Title: Homopolar Motor: Tiny Dancers	
Course: Physical Science, Earth Science, Chemistry **Grade:** 6-12	**Duration:** 45 minutes
Objective: Investigate the principles of electromagnetism by constructing a simple homopolar motor and exploring the Lorentz Force.	
Arkansas State Standards:	

SUBJECT:	**GRADE LEVELS:**	**CODE:**	**STANDARD:**
Physical Science	**6-8**	**3-PS2-1** **3-PS2-4** **6-PS3-5** **7-PS1-2**	Plan and conduct an investigation to provide evidence of the effects of balanced and unbalanced forces on the motion of an object Define a simple design problem that can be solved by applying scientific ideas about magnets. 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. Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred
Physics	**9-12**	**P-PS1-1** **P-PS2-3** **P-PS2-5**	P-PS1-1AR Create a model of motion and forces, including vectors graphed on the coordinate plane, to describe and predict the behavior of a system. Plan and conduct an investigation to rate the power used in performing work on a system. P-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.
Chemistry	**9-12**	**CI-PS3-5** **CII-PS2-4** **CII-PS-5-2**	Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the interaction Develop and use a model of two particles interacting through electric fields to illustrate

			forces between particles and the changes in energy due to the interaction. Plan and conduct an investigation to calculate changes in energy within a system and/or energy flows in and out of a system
Instructional Strategies and Practices: Student design and testing of materials with application of concepts			
Bloom's Level: Application and Evaluation			
Materials and Resources: - 1.5V D or AA battery - Neodymium magnets (3) - Copper wire (medium gauge) - Wire cutters/pliers - Pencil - Crepe paper (optional)			
Notes to Teacher: The homopolar motor demonstrates the Lorentz Force, which occurs when electricity moves through a magnetic field. This principle shows how electrical current and magnetic fields interact to create motion. Pay close attention to the safety measures for working with wire and temperature of battery while in use.			

Student Handout:

Materials:

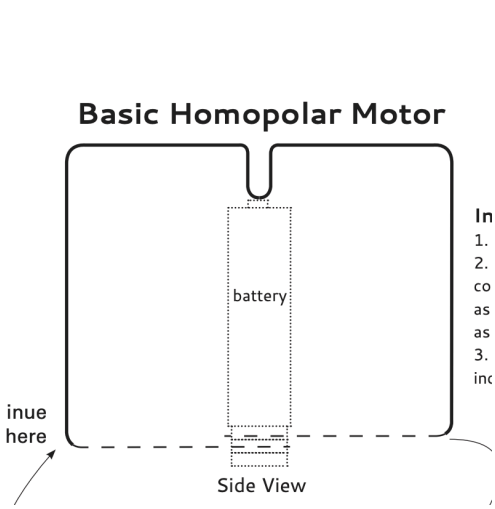
- 1.5V D or AA battery
- Neodymium magnets (3)
- 10” Copper wire (medium gauge)
- Wire cutters/pliers
- Pencil
- Crepe paper (optional)

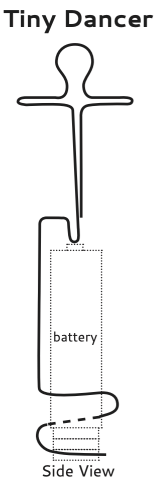
Safety Considerations: ⚠️ Important Safety Notes:

- Wear safety glasses
- Use gloves when handling metals
- Work under adult supervision
- Do not consume the experimental materials
- Neodymium magnets must be handled with adult supervision
- Do not touch batteries if they become warm
- Keep magnets away from electronic devices

Part 1: Basic Homopolar Motor Construction

1. Cut a 10-inch piece of copper wire
2. Bend the wire around the battery to create a balanced form either a homopolar motor or dancer
3. Create a circular base that can wrap around the battery and low enough to wrap around magnets
4. Place 3 neodymium magnets on the battery's negative terminal
5. Position the wire so it touches/balances on the battery's positive terminal
6. Observe the motor's rotation





Experimental Hypothesis:

Write a hypothesis about how changing the following variables might affect the motor's rotation:
- Wire symmetry

- Magnet placement

- Wire thickness

Background Understanding:

1. What is a homopolar motor?

2. Define the term "Lorentz Force" in your own words.

3. Who was Hendrik Lorentz, and why is he important in scientific history?

Observation Table:
Create a data table to record the following:

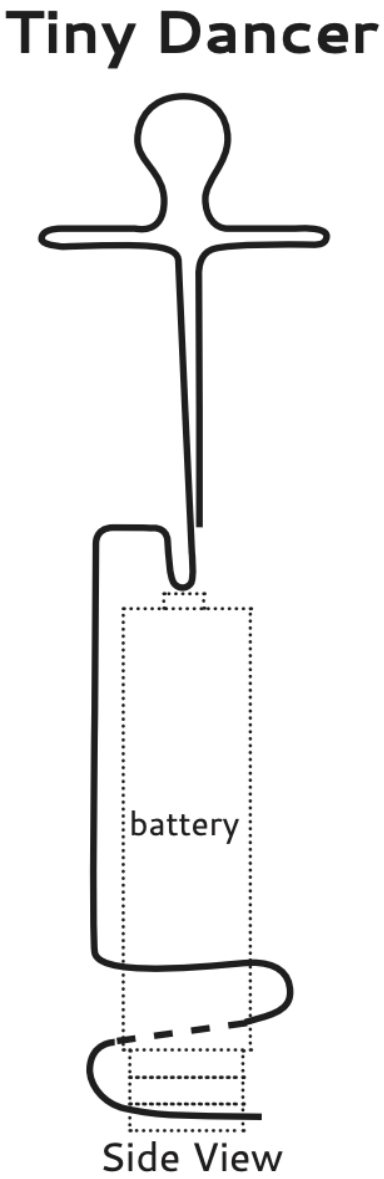
- Motor rotation speed
- Time of rotation
- Any unusual behaviors
- Temperature changes

Reflection:
Write a detailed paragraph explaining:

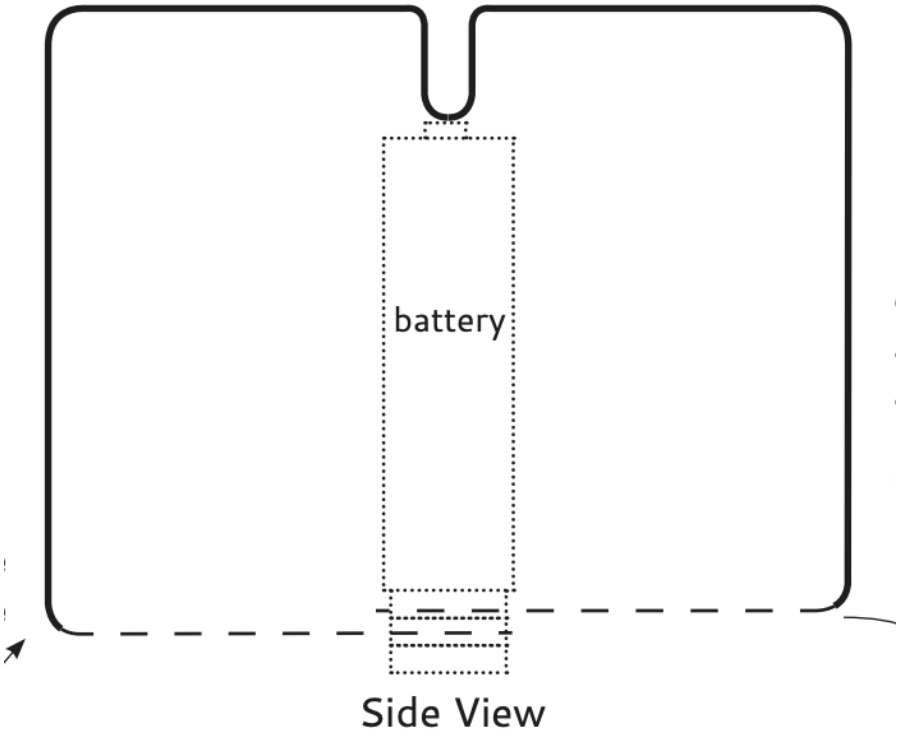
- What you learned about electromagnetism
- Challenges encountered during the experiment
- Potential real-world applications of this technology

Extension Activities:
1. Experiment with different wire gauges
2. Try creating a "dancing" wire sculpture
3. Research Hendrik Lorentz and his contributions to physics

Template:



Basic Homopolar Motor



Side View