## **Station 4: Circuit Puzzle Challenge**

**NGSS: MS-PS3-5** – Apply knowledge of energy systems
🎯 **Goal**: Create a circuit puzzle that only works when **all** paths are connected correctly.

### Materials:

 LEDs

 Buzzer

 Battery + holder

 Aluminum foil strips (or tape)

 Cardboard base

 Puzzle-shaped paper or cardboard pieces

 Wires or alligator clips

 Tape, scissors

### Student Directions:

#### 🗺️ Step 1: Create the Circuit Base

* Lay **foil strips** on cardboard to form your “hidden path.”
* Think like a game designer—**leave gaps** in the foil path where **puzzle pieces** will go!

#### 🧩 Step 2: Make Puzzle Connectors

* Cut paper or cardboard into puzzle pieces that will **bridge the gaps** in your foil path.
* Tape **foil to the bottom** of each piece so it **conducts electricity** when placed correctly.

#### ⚡ Step 3: Add LEDs and Buzzer

* Connect your circuit using the foil paths, puzzle bridges, battery, LED(s), and buzzer.
* Arrange the pieces so that the circuit is only complete—and works—when **ALL puzzle pieces are in the right spot**.

#### 🔄 Step 4: Test It!

* Try placing puzzle pieces one at a time.
* Does the LED light up? Does the buzzer buzz?
* What happens if a piece is missing or upside down?

### 🧪 **Test & Record**

| **Challenge Attempt** | **Did It Work?** | **What Went Wrong (If Anything)?** |
| --- | --- | --- |
| First Try | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Wrong Piece Used | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| All Correct Pieces | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

What was the **trickiest part** of the puzzle to get working?
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 Can you design a **second puzzle** for another team to solve?
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### **Reflection:**

* **How does your puzzle model real-world circuit design challenges (like in electronics or machines)?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **What does this puzzle teach about open vs. closed circuits?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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### ✅ **ITEEA STEL Standards – Middle School**

**STEL 1B** – Technological systems help meet individual and community needs.
→ Students simulate how circuit systems can be used in real-world applications, such as alarm systems or control panels.

**STEL 2B** – Design decisions consider performance, safety, and usability.
→ Students must design a circuit that works only under specific conditions (puzzle pieces connected correctly), mimicking critical control systems.

**STEL 3B** – The interaction of system parts influences function.
→ The activity shows how each puzzle piece (a component of the system) affects the performance of the overall circuit.

**STEL 4B** – Understanding system inputs, processes, and outputs helps students analyze and troubleshoot.
→ The circuit only functions when inputs (foil puzzle pieces) allow current to flow—modeling how open vs. closed circuits work.

**STEL 5B** – Design is an iterative process involving creativity and problem-solving.
→ Students brainstorm, build, test, and troubleshoot to get their puzzle to work, encouraging redesign and problem-solving.

**STEL 6B** – Modeling and prototyping clarify design ideas.
→ The foil paths and puzzle assembly act as a working prototype to explore how energy flows and how interruptions affect systems.

**STEL 7B** – Constraints and trade-offs influence design decisions.
→ Puzzle shape, path complexity, and material limitations challenge students to balance creativity with functionality.

### ✅ **Common Core Math Standards – Middle School**

**CCSS.MATH.CONTENT.6.SP.B.4–5** – Display and summarize data sets in context.
→ Students collect data on multiple circuit puzzle trials, track failures/successes, and analyze error causes.

**CCSS.MATH.CONTENT.7.EE.B.3** – Solve real-life problems using numerical and algebraic expressions.
→ Students apply reasoning to solve why their circuit does or doesn't work, sometimes requiring simple algebraic thinking (e.g., “2 LEDs + 1 buzzer = needs more power”).

**CCSS.MATH.PRACTICE.MP1** – Make sense of problems and persevere in solving them.
→ Building a working puzzle requires persistence through failure and iterative problem-solving.

**CCSS.MATH.PRACTICE.MP4** – Model with mathematics.
→ Students model how energy transfer depends on a complete conductive path (mathematically and structurally).

**CCSS.MATH.PRACTICE.MP5** – Use appropriate tools strategically.
→ Strategic use of foil, clips, buzzers, and LEDs to create a controlled system that tests their understanding of closed-loop circuits.

**CCSS.MATH.PRACTICE.MP7** – Look for and make use of structure.
→ Students must think logically about how physical arrangement affects circuit behavior and energy transfer.

### ✅ Summary

The **Circuit Puzzle Challenge** combines **engineering, logic, and science** by having students design an interactive system that teaches **open vs. closed circuits**, **energy transfer**, and **system thinking**. It addresses **ITEEA STEL standards** for system interaction and prototyping, and integrates **Common Core Math** through structured problem-solving, modeling, and data analysis.