BFSU A-5A · TEACHER

Opening Oration — The Invisible Hand (9:30 · ~3 min)

*Printed standalone as **Opening Oration.pdf** in this folder — nail alone on the cleared table, horseshoe magnet in your pocket, rehearse the slide once beforehand. Afterward pass the joined magnet-and-nail around the circle.*

Activities (kids do)

A1 · Magnetic or Not? Hunt — Card 1

9:40 · 30 min + 10 min second cut · card: experiment-cards/01-magnetic-or-not-hunt.pdf

Materials: one magnet per child · test basket (steel nail, paper clips, aluminum can, pennies, the **pre-tested non-magnetic** spoon, brass key, wooden block, plastic brick, glass marble, cloth, paper) · worksheet FRONT + pencils.

1. **Predict first, in pencil, before any magnet is touched** — circle sticks / doesn't for every object. No changing answers later.
2. Hand out magnets; test everything; mark the TEST column with what really happened.
3. Let the planted surprises land: can, penny, and spoon are metal and *ignored*; the plain gray nail **leaps**.
4. Tally both columns, then circle up: *"Everything the magnet grabbed — what do all of those have in common?"* Steer with A-5 language until they corner it: **iron and steel**.
5. **Second cut:** re-sort the NO pile into two hoops — *not metal at all* vs. *metal but not iron*. This is where the myth actually dies.
6. Optional room hunt (hinges, chair legs, zippers). **Rule first: magnets never touch screens, phones, watches, or cards.**

> *Say: "The magnet is not a metal-lover. It's an IRON-lover. If the magnet grabs it, there's iron hiding inside — that's how the junkyard sorts metal to this day."*

Failure modes: many stainless spoons ARE magnetic — pre-test yours the day before; swap in the brass key if it sticks. Chrome-plated steel toys look like exceptions — keep to the listed basket. Show the tissue-pinch trick early if magnets get furry with clips.

A2 · Attract & Repel Play — Card 2

10:30 · 25 min · card: experiment-cards/02-attract-and-repel.pdf

Materials: pair of bar magnets per pair of kids · ring magnets + pencil · magnetic wands + chips (the 3-year-olds) · one paper clip.

1. Free exploration first, as the book prescribes: *"find out everything these can do"* — 10 minutes, no teaching.
2. Collect discoveries; someone found the push. Name both: **attract** — pull together; **repel** — push apart.
3. **Ghost-push:** drive one magnet across the floor with the other, never touching. Every child drives.
4. **Floating stack:** ring magnets on a standing pencil, flipped to repel — each ring floats on an invisible spring. Squash the gap and feel it push back.
5. The sealing contrast: a paper clip is grabbed by BOTH ends of a bar magnet. *Plain iron never pushes away; only another magnet can be pushed.*

> *Say: "Every magnet has two ends — two POLES — and they are not the same as each other. Ends that match push apart. Ends that differ snap together. One day we'll learn the names of the two ends — today, just feel what they do."*

Failure modes: strong magnets pinch — teach *slide apart, don't pry*; keep neodymium discs teacher-side during free play. Weak ceramic pairs that "can't find the push" get the ring magnets. Restate the electronics rule.

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A3 · Paperclip Chains — Card 3

10:55 · 20 min · card: experiment-cards/03-paperclip-chains.pdf

Materials: strongest magnet per child (discs — handed out and counted back) · box of steel paper clips.

1. Hang one clip from the magnet; touch a second to the **bottom of the first** — it holds. Then a third, and more.
2. Contest: **whose chain grows longest before it falls?** Count clips out loud (the day's real number work; scoreboard on a scrap card, not binder sheets).
3. Feel that the last clip barely holds while the first holds hard — *the field fades with every step down the chain.*
4. The reveal: **lift the top clip off the magnet** — the whole chain rains down. Every child runs this ending.
5. Name it: each clip *became a magnet* while touching one, and passed the pull along. Off the magnet, the borrowed magnetism is gone.

> *Say: "Each clip borrowed the magnet's power and passed it down the line, like a bucket brigade. But it was only borrowed — take the magnet away and every clip goes back to being a plain clip."*

Failure modes: weak magnets stall at 2–3 clips — use the strongest discs here. Mechanically hooked clips aren't a magnetic chain — demonstrate tip-to-tip. Count the discs back into the lidded box out loud, as a ritual.

A4 · Magnet Through Stuff — Card 4

11:15 · 25 min · card: experiment-cards/04-magnet-through-stuff.pdf

Materials: magnet + paper clip per child · cardboard · paper plate · hardcover book · clear glass of water · their own hands.

1. Clip on TOP of the cardboard, magnet UNDERNEATH: drive the clip around like a race car. Full turns for everyone.
2. Repeat through the paper plate (easy), the hardcover book (harder — feel it weaken), and — the gasp — **through their own hand**.
3. **Water finale:** clip into a full glass; rescue it by sliding the magnet up the *outside* wall, towing the clip out — hands dry.
4. Rank what the field went through today: cardboard, paper, book, skin, glass, water — everything tried.
5. Connect backward: *"That's the same invisible reach that grabbed the nail this morning."*

> *Say: "The field doesn't need air or touching — it pours right through paper, glass, water, even YOU. Your hand can't feel it, but the clip can."*

Failure modes: book too thick = dead clip — that's concept 6 (fades with distance); name it, then use fewer pages. Slide the magnet slowly on the wet-glass rescue — yanking breaks the tow. Thin fridge magnets are too weak for this whole block.

Experiments (teacher runs, kids predict → watch → explain)

E1 · Iron Filings Field Display — Card 5 — THE CENTERPIECE

11:40 · 20 min · card: experiment-cards/05-iron-filings-field-display.pdf · teacher's hands only · the ONLY lesson in the curriculum that uses filings — stage it like the event it is

Materials: filings shaker · white rimmed tray with white paper taped flat inside · bar magnet · horseshoe magnet · second bar magnet · tissues · heavy zip-seal bag.

1. Kids around the counter, hands in laps: *"Nobody touches this powder — it's iron ground into dust."* Predict first: what shape will it make?
2. Bar magnet UNDER the tray, under the paper's center. Sprinkle **thinly** from low height, then **tap the tray edge** — the pattern snaps in: two dense bursts over the poles, arching lines between.
3. Walk the pattern with a pointing finger: *the curves pour out of one end, sweep around, and dive into the other — every line leaves a pole and comes home to a pole. A family of loops, here all along, invisible.*
4. **Fade with distance:** slide the magnet slowly away beneath — far filings relax and fall flat; slide back — they stand again.
5. Repeat over the **horseshoe** (dense arches between close poles), then **two bars attracting** (lines leap the gap) and **repelling** (lines refuse to cross — an empty seam down the middle).
6. Encore kids may hold: filings sealed in the heavy zip bag, laid flat — each child slides a bar magnet beneath. Same pattern, zero mess.
7. Cleanup before lunch, kids seated: funnel filings back via the taped paper; **pinch** strays off the magnet with tissue (wiping spreads, pinching lifts).

> *Say: "The filings didn't make the field — the field was already there, filling the air, this exact shape, all morning. The iron dust just makes it show itself. You are looking at the invisible."*

Failure modes: too many filings = a furry blob with no lines — sprinkle THIN (practice the day before). Filings straight onto a magnet = a beard you'll fight to remove — the paper/tray barrier is not optional. Humid-day clumps: tap harder, sprinkle higher. A lunging kid: the tray has a rim, you have a body between tray and audience, and the sealed-bag encore is the legal outlet. **Filings never go near eyes; damp-tissue any spill immediately** (a magnet inside a zip bag makes a good stray-filing vacuum).

E2 · Ferrofluid Spike Show — Card 6

12:40 · 15 min · card: experiment-cards/06-ferrofluid-spike-show.pdf · bottle stays SEALED

Materials: sealed ferrofluid display bottle · strong neodymium disc (teacher's).

1. Show it at rest — a lazy black liquid; shake, tilt, slosh. Predict: what happens when the magnet comes close?
2. Bring the disc slowly to the glass — the fluid **leaps** and erupts into a hedgehog of spikes. Hold; let them stare.
3. Drag the magnet around the bottle — the spiky creature follows, climbing and reshaping.
4. Pull the magnet away — instant collapse. Repeat: field near = spikes; field gone = puddle.
5. Connect: *"This morning the filings drew the field flat on paper. This liquid is FULL of iron dust — the field standing up, in 3-D."*

> *Say: "The spikes stand up along the field lines — the same invisible loops the filings showed us, now with a liquid climbing them."*

Failure modes: the bottle stays sealed — ferrofluid stains skin, clothes, and carpet permanently. Short holds against the glass (cheap bottles stain their walls if the fluid parks). Keep the disc away from the filings bag and wands bin while ferrofluid is out.

STRETCH (ranch, adult-run — NOT part of the core day).
Cow Magnet Story — a feed-store cow magnet is a smooth steel-cased cylinder ranchers have cattle swallow ON PURPOSE: it settles in the first stomach and holds swallowed fence wire and staples so they can't travel on ("hardware disease"). Tell the story, pass the magnet, then bury nails and wire scraps in a bucket of hay and let kids drag the cow magnet through to fish out every piece of steel — exactly its job inside a cow. (Repeat the swallow talk in reverse: cows get a smooth giant magnet on purpose; people must never swallow any.)
Magnet fishing — the high-pull kit in the pond or barn lot only ever hauls up iron and steel: the attracts-only-iron rule at landscape scale. Adult holds the rope; pull magnets pinch hard.

Prompts & Questions (use all day; from the book, p.89)

- What are the attributes of magnets? What are they attracted to — and what never?
- How do two magnets act toward one another? Both ways — show me.
- How would you sort a pile of junk into iron and not-iron?
- How might you fish the needles and pins out of a sewing basket in one pass?
- How could you tell aluminum cans from steel cans without reading a label?
- Can a magnet move something without touching it? Prove it three different ways.
- Does the field stop where the magnet stops? How do you know it keeps going?
- What happened when the paperclip chain lost its magnet? What does that tell you?
- Magnet under the table, clip on top — what is passing through the table?
- Wonder-question for the drive home: could a whole train float the way the ring magnets floated on the pencil? (It exists — the maglev.)

What to Watch For in Daily Life (send home with parents)

- Fridge magnets: what's REALLY holding them up? (Steel sheet under the paint.)
- Hunt the kitchen for a metal the magnet ignores — the foil roll and the soda can are hiding in plain sight.
- Find the hidden magnets: cabinet latches, purse clasps, phone cases, the knife strip, the shower-door catch.
- Magnets doing quiet jobs in town: screwdriver tips that hold the screw, the scrapyard crane on TV.
- Free magnet play at home (the book asks parents exactly this) — with the two house rules: nowhere near electronics, and the little discs stay in their counted box.

Prep-Ahead Checklist

When supplies arrive

□ Count the neodymium discs into the lidded box; write the count on the lid.

□ **Pre-test the spoon** with a magnet — if it sticks, swap the brass key into the basket.

□ Practice the filings display once, alone (the book insists, and it's right): thin-sprinkle amount, the tap, the tissue-pinch cleanup.

□ Rehearse the oration nail-slide to find your magnet's striking distance.

The day before

□ Assemble the test basket (nail, clips, can, pennies, spoon-or-key, brass key, wood, plastic, marble, cloth, paper) — nothing extra.

□ Tape white paper flat into the rimmed tray; stage shaker, tissues, zip bag.

□ Clear the demo table and counter of ALL electronics, cards, and watches.

□ Print binder sheets ×5 and the six cards (student-binder/, experiment-cards/).

The morning of

- ☐ Nail alone on the table; horseshoe magnet in your pocket.
- ☐ Magnet set counted and staged out of reach; wands/chips bin by the floor space.
- ☐ Ferrofluid bottle hidden until 12:40 (it steals attention on sight).

Review Hooks

- **Back:** A-5 (what is it made of? — the hunt is a materials sort with a new detector) · D-7 gravity (*"gravity pulls everything; a magnet chooses iron"*) · the Exploratorium magnetic wall (they've played with this force; today it gets its name and its rules).
- **Forward:** the **compass lesson** — *"a magnet's two ends have famous names, and hanging from a thread a magnet does something spooky that sailors bet their lives on — that's a whole day of its own."* Later in the progression (C-19): electricity and magnetism are two faces of one thing — motors, speakers, maglev.

BFSU A-5A · TEACHER

Opening Oration — The Invisible Hand

Magnets and Magnetic Fields • read aloud, ~3 minutes

Prop: A strong **horseshoe magnet** hidden in one pocket, and a single **steel nail** lying alone in the middle of the table before the children sit down. At the marked moment, set the magnet on the table a hand-span from the nail and slide it slowly closer until the nail *leaps* and slides across the table to meet it — with nothing touching it. (Prep: rehearse once to learn your magnet's striking distance; clear the table of everything else, especially anything electronic. Afterward, pass the joined magnet-and-nail around the circle so every child can feel the grip.)

Do you see that nail on the table? Just an ordinary nail. It has been lying there, perfectly still, all morning. Nails don't move by themselves. Nothing does.

If I want that nail, I have to walk over and pick it up with my fingers. That's the rule, isn't it? To move a thing, you have to *touch* the thing. You push a door. You pull a wagon. You pick up your shoe. Touch, then move.

But this morning I brought something that breaks the rule.

(Take out the horseshoe magnet. Hold it up. Say nothing for a moment.)

This is a **magnet**. It looks like a plain piece of metal — no button, no battery, no trick. But right now, this very second, something invisible is pouring out of it, in every direction, filling the air all around it. You cannot see it. You cannot smell it. Hold your hand right here and you cannot even feel it.

But the nail can.

(Set the magnet down and slide it slowly toward the nail… until the nail leaps.)

Did you see that? *Nothing touched it*. The nail felt something reaching across the table — something real enough to grab it and drag it — and that something has a name. It is called a magnetic **field**: the invisible reach all around a magnet.

Here is what we're going to find out today. This magnet will not grab everything — it chooses. It will ignore a penny, ignore a soda can, ignore your toys, and pounce on some things as if it loves them — and by lunchtime *you* will know its secret. We'll find out that every magnet, big or small, has two special ends, and that its two ends do not behave the same way at all. And at the very end — this is my favorite — I am going to make the invisible field itself **appear**, right before your eyes, so you can see the exact shape of something that cannot be seen.

The whole invisible world is about to show itself. Let's go catch it.

(Pass the magnet with the nail stuck to it around the circle — let each child pull the nail off and feel the magnet snatch it back.)

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A-5A Supply List — Magnets and Magnetic Fields

Everything for the full 9:30–2 day. Prices are rough. Nothing here needs days of lead time, but the magnet set and filings must arrive before lesson day — the whole day is them.

> ⚠ **SAFETY — READ BEFORE BUYING OR UNPACKING** > - **Small neodymium magnets are a swallow hazard.** Two swallowed magnets can clamp > through gut walls — a surgical emergency. With kids aged 3–6: buy discs **1 inch or > larger**, count them out and count them back in every time, and keep the set in a > lidded box that only the teacher opens. If a magnet is ever missing, stop and find it. > - **Iron filings are a fine iron powder** — same swallow/eye concern. They stay sealed > in their shaker or zip bag except during the teacher-run demo, and they never travel > near faces. (See card 05's safety box.) > - **Keep all magnets away from electronics** — laptops, phones, tablets, credit/hotel > cards, watches, hearing aids. Clear the demo table before the oration. > - Strong magnets **pinch** — they snap together fast. Teach the kids to slide them > apart, not pry.

Already Have (typical household)

☐	Item	Used in
☐	One plain steel nail (2–3 in)	Oration prop · A1 basket
☐	Box of steel paper clips	A1 · A3 chains · A4 through-stuff
☐	Empty aluminum soda can	A1 planted surprise
☐	Copper pennies (a few)	A1 planted surprise
☐	Metal spoon — **pre-test it: must NOT stick to a magnet** (swap in a brass key if it does)	A1 planted surprise
☐	Brass key (backup surprise)	A1
☐	Wooden block, plastic toy brick, glass marble, cloth scrap, bit of paper	A1 non-metal test objects
☐	Small basket or bowl for the test objects	A1
☐	Piece of cardboard (~8×10 in) + a paper plate + a hardcover book	A4 through-stuff
☐	Clear drinking glass	A4 (clip in a glass of water)
☐	White rimmed baking tray / sheet pan	E1 filings containment
☐	White paper (a few sheets) + masking tape	E1 (taped into the tray)
☐	Tissues	E1 cleanup (pinch filings off the magnet)
☐	Gallon zip-seal bag (heavy duty)	E1 sealed-bag encore + filings storage
☐	Pencils (one per child)	A1 worksheet
☐	Lidded box for the magnet set	storage + count-in/count-out

TO BUY

☐	Item	Qty	~Price	Why	Order ahead?
☐	Magnet set: **horseshoe + 2 bar magnets + large (≥1 in) neodymium discs**	1 set	$18	The workhorse of every activity — oration, hunt, chains, through-stuff, filings display. Bar magnets are essential for E1's classic arch pattern	Yes — the day is this set
☐	Ring magnets (fit on a pencil)	1 set	$10	A2 — the floating-stack trick: one ring hovers above another on nothing but repel	Yes
☐	Iron filings in a shaker bottle	1	$10	E1 centerpiece — the only lesson in the whole curriculum that uses filings	Yes
☐	Ferrofluid display bottle	1	$25	E2 — the field in three dimensions; the single most memorable image of the day	Yes
☐	Magnetic wands + steel-rimmed counting chips	1 set	$14	A2 free play for the 3-year-olds — big, safe, unswallowable	Yes

Total new spend: ~$77.

STRETCH purchases (only if pursuing the ranch extras — see Teacher Guide STRETCH)

☐	Item	~Price	For
☐	Genuine feed-store cow magnets (pair)	$8	Cow Magnet Story + hay-bucket fishing
☐	Magnet-fishing kit (high-pull, rope)	$45	Pond/barn-lot magnet fishing — adult holds the rope; pinch hazard

Check-you-own-it notes

- **A spherical neodymium magnet + metal objects** may already be owned from D-7 (gravity). The sphere is a fine extra for A2 play, but it is small — same lidded-box,

count-it-back rule as the discs.

- The **magnetic wall** at a science museum, if the family has visited one, is a memory hook for review — nothing to buy.

> Tick the box beside each item as it goes in the box. Anything flagged **order ahead** ships — buy it a week before the lesson.

Magnetic or Not? Hunt

KIDS HANDS-ON | RUN AT 9:40 | 30 MIN + 10 MIN SECOND CUT

The point

Magnets do not grab "metal." They grab **iron and steel** — and the kids corner that secret themselves.

Materials

- One magnet per child (horseshoe, bar, or large disc)
- Test basket: steel nail · paper clips · aluminum can · copper pennies · **pre-tested non-magnetic** spoon · brass key · wooden block · plastic brick · glass marble · cloth scrap · paper
- Worksheet FRONT + pencils

Steps

1. **Predict first, in pencil** — every object, before any magnet is touched. No changing later.
2. Hand out magnets; **test everything**; mark what really happened.
3. Let the surprises land: can, penny, spoon — metal, **ignored**. The plain nail **leaps**.
4. **Tally** both columns on the sheet.
5. Circle up: **"what do all the grabbed things have in common?"**
6. **Second cut:** re-sort the NO pile — *not metal at all* vs. *metal but not iron*.

> *Say: "The magnet is not a metal-lover. It's an IRON-lover. If the magnet grabs it, there's iron hiding inside."*

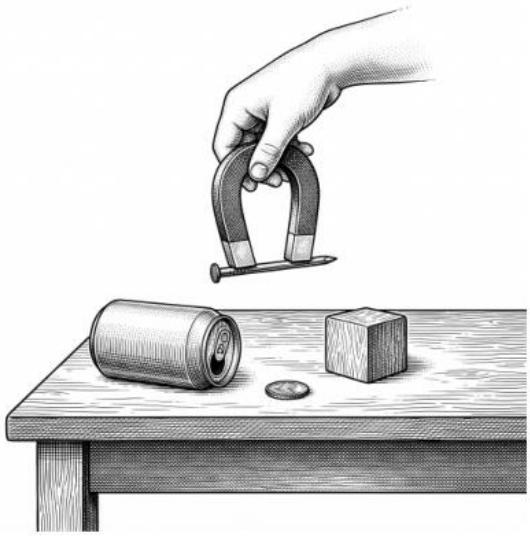


Fig. 1 — the nail leaps; the can and penny never move

TEACHER PREP — THE DAY BEFORE

Pre-test the spoon: if it sticks to a magnet, swap the brass key in and retire the spoon. Assemble the basket exactly as listed — nothing extra.

SAFETY

Magnets never touch electronics — screens, phones, watches, cards. State the rule before handing out magnets. Small neodymium discs are a **swallow hazard**: teacher hands them out, counts them back.

What to watch for

- The gasp at the ignored aluminum can — "but it's metal!"
- A child saying "iron" or "steel" before you do

EXPECTED RESULT

Wood, plastic, glass, cloth, paper — ignored. Aluminum, copper, brass — **also ignored**. Only the iron/steel things attract, every time: **the magnet detects iron**, not metal.

Attract & Repel Play

KIDS HANDS-ON | RUN AT 10:30 | 25 MIN

The point

Every magnet has two ends — two **poles** — and they are different: one pairing **attracts** (pulls together), the flipped pairing **repels** (pushes apart). *No pole names today — those wait for the compass lesson.*

Materials

- A pair of bar magnets per pair of kids
- Ring magnets + a pencil (the floating stack)
- Magnetic wands + counting chips (for the littlest)
- One paper clip (the closing contrast)

Steps

1. **Free exploration first** — "find out everything these can do." 10 minutes, no teaching.
2. Collect discoveries; **name both**: attract — pull together; repel — push apart.
3. **Ghost-push:** drive one magnet across the floor with the other, never touching.
4. **Floating stack:** ring magnets on a standing pencil, flipped to repel — squash the gap, feel the invisible spring.
5. Closing contrast: a paper clip is grabbed by **both** ends — plain iron never pushes away; only another magnet can be pushed.

> *Say: "Ends that match push apart. Ends that differ snap together. One day we'll learn the two ends' names — today, just feel what they do."*

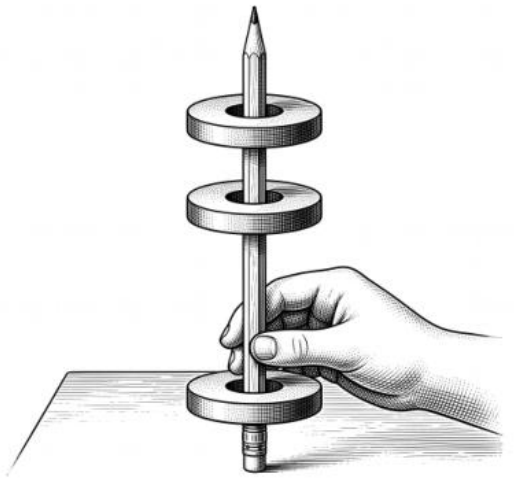


Fig. 2 — the floating stack: each ring rides an invisible spring

TEACHER PREP

Test each bar-magnet pair beforehand — a weak ceramic pair hides the push. Stage the ring magnets and pencil for step 4.

SAFETY

Strong magnets **pinch** — teach *slide apart, don't pry*. Neodymium discs stay teacher-side during free play. Magnets nowhere near electronics.

What to watch for

- The flip moment: same magnets, opposite behavior
- The push growing springier as the gap closes

EXPECTED RESULT

Two magnets snap together one way and shove apart the other — because **the two poles are different from each other**. Iron is only ever pulled; a push means both things are magnets.

Paperclip Chains

KIDS HANDS-ON | RUN AT 10:55 | 20 MIN

The point

Iron touching a magnet **becomes a magnet itself — temporarily**. Each clip passes the pull to the next, and the whole chain lives or dies with the real magnet.

Materials

- Strongest magnet per child (the neodymium discs shine here)
- Box of steel paper clips
- Scrap card for a scoreboard (optional)

Steps

1. Hang one clip from the magnet.
2. Touch a second clip to the **bottom of the first** — it holds, touching no magnet. Add a third, and more.
3. Contest: **whose chain grows longest before it falls?** Count the clips out loud.
4. Feel the ends: first clip grips hard, **last clip barely holds** — the field fades down the chain.
5. The reveal: **lift the top clip off the magnet** — the whole chain rains down. Everyone runs this ending.

> *Say: "Each clip borrowed the magnet's power and passed it down the line, like a bucket brigade. Take the magnet away — and every clip goes back to being a plain clip."*

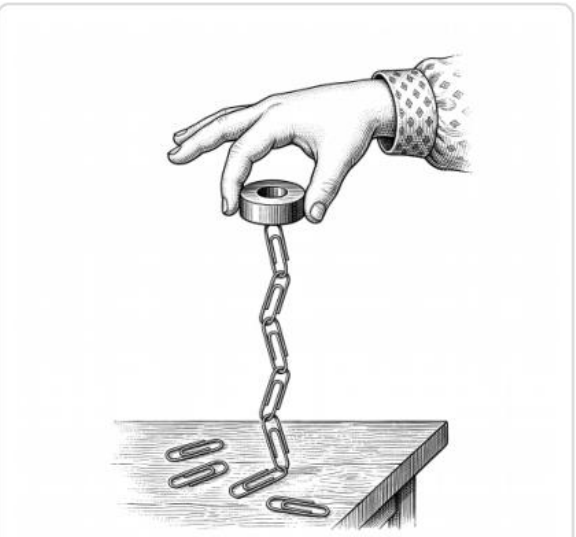


Fig. 3 — every clip in the chain is a borrowed magnet

TEACHER PREP

Count the discs out of the lidded box as you hand them over; write the number down. Weak magnets stall at 2–3 clips — give this activity the strong ones.

SAFETY

Neodymium discs are a **swallow hazard** — count them out, count them back, out loud, every time. Discs nowhere near electronics.

What to watch for

- Clips hanging tip-to-tip (magnetic), not hooked through each other (mechanical)
- A child noticing the grip weakening down the chain unprompted

EXPECTED RESULT

Chains of 4–8+ clips from a strong disc; the last clip holds at a distance impossible without the clips between — each clip **conducts the field along**. Off the magnet, all magnetism vanishes at once.

Magnet Through Stuff

KIDS HANDS-ON | RUN AT 11:15 | 25 MIN

The point

The **field** reaches right through solid things — cardboard, a book, water, even your own hand. The pull needs no touching and no air.

Materials

- Magnet + paper clip per child
- Piece of cardboard (~8×10 in)
- Paper plate · hardcover book
- Clear drinking glass, filled with water

Steps

1. Clip on TOP of the cardboard, magnet UNDERNEATH: **drive the clip around** like a race car.
2. Repeat through the paper plate (easy), then the hardcover book — **feel the pull weaken**.
3. The gasp: **through their own hand** — clip on the back, magnet under the palm.
4. **Water rescue:** drop the clip into the full glass; slide the magnet up the *outside* wall and **tow the clip out** — hands dry.
5. Rank together everything the field passed through today.

> *Say: "The field pours right through paper, glass, water, even YOU. Your hand can't feel it — but the clip can."*

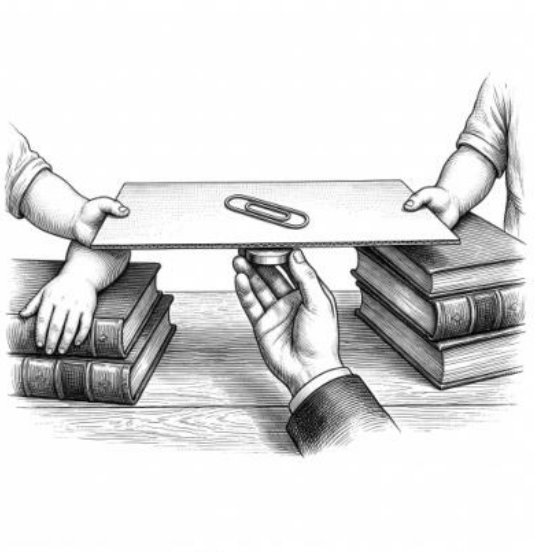


Fig. 4 — the clip follows a magnet it never touches

TEACHER PREP

Use the good magnet set — thin fridge magnets fail every step. Fill the glass just before the block; stage a towel.

SAFETY

Magnets nowhere near electronics. Discs counted out and back (swallow hazard). Slide, don't snap, when two kids' magnets meet through one sheet.

What to watch for

- Delight at the hand step — the field going through *me*
- Someone noticing the book is "harder" — that's distance, name it

EXPECTED RESULT

The pull works through everything tried; a thick book weakens it (**the field fades with distance** — same lesson as the chain). Nothing in the house blocks it.

Iron Filings Field Display

TEACHER DEMO | RUN AT 11:40 — THE CENTERPIECE | 20 MIN

The point

The invisible **field** made visible. The filings don't create it — they reveal a shape that was there all along. *This is the only lesson in the whole curriculum that uses filings — stage it like the event it is.*

Materials

- Iron filings in their shaker bottle
- White rimmed tray, white paper taped flat inside
- Bar magnet · horseshoe magnet · second bar magnet
- Tissues · heavy zip-seal bag (encore + storage)

Steps

1. Kids around the counter, **hands in laps**. Predict: what shape will iron dust make over a hidden magnet?
2. Bar magnet UNDER the tray. **Sprinkle thinly** from low height, then **tap the tray edge** — the pattern snaps in.
3. Walk it with a pointing finger: **every line leaves one pole and curves home to the other** — a family of loops.
4. **Slide the magnet away** beneath — far filings relax and fall; slide back — they stand again. The field fades with distance.
5. Repeat over the **horseshoe**, then two bars **attracting** (lines leap the gap) and **repelling** (lines refuse to cross).
6. Encore kids may touch: filings **sealed in the zip bag**, laid flat, magnet slid beneath.
7. **Cleanup before lunch**, kids seated: funnel filings back via the paper; **pinch** strays off the magnet with tissue.

> *Say: "The filings didn't make the field — it was already here, this exact shape, all morning. You are looking at the invisible."*

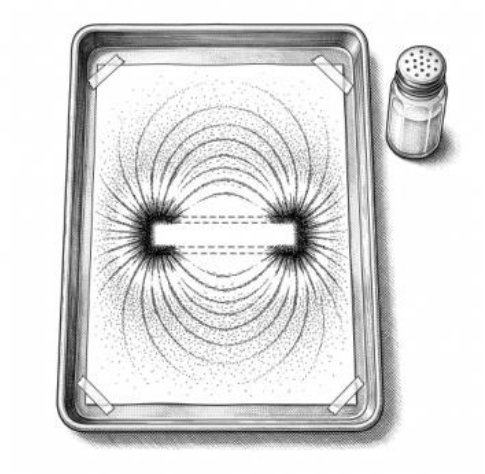


Fig. 5 — the filings line up ALONG the field's loops, densest at the poles

TEACHER PREP — BEFORE LESSON DAY

Practice once, alone (the book insists): learn the thin-sprinkle amount, the tap, the tissue-pinch cleanup. Too many filings = a furry blob.

SAFETY — FILINGS PROTOCOL

A fine iron powder. **Stays in sealed bags or the rimmed tray — never loose, never near eyes or faces.** Teacher's hands only; kids' hands in laps; the sealed-bag encore is the touching outlet. Damp-tissue any spill; back in the shaker before lunch.

What to watch for

- The gasp when the pattern snaps in at the tap
- Kids spotting that the lines **bunch at the two poles**
- The repel pattern's empty seam — lines that refuse to meet

EXPECTED RESULT

Two dense bursts over the poles, arching lines between; the pattern **fades smoothly** as the magnet slides away — strongest at the poles, no sharp edge, every line closing pole to pole.

Ferrofluid Spike Show

TEACHER DEMO | RUN AT 12:40 | 15 MIN

The point

The field in **three dimensions**: a liquid full of iron dust leaps into spikes along the field lines — and collapses the instant the field leaves.

Materials

- Sealed ferrofluid display bottle
- Strong neodymium disc (teacher's)

Steps

1. Show the bottle at rest — a lazy black liquid. **Shake and tilt**; it sloshes like oil.
2. Predict: what will it do when the magnet comes close?
3. Bring the disc **slowly to the glass wall** — the fluid leaps into a hedgehog of spikes. Hold. Let them stare.
4. **Drag the magnet around the bottle** — the spiky creature follows, climbing and reshaping.
5. **Pull the magnet away** — instant collapse. Repeat: field near = spikes; field gone = puddle.

> *Say: "The spikes stand up along the field lines — the same invisible loops the filings showed us this morning, now with a liquid climbing them."*



Fig. 6 — spikes where the field is strong; flat where it's gone

TEACHER PREP

Keep the bottle hidden until 12:40 — it steals attention on sight. Test your disc's striking distance through the glass once beforehand.

SAFETY

The bottle stays SEALED, always — ferrofluid stains skin, clothes, and carpet permanently. Short holds against the glass (parked fluid can stain the inner wall). Keep the disc well away from the filings bag and the wands bin while this is out. Magnets nowhere near electronics.

What to watch for

- The instant, total collapse when the field leaves
- A child connecting it to the morning's filings unprompted

EXPECTED RESULT

Spiky peaks that **track the magnet exactly** and vanish without it — the field is real, three-dimensional, and only there while the magnet is near.

Magnets & Magnetic Fields

The invisible pull that fills the space around a magnet

The Big Idea

*A **magnet** can move things without touching them — because the space all around it is filled with an invisible, real force called a **field**.*

The field is there even when nothing shows it. Sprinkle iron dust near a magnet and the field draws its own picture: curving lines that pour out of one end, sweep around, and dive back into the other end.

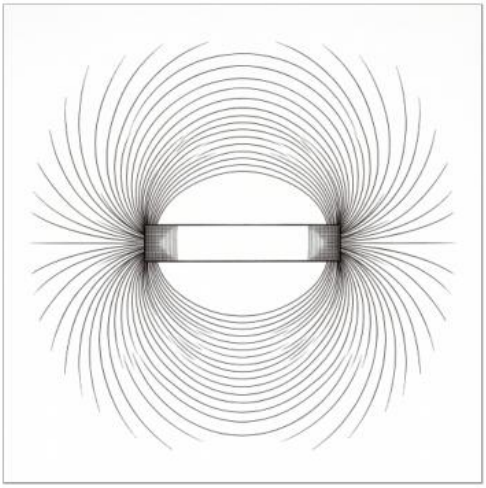


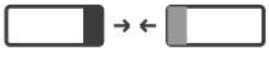
*Fig. 1 — the **field**: the invisible reach all around a magnet. Every line leaves one pole and curves home to the other.*

Magnets Are Picky

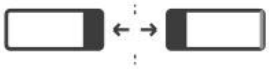
A magnet does **not** grab all metal. It ignores a penny, a soda can, and most jewelry. It grabs only **iron** — and **steel**, which is mostly iron. *If the magnet grabs it, there is iron inside.*

The Two Ends

Every magnet has two ends called **poles** — where the pull is strongest. The two ends are not the same:



*different ends **attract** — pull together*



*matching ends **repel** — push apart*

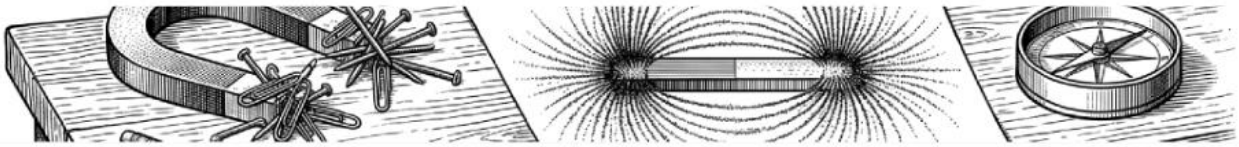
Words to Know

magnet · pole · iron · field · steel · attract · repel

magnet — a piece of metal with an invisible pull · pole — one of the two ends, where the pull is strongest · iron — the metal magnets grab · field — the invisible reach all around a magnet · attract — pull together · repel — push apart

Watch For This in Everyday Life

- Test the fridge magnets — *"what is really holding this up: the paper, or steel hiding under the paint?"*
- Hunt the kitchen for a metal the magnet ignores — *"the foil and the soda can are metal… so why won't it grab them?"*
- Find the hidden magnets in the house — cabinet latches, purse clasps, the knife strip — *"how did you know a magnet was in there?"*
- When a magnet works through a door or a tabletop — *"what is the pull passing through?"*



magnet

magnet

pole

pole

iron

iron

Magnets & Magnetic Fields

Magnetic or not? — predict, then test — front

WORKSHEET

1 · Guess first, test after

BEFORE any magnet is picked up: in the MY GUESS column, circle the little picture you believe — sticks, or doesn't. Then test each thing for real and circle what truly happened in the TEST column. No fair changing a guess!

THE THING	MY GUESS		THE TEST	
 *steel nail*	sticks	doesn't	sticks	doesn't
 *paper clip*	sticks	doesn't	sticks	doesn't
 *soda can (aluminum)*	sticks	doesn't	sticks	doesn't
 *penny (copper)*	sticks	doesn't	sticks	doesn't
 *shiny spoon*	sticks	doesn't	sticks	doesn't
 *wooden block*	sticks	doesn't	sticks	doesn't
 *plastic brick*	sticks	doesn't	sticks	doesn't
 *glass marble*	sticks	doesn't	sticks	doesn't

2 · Count your results

How many things did the magnet **grab**? ☐ How many did it **ignore**? ☐

3 · Think like a scientist

Look at everything the magnet grabbed. **What are all of those things made of?** Tell someone the magnet's secret.

BFSU A-5A

Draw the Invisible Field

You saw the iron dust make it appear — now draw it from memory

WORKSHEET

1 · Draw the field around this magnet

The iron dust showed you the field's secret shape. Draw the **curving lines** all around this magnet — remember: every line **leaves one end and curves back to the other end**. Then trace the word **pole** at each end.



draw the curving lines you saw — then add ONE thing the magnet is pulling in

2 · Where is the pull strongest?

Put a big ★ **star** at each place on your drawing where the iron dust piled up thickest. *Hint: there are two.*

3 · Think like a scientist

The field is still there right now, even with no iron dust to show it. Tell someone: **how do you know it's real if you can't see it?**

BFSU A-5A

The Invisible Pull

the lesson's song — sing it, then say what it means

SONG

Verse 1

There's a nail on the table and it's sitting there still,
Nothing's gonna move it — and nothing ever will...
Till the magnet comes a-sliding, gets closer and near —
And the nail jumps up like it suddenly could hear!

Chorus

It's the invisible pull, the invisible pull —
There's a *field* all around it and the empty air is full!
It reaches through your hand, through the water, through the wall,
But if you're not iron... it won't pull you at all.
(The invisible pull!)

Verse 2

Every magnet has two ends, and we call each end a *pole* —
That's where the pull is strongest, that's the engine of the whole.
Two magnets snap together, then you flip one — whoa!
They push away like strangers saying "no, no, no!"

(Chorus)

Verse 3

Sprinkle iron dust and give the tray a tap —
The field draws its picture like a secret map!
Loops out of one end, curving 'round the bend,
Every line comes home to the other end.

(Chorus ×2, second time stomp on "pull, pull")

Tag (spoken, kids): "Magnet... pole... iron... FIELD!"

How to use it. Play the recording once while everyone just listens. Play it again and join in on the chorus only — that is the part carrying the lesson. By the third time most children have the chorus. Then close the binder and ask what the words actually mean; a child who can sing it and explain it has the idea for good.