**📍 Station 2: Energy Explorer**

**Focus:** Measuring Voltage and Energy Transfer  
**NGSS:** MS-PS3-5, 4-PS3-4, 3-PS2-4

### **Goal:**

Explore how electrical energy is transferred from a battery to a device, like a motor or LED, and how voltage relates to how much energy is being delivered.

**Materials Needed:**  
 1 AA battery

 Multimeter

 Small motor or LED light

 Alligator clip wires (2–3)

**Student Directions:**

#### Step 1: Build Your Circuit

1. Connect one wire from the **positive (+) end of the battery** to one end of the **motor or LED**.
2. Connect another wire from the **negative (–) end of the battery** to the **other side of the motor or LED**.
3. Observe: Does the device **turn on, spin, or light up?**

#### 📏 Step 2: Measure Voltage with a Multimeter

1. Set the multimeter to **DC volts (V)**, in the 20V or 2V range.
2. Touch the black probe to the **negative (-)** battery terminal.
3. Touch the red probe to the **positive (+)** battery terminal.
4. Write down the number on the screen — that’s the **voltage**!

#### 🔁 Step 3: Reverse the Battery

1. Carefully switch the wires — connect the battery **backward**.
2. Observe what happens to the motor or LED.
   * Did it **spin the other way**?
   * Did the **light turn off or dim**?
3. Try measuring the voltage again.

### 📊 Record Your Results:

| **Test** | **Voltage Reading (V)** | **Motor/Light Reaction** | **What Happened When Reversed?** |
| --- | --- | --- | --- |
| Try 1 |  |  |  |
| Try 2 (Reversed) |  |  |  |

### 💬 Think & Reflect:

📝 **How does electrical energy change when transferred to the motor or light?**  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

🧠 **Bonus Question:** What form of energy does the motor or light give off?  
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### 📍 Station 2: **Energy Explorer**

**Focus:** Measuring Voltage and Energy Transfer  
**NGSS Alignment:**

* **MS-PS3-5** – Construct, use, and present arguments to support the claim that when the kinetic energy of an object changes, energy is transferred to or from the object.
* **4-PS3-4** – Apply scientific ideas to design, test, and refine a device that converts energy from one form to another.
* **3-PS2-4** – Define a simple design problem that can be solved by applying scientific ideas about magnets.

### ✅ ITEEA STEL Standards – Middle School

**STEL 1E** – Technological systems use inputs, processes, outputs, and feedback to solve problems.  
→ Students explore how voltage (input) affects energy transfer (process/output) in a working electrical circuit.

**STEL 2E** – Technological systems are made up of interactive parts.  
→ The battery, wires, and device (motor/LED) function as a complete circuit system, with parts working together.

**STEL 6E** – Energy is the capacity to do work.  
→ Learners observe how electrical energy is converted into motion (motor) or light (LED).

**STEL 7F** – Technological products and systems can be used to apply energy in a variety of ways.  
→ The activity demonstrates multiple energy conversions: electrical → kinetic (motor), or electrical → light (LED).

**STEL 11E** – Modeling, testing, evaluating, and modifying are used to transform ideas into practical solutions.  
→ Students measure voltage, test system behavior under different configurations, and evaluate results.

### ✅ Common Core Math Standards – Middle School

**CCSS.MATH.CONTENT.6.SP.B.4** – Display numerical data in plots on a number line, including dot plots, histograms, and box plots.  
→ Students record and could visualize voltage readings and device behavior before and after changes.

**CCSS.MATH.CONTENT.6.EE.C.9** – Use variables to represent two quantities that change in relationship to one another.  
→ Students can relate voltage (input) and light/motion response (output) as dependent variables in a system.

**CCSS.MATH.CONTENT.7.RP.A.2** – Recognize and represent proportional relationships between quantities.  
→ Students could explore how energy output (e.g., brightness, motor speed) relates proportionally to input voltage.

**CCSS.MATH.PRACTICE.MP2** – Reason abstractly and quantitatively.  
→ Interpreting voltage readings in the context of energy flow and physical changes in the circuit.

**CCSS.MATH.PRACTICE.MP5** – Use appropriate tools strategically.  
→ Multimeters are used to collect and interpret real quantitative data.

### ✅ Summary:

This station introduces foundational engineering skills—**measuring, testing, observing, and interpreting**—as students manipulate a simple circuit. It aligns with both **ITEEA STEL standards** for systems and energy, and **Common Core Math standards** for data interpretation, tool use, and proportional reasoning.