

Electromagnet Builder

S1-S4 Physics | Estimated time: 60-75 minutes | Pack version 2026-07-28

HOW TO USE THIS PACK

Follow the learning sequence: Predict, Simulate, Build and Explain. The simulation can be completed online before this pack is downloaded. The practical activity and written pages work without internet access.

Learning goals

- Build a temporary magnet using current in a coil.
- Test how coil turns or current affect magnetic strength.
- Use paper clips as a repeatable strength measure.
- Connect electromagnets to motors, relays and lifting devices.

Materials

- 1 large iron nail
- 60-100 cm insulated copper wire
- 1.5 V or 3 V battery holder
- 10-20 steel paper clips
- tape, paper and pencil

LOCAL SUBSTITUTION

Use an iron bolt if a clean iron nail is unavailable. Do not use a sharp rusty nail.

SAFETY RULE

Use low-voltage batteries only. Connect for no more than 10 seconds per trial. Disconnect immediately if the wire or battery becomes warm.

Learner or safe alias

Class / club

Date

1. Predict and simulate

PREDICTION CHALLENGE

What will happen to magnetic strength when coil turns increase from 10 to 30 while battery voltage stays the same?

My prediction and reason

Simulation steps

1. Set the coil to 10 turns and current to the starting value. Record field strength.
2. Increase to 20 and then 30 turns without changing current.
3. Return to 20 turns and change current once.
4. Choose evidence that separates the effect of turns from the effect of current.

My simulation evidence

Trial	Coil turns	Battery / current setting	Clips lifted	Heat / observation
1	10			
2	20			
3	30			
4				

What pattern do the numbers show?

Which variable did you change, and which did you keep the same?

2. Build the idea safely

BEFORE TOUCHING MATERIALS

Use low-voltage batteries only. Connect for no more than 10 seconds per trial. Disconnect immediately if the wire or battery becomes warm.

Practical steps

1. Leave 10 cm of wire free, then wind 10 tight turns around the nail.
2. Connect the wire ends to the battery for up to 10 seconds.
3. Lift paper clips, count them, disconnect, and let the wire cool.
4. Repeat with 20 and 30 turns using the same nail and battery.
5. Reverse the battery connection and observe what changes.

Hands-on results

Trial	Coil turns	Battery / current setting	Clips lifted	Heat / observation
1	10			
2	20			
3	30			
4				

Draw or label the setup

3. Explain, assess and teach

Evidence explanation

Write a claim, use at least two observations or measurements as evidence, and explain the scientific reason linking the evidence to the claim.

Claim: _____

Evidence: _____

Scientific reason: _____

Teacher assessment rubric

Criterion	0 - none	1 - beginning	2 - developing	3 - secure	4 - exceptional
Observation					
Variable control					
Use of evidence					
Explanation					

Teacher decision

Total: _____ / 16 ☐ Changes requested ☐ Approved (minimum 12 / 16)

Feedback: _____

Teacher answer and discussion guide

- Expected model: a current-carrying coil creates a magnetic field; an iron core strengthens it.
- More turns or more current generally increases field strength within safe limits.
- Reversing current reverses the magnetic poles but may not change the number of clips lifted.
- Strong evidence reports repeat trials and identifies turns, current, core and clip method.

FAMILY OR PEER TEACHING QUESTION

Find examples of electromagnets in daily life, such as speakers, bells, motors or relays. Explain why switching the magnet on and off is useful.