## 📍 **Station 2: Motion Defense Spinner**

**NGSS: MS-PS3-5** – Show how kinetic energy transfers through circuits
🎯 **Goal**: Use electrical energy to create movement and defend your base!

### **Materials:**

 Small DC motor

 Battery + holder (AA or 9V)

 Paper fan blades or spinner

 Cardboard or jungle platform (your mount)

 Tape, straw, and scissors

 Jumper wires or foil strips

 Optional: different battery sizes or weights

### **Student Directions:**

#### **Step 1: Assemble the Power Core**

* Connect your **motor terminals** to the battery using **jumper wires or foil strips**.
* Make sure your connections are secure and wires aren’t crossing.

#### **Step 2: Build the Jungle Fan**

* Cut out a paper fan or spinner with large “blades.”
* Use tape to attach it **firmly** to the shaft of the motor (centered!).
* Add a straw if needed to elevate or extend your motor mount.

#### **Step 3: Construct the Mount**

* Mount the motor to cardboard (this is your **Base Defense Platform**).
* Tilt it slightly, or make it upright, depending on your defense style.

#### **Step 4: Test + Troubleshoot**

* Power it up!
* What happens when you **reverse the wires**? What direction does it spin now?
* Try **tilting the fan**, or making the blades bigger. Does the speed change?
* Add more **weight** or try a **different battery**. What happens?

###  **Test & Record:**

| **Test Variable** | **What You Changed** | **What Happened?** |
| --- | --- | --- |
| Default Setup | — | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Reversed Wires | Changed polarity | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Increased Fan Size | Larger blades | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Battery Type | Swapped voltage | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Tilted Base | Changed angle | \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

### **Mission Reflection:**

* **What type of energy is stored in your battery?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **What kind of energy did it turn into?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **What helped your fan spin faster or better? Why?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_
* **If you added one more feature to improve defense, what would it be?**
→ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

### Bonus Mission (Optional):

**Design a Jungle Alert System** — Add a **light or buzzer** that activates when the motor is running! You’ll combine **motion + sound/light** for ultimate base defense.

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

**STEL 1B** – Technology helps to shape the natural world and solve problems.
→ Students use a motor-powered system to address a design challenge in a simulated environment—defending a base using motion.

**STEL 2B** – Technological decisions should consider effectiveness, safety, and sustainability.
→ Students explore fan blade size, motor tilt, and power source to optimize performance in a safe, practical way.

**STEL 3B** – Systems thinking helps students understand how different components interact.
→ They evaluate how motors, blades, batteries, and mount angles function together as a complete mechanical system.

**STEL 4B** – Systems have inputs (battery), processes (electrical-to-kinetic conversion), and outputs (motion).
→ The spinner is a hands-on model of energy transfer and system operation.

**STEL 5B** – Engineering design uses creativity, testing, and iteration.
→ Students modify the spinner’s performance by testing variables like blade size, polarity, and power sources.

**STEL 7B** – The design process includes defining problems, testing solutions, and refining outcomes.
→ Troubleshooting and optimizing the spinner system promotes iterative engineering practices.

**STEL 8B** – The selection and use of tools and materials affect how a technology functions.
→ Students analyze how different materials (e.g., paper, cardboard, batteries) influence speed and movement.

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

**CCSS.MATH.CONTENT.6.RP.A.3** – Use ratio and rate reasoning to solve real-world problems.
→ Students make comparisons between fan size, speed, and motor behavior under varying conditions.

**CCSS.MATH.CONTENT.7.EE.B.3** – Solve multi-step real-life problems using numerical expressions.
→ By changing variables and recording outcomes, students use math reasoning to describe trends in their spinner's behavior.

**CCSS.MATH.CONTENT.6.SP.B.4–5** – Display and summarize numerical data in relation to context.
→ The data table (“Test & Record”) prompts students to organize results and describe relationships between input changes and motor response.

**CCSS.MATH.PRACTICE.MP2** – Reason abstractly and quantitatively.
→ Students apply concepts of force, speed, and energy to explain physical outcomes from different design setups.

**CCSS.MATH.PRACTICE.MP4** – Model with mathematics.
→ When students predict motion based on energy input and component changes, they are modeling real-world energy transfer.

**CCSS.MATH.PRACTICE.MP5** – Use appropriate tools strategically.
→ Choosing between materials and components (e.g., battery voltage, blade type) develops strategic tool use and evaluation.

### ✅ Summary

The **Motion Defense Spinner** activity combines **NGSS concepts of kinetic energy and energy transfer** with **ITEEA engineering design principles** and **math standards** involving **reasoning, modeling, and data interpretation**. It’s an engaging, experimental challenge that builds both conceptual understanding and real-world problem-solving skills.