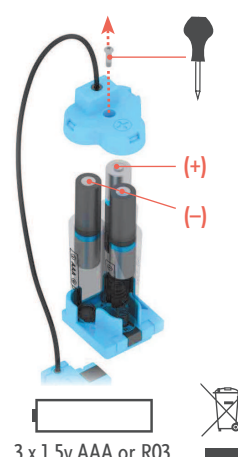
CHALLENGE CREATOR:

Special thanks to Wei-Hwa Huang, whose full genius is on display with this extraordinary collection of Circuit Maze challenges.

CHALLENGE CURATOR:

Special thanks to Tyler Somer, for a masterful job of refining and optimizing the challenges into final form ready for your puzzling pleasure.

BATTERY INSTALLATION:

(+)

(−)

3 x 1.5v AAA or R03

IMPORTANT BATTERY INFORMATION: ⚠ CAUTION

1. Always follow the instructions carefully. Use only batteries specified and be sure to insert them correctly by matching the + and – polarity markings.

2. Remove batteries if product is not to be played with for a long time.

3. Do not mix old batteries and new batteries, or standard (carbon-zinc) with alkaline batteries.

4. Remove exhausted or dead batteries from the product.

5. Do not short-circuit the supply terminals.

6. NON-RECHARGEABLE BATTERIES ARE NOT TO BE RECHARGED.

7. Remove rechargeable batteries before recharging.

8. Only charge rechargeable batteries under adult supervision.

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