**NGSS HS ACTIVITY FOR CIRCUITRY GAME:**

**🔌💡 Activity Title: “Code the Circuit: Escape the Power Grid!”**

**A Circuit-Based Puzzle Challenge for Energy & Electricity**

**Grades:** High School | **Time:** 1–2 class periods
**Focus:** NGSS Standards HS-PS2-6, HS-PS3-1, HS-PS3-2, HS-PS3-3, HS-PS3-5

**🎯 Scenario (Student-Friendly Prompt):**

🚨 You’re trapped inside a broken power station! To **escape**, you must **repair and power up** parts of the system using only what you can find. Each working circuit unlocks a new “door” in the escape sequence. Will your circuitry skills save the day?

**🛠️ Materials (Easy-to-Find):**

* Copper tape or aluminum foil strips
* Paper or cardboard “circuit board” base
* LEDs (or mini bulbs)
* Buzzers (or use vibration motors for sound/feedback)
* 3V coin cell batteries or AA batteries with holders
* Alligator clips or binder clips and paper clips
* Straws, tape, index cards, scissors
* Optional: Magnets + copper wire coil (for electromagnetic trigger)
* Multimeter (or simple battery-powered continuity tester)
* Basic resistors (optional for Ohm’s Law challenges)

**🔧 Instructions (Student Steps):**

**🔍 Station 1: “Material Match-Up”**

**🔍 Station 1: Material Match-Up – Conductors vs. Insulators**

**NGSS Connection:** *HS-PS2-6 – Evaluate materials based on their properties for electrical applications*
**Class: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Partner(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**🎯 Your Mission:**

You're a circuit repair technician! A wire has broken in your system, and you need to find a material that can **complete the circuit** and allow electricity to flow. You'll test different everyday objects to see if they are **conductors** or **insulators**.

**🛠️ Materials at This Station:**

* Copper tape or wire
* Coin cell battery or AA battery pack
* LED light
* Testing materials: paper clip, foil, plastic, rubber band, pencil lead (graphite), wood, etc.
* Tape (if needed to hold materials in place)
* Worksheet or notebook for recording results

**👣 Step-by-Step Student Directions:**

**1️⃣ Build a Simple Circuit**

* Create a basic circuit using copper tape or wires, battery, and LED.
* Leave a **small open gap** in the circuit where you will test each material.

**2️⃣ Test Materials One at a Time**

* Place one test material across the gap.
* Observe: **Does the LED turn on?**
	+ **Yes?** → The material is a **conductor** (electricity flows).
	+ **No?** → The material is an **insulator** (electricity does not flow).

**3️⃣ Repeat for Each Item**

* Be sure to test **at least 5 materials**.
* Record your observations in the table below.

**📊 Data Table:**

| **Material** | **LED On? (Yes/No)** | **Conductor or Insulator?** | **Notes (How well did it work?)** |
| --- | --- | --- | --- |
| Paper Clip |  |  |  |
| Aluminum Foil |  |  |  |
| Plastic Strip |  |  |  |
| Rubber Band |  |  |  |
| Pencil Lead (Graphite) |  |  |  |
| (Add your own) |  |  |  |

**⚡ Challenge Question:**

**Which material worked best to “patch” the broken wire, and why do you think it worked so well?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**💬 Discussion Prompt:**

* What do conductors have in common?
* Why are insulators important in real circuits and electronics?

**⚡ Station 2: “The Power Puzzle”**

**NGSS Connection:** *HS-PS3-1 (Energy conservation), HS-PS3-2 (Energy transfer in circuits)*
**Class: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Partner(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

**🎯 Your Mission:**

You’re the circuit designer for a high-tech LED lighting system! Your job is to figure out the **correct resistance** needed to safely power your LED—too much current, and it could burn out!

**🛠️ Materials at This Station:**

* Copper foil or wire strips (short and long pieces)
* LED light
* Battery (e.g., coin cell or 9V)
* Multimeter (to measure voltage or current)
* Optional: Resistors of various values
* Tape and scissors

**Student Directions:**

 **Build a Simple LED Circuit**

* Connect your LED to the battery using **short copper tape strips** or wires first.
* Observe the **brightness** of the LED. Is it too bright? Dim? Just right?

 **Try a Longer Copper Tape Path**

* Replace one of the short strips with a **longer path** of copper tape.
* Observe again: Has the brightness changed?

 **Estimate or Measure Values**

* Use the **multimeter** to measure:
	+ **Voltage (V)** across the LED
	+ **Current (I)** flowing in the circuit
	*OR* use the LED packaging to estimate how much voltage/current it needs (most LEDs use ~2V and 20mA).

 **Calculate Resistance**

* Use **Ohm’s Law**:
* Use your measurements or estimates to solve for **R** (resistance needed in ohms, Ω).

**Data Recording Table:**

| **Setup Type** | **Voltage (V)** | **Current (A)** | **Resistance (Ω)** | **LED Brightness (Low / Medium / High)** |
| --- | --- | --- | --- | --- |
| Short copper strip |  |  |  |  |
| Long copper strip |  |  |  |  |
| (Optional) with resistor |  |  |  |  |

**🔍 Analysis & Challenge:**

* **Voltage used:** \_\_\_\_\_\_\_\_\_\_\_
* **Resistance calculated:** \_\_\_\_\_\_\_\_\_\_\_
* **What happened when resistance was too low?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**💬 Discussion Prompts:**

* How does resistance affect how much energy your LED receives?
* What might happen to a real-world device if resistance isn’t controlled properly?
* Why do you think engineers carefully calculate resistance in every circuit?

**🎮 Station 3: “Trigger the Gate” – Game Mechanism Design**

**NGSS Connection:** *HS-PS3-3 (Designing energy systems and conversions)*
\**Class: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Partner(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**🎯 Your Mission:**

You’re designing a **game mechanism** for an escape room challenge! Your goal is to build a creative **switch or trigger** that turns on a **light or buzzer** when solved by a player.

You’ll explore **how mechanical actions (like pressing, tilting, or pulling)** can complete an electrical circuit—and convert **mechanical energy into electrical energy**.

**Materials at This Station:**

* Battery (coin cell or 9V)
* Buzzer or LED light
* Wires or copper tape
* Paperclips, magnets, sponges, rubber bands, cardboard
* Aluminum foil, foam, ball bearing, tape, scissors
* Optional: Reed switch or small motor

**Student Directions:**

**Explore Switch Options**

Pick one or more designs to build:

* **Pressure Plate Switch:** Layer foil and sponge so the circuit closes when pressed.
* **Tilt Switch:** Create a simple seesaw or pathway with a metal ball or paperclip that bridges a circuit when tilted.
* **Magnetic Switch:** Use a **magnet** and a **metal paperclip** or **reed switch** to create contact.

 **Build and Test Your Switch**

* Connect your battery, switch, and buzzer/light in a simple circuit.
* When the switch is triggered, your **output device** (light or buzzer) should turn on.
* Troubleshoot as needed: Is the connection tight? Does the circuit close completely?

 **Incorporate into a Game Mechanism**

* Imagine this switch is part of an **escape room puzzle.**
* Mount it onto a board or inside a box.
* Think: How does a player *trigger* the circuit? Is it fun and challenging?

**Record Your Results:**

| **Switch Type Tried** | **Did It Work? (Y/N)** | **Easy to Use? (✔/✘)** | **Notes or Observations** |
| --- | --- | --- | --- |
| Pressure Plate |  |  |  |
| Tilt Switch |  |  |  |
| Magnetic Switch |  |  |  |

**Analysis Questions:**

**What kind of energy conversion occurred in your system?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What was the most reliable switch design and why?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**💡 Design Tip:**

Think like an engineer! The best switch is not just cool—it’s **reliable**, **reproducible**, and **safe** for others to use in your game setup.

**🧲 Station 4: “Field Effects” – Magnetic Interaction Mini-Challenge**

**NGSS Connection:** *HS-PS3-5 (Conservation of Energy and Energy Transfer via Fields)*
\**Class: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Partner(s): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

**🎯 Your Mission:**

Explore how **magnetic fields** can cause **motion or signals**—without even touching anything! You’ll use a magnet and a coil of wire (or speaker) to **detect invisible forces** and see how they might trigger part of a puzzle in a game circuit.

**🛠️ Materials at This Station:**

* Strong magnet (neodymium recommended)
* Copper wire coil or DIY earpiece speaker
* Compass (optional)
* Small LED or buzzer (if available)
* Wires with clips or copper tape
* Cardboard, paperclip, foam (for building magnetic triggers)

**Student Directions:**

 **Test Magnetic Effects**

* Gently move a **magnet** close to a **coil of copper wire** or small speaker.
* Try moving the magnet back and forth quickly near the coil.
* If using a **speaker setup**, listen carefully for tiny *clicks* or *buzzing.*
* Observe a **compass needle** when you bring the magnet near. What changes?

 **Magnet vs. Motion**

* Experiment with placing a metal object inside a coil and moving a magnet nearby.
* Try switching directions and speed of movement.
* Optional: Use the coil + LED/buzzer to test if any electrical signal is created by motion.

**Mini-Challenge: Add to Your Game!**

* Design a **“magnetic switch”** for your escape game puzzle!
Examples:
	+ **Magnet + Paperclip Trigger** – when aligned, they complete a circuit.
	+ **Reed Switch Activation** – use a hidden magnet to turn on light or buzzer.
	+ **Magnetic Maze** – move a metal object using a magnet from underneath.

 **Record Your Observations:**

**What happened when the magnet moved near the wire or speaker coil?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**What happened to the compass needle near the magnet?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**How can magnetic force be used to move or activate something *without touching it*?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**How could you use a magnet as a trigger in your game puzzle?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Energy Insight:**

Magnetic fields can transfer **energy through space**—no contact needed! This is how motors, generators, and even some wireless chargers work.

 **Wrap-Up: Final Build + Escape Test**

**Task:** Now combine **at least 2 of your circuit components** into one final **escape challenge board** for classmates to solve.
Example: Press the foil pressure plate AND complete the circuit with a conductor to light the escape beacon!

💬 *Reflection Prompts:*

* What forms of energy were involved in your circuit?
* How did your materials impact how well your circuit worked?
* What was challenging about converting energy in your circuit?

**✅ NGSS Learning Summary:**

| **Standard** | **Concept Practiced** |
| --- | --- |
| **HS-PS2-6** | Material structure: conductor vs. insulator |
| **HS-PS3-1** | Ohm’s Law modeling |
| **HS-PS3-2** | Energy as motion & position |
| **HS-PS3-3** | Energy transformation in circuits |
| **HS-PS3-5** | Electric/magnetic field interaction |

**NGSS MS ACTIVITY FOR CIRCUITRY GAME:**

Here’s a **creative, station-based activity** for the **Build Your Own Circuitry Game Kit**, designed for **middle school students** and fully aligned with the **NGSS Physical Science standards** you listed. The activity is hands-on, fun, and uses **simple, low-cost materials** to help students explore energy transfer, circuit design, and electrical forces.

🔌 **Circuit Challenge: Power Up Your Game!**
**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Date: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
**Class:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  Team: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

🎯 **Mission:**
You’re a game engineer! Rotate through each station to learn how circuits work, how energy moves, and how to control power in your own electronic game. At the end, you’ll use what you learned to build a mini challenge circuit for a **buzz-wire game**, **LED maze**, or **pressure sensor puzzle**!

**🔧 Station 1: Conductor vs. Insulator Showdown**

**NGSS Standard:** *MS-PS2-3 – Electric and Magnetic Forces*
**Focus Question:** *How do different materials affect the flow of electric current?*

**🎯 Your Mission:**

You are testing mystery materials to find out which ones allow electricity to pass through (conductors) and which ones block it (insulators). This helps engineers choose the right materials for wiring and safety!

**🛠️ Materials at Your Station:**

* Battery pack (AA or 9V)
* Light bulb holder + bulb **OR** LED with resistor
* Alligator clip wires (at least 3)
* Test items:
	+ Metal paper clip
	+ Plastic straw
	+ Cardboard
	+ Aluminum foil
	+ Rubber band
	+ Wooden stick or craft stick

**👣 Student Directions:**

**1️⃣ Build Your Circuit**

* Connect one end of a wire to the **positive (+)** side of the battery.
* Connect the other end of that wire to the **first leg** of the light bulb or LED.
* Connect another wire to the **second leg** of the light.
* Leave the end of that wire **open**—this is where you’ll test your materials.
* Finally, connect the **third wire** from the **negative (–)** side of the battery. This wire also remains open for testing.

**2️⃣ Test Each Material**

* Touch or clip one end of your **test material** to the open end of the wire from the **bulb**.
* Touch or clip the other end of the material to the open end from the **battery**.
* **Watch the light!** If it turns on, the material conducts electricity.
* If it stays dark, the material is an insulator.

**3️⃣ Complete the Data Table**

| **Material** | **Did the Light Turn On?** | **Conductor or Insulator?** |
| --- | --- | --- |
| Aluminum foil | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Plastic straw | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Rubber band | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Metal paper clip | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Wood stick | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Cardboard | ☐ Yes ☐ No | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

**🧠 Reflect and Explain:**

**What do all the conductors have in common (look at color, feel, material type)?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Why is it important to know which materials are conductors or insulators in real life?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**⚡ Station 2: Power Up! Potential Energy in Batteries**

**NGSS Standard:** *MS-PS3-2 – Energy Transfer and Conservation*
**Focus Question:** *How does a battery store and release energy to power devices?*

**🎯 Your Mission:**

Batteries store chemical potential energy. Your job is to measure and compare how much energy is stored in different batteries and observe how it powers a light.

**🛠️ Materials at Your Station:**

* 1 AA battery (1.5V)
* 1 9V battery
* Multimeter or voltage tester
* Battery holders (for each battery type)
* LED (with resistor to prevent burn-out)
* Breadboard or jumper wires (optional, for easy setup)

**Student Directions:**

 **Measure Voltage**

* Use the **multimeter or voltage tester** to read the voltage of each battery.
* Place the red probe on the **positive (+)** side and the black probe on the **negative (–)** side.
* **Record** the reading for each battery in volts (V).

 **Build a Simple Circuit**

* Insert the **AA battery** into its holder.
* Connect the **positive and negative wires** from the battery holder to the LED circuit (use a breadboard or clip wires).
* Observe the **brightness** of the LED and describe it as **Low**, **Medium**, or **High**.
* Repeat the same setup with the **9V battery**.

💡 *Hint: Make sure to use the same LED each time for a fair comparison!*

**3️⃣ Fill in the Data Table**

| **Battery Type** | **Voltage Reading (V)** | **Brightness of LED (Low, Med, High)** |
| --- | --- | --- |
| AA | \_\_\_\_\_\_\_ V | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| 9V | \_\_\_\_\_\_\_ V | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

 **Think & Record:**

**Which battery stored more energy, and how can you tell?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**How does the voltage relate to how much energy is available to power the LED?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**In real life, why might someone choose a higher-voltage battery?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**🔥 Station 3: Hot Circuits!**

**NGSS Standard:** *MS-PS3-3 – Apply scientific principles to design devices that convert energy.*
**Focus Question:** *What happens when circuits resist electric current?*

**Your Mission:**

You’ll explore how **resistance** affects electrical energy. Some resistors slow down current more than others. As electricity encounters resistance, energy can turn into **heat**—just like in real devices!

**Materials at Your Station:**

* Battery pack (3V–9V)
* LED (with built-in or external resistor)
* Three resistors: 100Ω (low), 330Ω (medium), 1kΩ (high)
* Alligator clip wires or breadboard
* Infrared thermometer or use fingers to carefully sense warmth (ask your teacher first!)
* Stopwatch (optional, for timed tests)

**Student Directions:**

 **Set Up Your Circuit**

* Use the **battery**, **LED**, and **resistor** to create a simple series circuit.
* Start with the **100Ω resistor**.
* Make sure your LED lights up—**long leg = + (positive side).**
* Observe the **brightness** and carefully (or using the thermometer) check for **heat near the resistor** after it’s been on for 20–30 seconds.

 **Repeat the Test**

* Switch out the 100Ω resistor with the **330Ω resistor**.
* Repeat the observation: brightness and any heat.
* Then test the **1kΩ resistor** (1,000 ohms).
* Wait the same amount of time for each test before checking for heat or brightness.

**Fill in the Data Table:**

| **Resistor Value** | **Brightness** | **Heat Observed? (Yes/No)** |
| --- | --- | --- |
| 100Ω | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | ☐ Yes ☐ No |
| 330Ω | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | ☐ Yes ☐ No |
| 1kΩ | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ | ☐ Yes ☐ No |

 **Think & Record:**

**What did you learn about resistance and energy in circuits?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Which resistor let the most current flow? How could you tell?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**In a real-world device, why might we want higher or lower resistance?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**🔔 Station 4: Energy in Motion!**

**NGSS Standard:** MS-PS3-5
**Focus:** How does electrical energy turn into other types of energy?

**Goal:**

You’ll build simple circuits and test different output devices (a buzzer, motor, and LED). Observe how electrical energy changes into **sound**, **motion**, or **light**. You are exploring *energy transformations!*

**Materials:**

* Buzzer or motor
* LED (light-emitting diode)
* Arduino OR basic battery-powered circuit with a switch
* Breadboard or circuit base
* Wires and alligator clips
* Battery pack (AA or 9V)

**Student Directions:**

**STEP 1: Set Up Your Power Source:**

* + Connect the battery pack to the breadboard or Arduino.
	+ Be sure the power is OFF at the start.

**STEP 2: Connect Your Output Device:**

* + Choose one output (LED, buzzer, or motor) and connect it to the circuit.
	+ Make sure the polarity (positive and negative) is correct for the LED or motor.

**STEP 3: Test the Circuit:**

* + Flip the switch ON and observe what happens.
	+ What do you hear? What do you see? What do you feel?

**STEP 4: Repeat with Other Devices:**

* + Swap out the output device (try all 3: buzzer, motor, and LED).
	+ Turn the switch ON/OFF each time and record your observations.

**STEP 5:Observe and Record:**

* + Fill in the data table below. Think about what type of energy is produced and where it came from.

**🧠 Record It!**

| **Output Device** | **Type of Energy Produced** | **Energy Transfer (From → To)** |
| --- | --- | --- |
| Buzzer |  |  |
| Motor |  |  |
| LED |  |  |

**💡 Think About It:**

* What happened when you turned the switch on?
* What energy change occurred each time?
* Which device surprised you the most?

✍️ Write your reflection or explanation on the back of your worksheet or notebook.

**🎮 Final Challenge: Build Your Own Mini Game Circuit!**

**NGSS Standards:**

* *HS-PS3-3 – Design a device to convert energy from one form to another*
* *HS-ETS1 – Engineering Design Process*

**🎯 Your Mission:**

Use what you’ve learned from all the stations to **design and build your own interactive game** that uses a working circuit! Your game should involve **energy transfer** (like from electrical to light, sound, or motion).

 **Choose a Game Type:**

Pick **ONE** of the following mini game designs (or invent your own!):

 **Buzz Wire Game**

Guide a metal loop along a bent wire without touching it. If the loop touches, a buzzer goes off!

**🔦 LED Maze**

Create a puzzle path. When the player completes the correct route, it closes the circuit and lights up the LEDs.

**🟪 Pressure Pad Puzzle**

Use foil and foam to make a pad that only completes the circuit when weight is applied—triggering a light or buzzer.

**Available Materials:**

* Battery (9V or AA with holder)
* LEDs, buzzer
* Wire or copper tape
* Aluminum foil, foam board, cardboard
* Tape, glue, resistors, switches
* Scissors or paper clips

**Student Directions**

**1️⃣ Plan Your Game**

* Decide which game you want to build.
* Think about how a player will interact with it.
* Sketch your circuit and layout on the template below or on a blank page.

**2️⃣ Build the Circuit**

* Use wire, foil, or copper tape to create paths.
* Connect your components (LEDs, buzzers, switches) using a breadboard or alligator clips.
* Make sure your circuit **completes** only when a player makes the correct move.

**3️⃣ Test & Tweak**

* Try playing your game!
* Fix any parts that don’t work by checking your connections, battery, and component placement.
* Ask another group to test your game and give feedback.

**Sketch Your Game Circuit & Layout:**

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**Which Energy Transfers Happen in Your Game?**

(E.g., Electrical → Light, or Electrical → Sound)
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**💬 Wrap-Up Reflection:**

**What surprised you most about how circuits work?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**If you had more time, what feature would you add to your game?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Which part of the challenge helped you learn the most?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**NGSS ES ACTIVITY FOR CIRCUITRY GAME:**

Here’s a **creative, hands-on activity** for your **Elementary Circuitry Game Kit**, aligned with **NGSS Physical Science standards**. It’s designed for **Grades 1–4**, with **simple materials** and playful tasks that encourage students to explore energy transfer, sound, and circuit design while building their own **“Buzz & Glow” game**.

**🔌 Buzz & Glow Builders: A Circuit Game Adventure**

**Name:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Date:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
**Class:** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_    **Partner(s):** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

🎯 **Your Mission:**
You're an inventor! Today, you’ll use lights, buzzers, and wires to build a game where players light up LEDs or make buzzers buzz when they complete a circuit. Explore how electricity moves, how it makes sound and light, and how you can redesign your creation to work even better!

**🛠️ Station 1: Make It Shine!**

**NGSS Standard: 4-PS3-2**
**Focus:** Energy transfer using electric circuits.

**Materials:**

* 2 AA batteries + holder
* Alligator clip wires
* LED light
* Paper and tape
* Battery switch (optional)

**Student Directions:**

**STEP 1: Build Your Circuit:**

* Attach the **battery holder wires** to your **alligator clips**.
* Clip one wire from the **positive (+) end** of the battery holder to one leg of the **LED**.
* Clip another wire from the **negative (–) end** of the battery holder to the other leg of the LED.

**STEP 2: Test It Out!**

* **Does your LED light up?**
	+ ✅ Yes: Great job!
	+ ❌ No: Flip the LED around — it only works in **one direction!**

**STEP 3: Tape It Down:**

* Once it lights up, **tape the LED** to a **sheet of paper** to start your **game board** design.

**STEP 4: Decorate the Flow:**

* Use arrows to **show the path of the electricity**:
**Battery ➝ Wire ➝ LED ➝ Wire ➝ Back to Battery**

**STEP 5: Design Your Game:**

* Add fun decorations!
Example: "Touch the button to light the treasure!" or “Complete the circuit to unlock the safe!”

**🖊️ Draw & Label Your Circuit Below:**

* Include: battery, wires, LED, and direction of current (arrows!)

**🔊 Station 2: The Buzzer Beats**

**NGSS Standard: 1-PS4-1**
**Focus:** Sound from vibrating materials.

**Materials:**

 1 small **buzzer**

 1 **battery pack** (2 AA batteries or 9V)

 2 **alligator clip wires**

 1 **plastic cup** (to act as a sound amplifier)

**Student Directions:**

**Step 1: Build the Circuit:**

* Use alligator clip wires to connect the **buzzer** to the **battery pack**.
	+ Clip **one wire** to the **positive (+)** side of the battery and to one buzzer wire.
	+ Clip the **second wire** to the **negative (–)** side of the battery and to the other buzzer wire.

**Step 2: Listen Up!**

* **What do you hear when the buzzer is connected?**
	+ If you hear nothing, double-check your connections and make sure the buzzer is facing the correct direction.

**Step 3: Amplify the Sound:**

* Place the **buzzer inside the plastic cup**.
* **Listen again** — is the sound louder now?

**Step 4: Feel the Vibration:**

* Gently **touch the buzzer while it’s buzzing.**
	+ Can you **feel it vibrating**? That’s what creates the sound you hear!

**Record Your Observations:**

| **Question** | **Your Answer** |
| --- | --- |
| Sound: | ☐ Loud ☐ Soft ☐ No Sound |
| Vibration (felt when touched): | ☐ Yes ☐ No |
| Did the cup make the sound louder? | ☐ Yes ☐ No |

**What made the buzzer work?**

→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**🔄 Station 3: Build, Break & Rebuild**

**NGSS Standard: 2-PS1-3**
**Focus:** Breaking down and rebuilding circuits.

**Materials:**

 Snap circuit board or breadboard (if available)

 LEDs (light-emitting diodes)

 Buzzers or sound modules

 Connecting wires

 Battery pack

 Switch (optional)

**Student Directions:**

**Step 1: Carefully break down your old circuit.**

* Take apart the circuit you built in **Station 1 or Station 2**.
* Keep the materials organized so they’re easy to reuse.

**Step 2: Review your parts.**

* Lay out your **LED**, **buzzer**, **wires**, and **battery pack**.
* Check the **positive and negative sides** of the components (especially the LED and buzzer—they only work one way!).

**Step 3: Begin rebuilding your circuit.**

* Start with a **simple loop**: Connect the battery to the buzzer or light.
* Then try to **add the second component** (so it includes both a light and a sound).
* Decide if you want them to work at the same time or use a switch to control them.

**Step 4: Test your new circuit.**

* Make sure all connections are tight and that the batteries are working.
* Turn it on (if there’s a switch) or complete the circuit to test it.

**Step 5: Problem-solve and adjust.**

* If one part doesn’t work, check:
✅ Is it connected in the correct direction (especially LEDs)?
✅ Are all connections complete?
✅ Is the battery charged?
* Try switching the order of components or changing the design.

**Sketch Your New Circuit Design Below:**

(Include batteries, wires, light, and buzzer in your drawing.)
 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
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 **Did your new circuit work?**

☐ Yes  ☐ No  ☐ Sort of

If it didn’t work, what will you try differently next time?
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**🎮 Final Challenge: Design a Circuit Game!**

**NGSS Standard: 4-PS3-4**
**Goal:** Create a simple “touch the target” or “match the wire” game that uses **light** or **sound** when players win.

**Materials Needed:**

* LEDs and/or buzzers
* Aluminum foil (for creating switches or contact points)
* Wires or paper clips
* Paper or cardboard (for the game board)
* Tape, scissors, glue
* Markers or crayons (for decoration)
* Battery pack (with batteries)

**Student Directions:**

**Step 1: Plan Your Game**
Think of a game idea that uses a **circuit to signal success**. Choose one:

* **Touch Match Game** – Players touch two foil pads to complete a circuit and turn on the light/buzzer.
* **Wire Maze Game** – Players guide a metal loop along a wire path. If they touch the wire, the buzzer sounds!

**Sketch your game board idea on scrap paper or in your notebook.**
Think about: Where will the switch go? Where will the foil be? Where will the light or buzzer be?

**Step 2: Build Your Game Board**

* Use paper or cardboard as your game base.
* Create your foil pads or maze using aluminum foil and tape.
* Decorate your board with colors, designs, or labels.

**Step 3: Build the Circuit**

* Connect the **battery**, **LED or buzzer**, and **foil/contact points** using wires.
* Make sure the **foil or wire maze is part of the circuit path**—it should only close the circuit when touched (or not touched, depending on the game).
* **Test each part** as you go. Does the LED or buzzer work?

**Step 4: Test & Improve**
Try playing your game! Then answer the checklist:

✅ Does the **LED light up** when the player wins?
✅ Does the **buzzer sound** when the player touches the maze?
✅ Do any parts need fixing or re-taping?

Use trial and error to make the game more reliable and fun!

**Design Thinking Questions:**

1. **What part of the game triggers the light or buzzer?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **What kind of energy is being used and changed in your circuit?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Wrap-Up Reflection**

1. **What did you learn about how electricity makes things work?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
2. **Which part was the most fun to build or redesign?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
3. **If you could make your game even better, what would you add or change?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_