**🧲 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.

**FOCUS:**

Magnetic Fields, Motion, and Energy Transfer Without Direct Contact

**🛠️ 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:**

**STEP1: 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?

**STEP 2: 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.

**STEP 3: 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?

🧲 **Station 4: “Field Effects” – Magnetic Interaction Mini-Challenge**  
🔬 **NGSS Connection:** HS-PS3-5 – Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces and the energy changes between the objects due to the interaction.

✅ **ITEEA STEL Standards – High School**

**STEL 1H** – Technological systems include input, processes, output, and feedback.  
→ Students build a functioning system where magnetic fields act as an input to trigger motion or a signal.

**STEL 4J** – The engineering design process involves defining problems, generating ideas, selecting solutions, testing, and evaluating.  
→ Students experiment with different magnetic configurations and refine a magnetic trigger for their game system.

**STEL 5H** – Devices and systems are repaired using troubleshooting and problem-solving.  
→ Students troubleshoot why a magnetic setup may or may not activate a buzzer, LED, or compass reaction.

**STEL 7G** – The use of tools and materials in technology involves assessing their impact and characteristics.  
→ Students test magnetic field effects using various materials (paperclips, coils, reeds) to evaluate effective designs.

**STEL 8H** – Applying science, math, and engineering principles helps solve practical problems.  
→ Students apply electromagnetic principles to create a no-contact, field-based activation system for a game puzzle.

✅ **Common Core Math Standards – High School**

**HSN-Q.A.1** – Use units as a way to understand problems and guide the solution of multi-step problems.  
→ Students may consider energy transfer rates, movement speeds, and magnetic field impact when designing systems.

**HSF-IF.C.7** – Graph functions expressed symbolically and show key features of the graph.  
→ If students track speed vs. signal strength or frequency of movement, they can model how changing motion impacts output.

**HSS-IC.B.6** – Evaluate reports based on data.  
→ Students make claims about which magnetic design worked best, based on the results of their experimentation.

**HSG-MG.A.3** – Apply geometric concepts in modeling situations.  
→ Students use spatial reasoning to align magnetic fields, motion direction, and object placement in their trigger designs.

💡 **Summary:**  
This activity immerses high school students in field-based energy transfer through hands-on testing, iteration, and creative game puzzle design. It fosters systems thinking, engineering design application, and real-world use of physics and magnetism in an engaging, STEM-integrated context.