

Opening Oration — Water Is a Shapeshifter

9:30 · read aloud, ~3 minutes · also printed standalone as *Opening Oration.pdf*

Prop: A tray with an ice cube on a small plate, a clear jar of water, and an “empty” lidded jar (full of nothing but air), covered with a cloth until the marked moment. (*Freeze the cube overnight; pull it out just before you sit down.*)

Before we start, I want to tell you about a shapeshifter. A real one. It is in this room right now.

A shapeshifter is something that can change its disguise — the same thing, wearing different costumes. And the greatest shapeshifter in the whole world is something you drink every single day.

Water.

(Pull the cloth off the tray.)

Look at these three things. This cold, hard cube — you could stack it, you could hold it, it keeps its corners all by itself. This jar of water — try to stack THAT! It slides, it flows, it lies down flat in its jar. And this jar here... what’s in this one?

Nothing? Are you sure? It’s not nothing. It is full to the very top — with air. Air you can’t see, pressing out to fill every corner of its jar, the way it fills every corner of this room.

Here is the secret: **everything you will ever touch is one of these three.** A thing that keeps its shape by itself — we call that a **solid**. A thing that flows and takes the shape of its container — a **liquid**. A thing that spreads out to fill all the space it can find — a **gas**. Every toy, every drink, every breath. Rocks are solid. Milk is liquid. The wind is a gas. Today, nothing in the world is safe from our sorting.

And water? Water can be **all three**. This ice cube is water in its solid costume. This jar is water in its liquid costume. And floating in the air of this very room — invisible — there is water in its gas costume, too.

So what is the magic word that changes the costume? It isn’t *abracadabra*. It is **temperature**. Warm the ice cube and it melts into water. Warm the water enough and it flies off into the air as gas. Cool it back down... and it comes all the way back, drop by drop, all the way to ice. The shapeshifter never loses itself. It only changes its state.

Today we are going to melt things you have never seen melt. We will read the secret numbers where the changes happen. We will melt a real metal in the palm of your hand. And at the very end, I will show you a solid so strange it skips being a liquid altogether and vanishes straight into fog.

But first — the whole world is waiting to be sorted. Solid, liquid, or gas: let's find out where everything belongs.

Games & Activities (kids do)

G1 · Three Buckets Sort — game, no card (components in game-components/)

10:00 · 25 min · the book's own game (pp. 51–53), played with our illustrated deck

Materials: the 18 illustrated sort cards (sheets 1–2, cut + laminated) · three buckets/boxes or taped floor zones wearing the printed zone labels (*03 Zone Labels.pdf*).

1. Set out the three labeled zones. Seed each yourself first, saying the sentence as you place: “*Water is a liquid.*” “*A rock is a solid.*” “*Air is a gas*” — blow on a hand as you say it.
2. Deal the cards. Each child in turn places one and **must say the sentence**: “A ___ is a ___.” Group votes thumbs up/down; wrong placements get discussed, never silently corrected — mistakes are the curriculum. **No Venn, no overlap zone** — a thing is usually in ONE definite state.
3. The test, said out loud every time: **does it keep its shape by itself? does it flow and take its container's shape? does it spread out to fill everything?**
4. Challenge cards last (marked on the answer key): **sugar jar** and **cereal bowl** pour like liquids — but spilled sugar sweeps into a pile that **KEEPS** its shape, while a pushed “pile” of water instantly flattens; granular things are still solids. **Balloon** and **bubbles** are combinations — a solid skin around trapped gas. **Kettle**: the white puff is tiny liquid drops; the invisible gas is in the clear gap. **Perfume**: every smell is something in gas form — safety moment: strange bad smell = fresh air + tell an adult.
5. Extend to the room — but be careful with your questioning (book p. 53): pointing at a bottle of juice, say whether you mean the juice (liquid) or the bottle (solid). Finish with bodies: solid bones and teeth, liquid blood and spit (urine gets the biggest laugh, the book promises), gas in the lungs — puff your cheeks.

Answer key with challenge-card talk tracks: game-components/Answer Key.md.

Failure modes: arguments about combination cards are the GOAL — let them run. A younger child parking everything in one bucket gets the three questions as a script, one at a time. Laminate the deck to survive the year.

G2 · Bar-Chart Line-Up — game, no card

10:25 · 15 min · straight from G1 · worksheet FRONT

1. Lay each zone's cards end to end in three parallel floor rows from one taped baseline. **The longest row wins.**
2. Say the new words while pointing: this is a **bar chart** — the *taller* the bar, the *more* we found. “*Which state did we find the most of? The least?*”
3. To the table: kids cut minis from the paste strip (*04 Paste Strip.pdf*, one per child), glue each into its worksheet column, then **shade one bar square per card** to copy the floor chart onto paper.

Failure modes: rows get shuffled — tape the baseline, appoint a “chart inspector.” Gluing runs long — pre-cut strips for the youngest two.

G3 • Solid-Liquid-Gas Acting Game — no card (play-act)

10:50 • 15 min • field-proven — reuse verbatim

Kids ARE the particles. Caller shouts a state; the group becomes it: **SOLID** — huddle tight, packed shoulder to shoulder, hold the shape • **LIQUID** — hold hands loosely and slide around each other, flowing into a corner (“your container”) • **GAS** — let go and spread to every corner, no touching.

Then narrate temperature: “*I’m turning up the heat...*” (huddle loosens to liquid, liquid breaks into gas) — “*now the cold comes...*” (gas drifts together, freezes into a block). Call each transition by name: melting, boiling, condensing, freezing.

Failure modes: it becomes tag — the caller’s hand on a shoulder is the only “heat,” so only touched particles change. If they ask, yes — it’s the same game from the A-4 day, because states of matter ARE particle behavior (A-4 forward hook).

A1 • My Own Ice Shape — no card (background race)

11:05 set-out • checks all day • winner declared 1:50 • Number Log section 2

Each child picks one of the fun-shaped ice blocks frozen overnight (one distinct silicone-mold shape per child + one plain cube as control), each on its own named plate on the windowsill.

1. Predict out loud: “*Which shape will melt away first? Why?*” Steer toward size and thinness — a skinny shape has more of itself touching the warm air.
2. Check on the way to lunch and between afternoon blocks; at 1:50 declare the winner and argue why (small/thin/spread-out melts first — surface beats bulk).

Failure modes: cool room = slow race — use a sunny windowsill, all shapes in the SAME sun or it isn’t a fair race (A-B-1 callback). No poking — finger heat cheats.

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

E1 • Three States Trio — Card 1

9:45 · 15 min · field-proven — reuse verbatim · card: 01-three-states-trio.pdf

The oration tray grows into the proven trio: **ice cubes** (solid), a **bowl of water** (liquid), and the **humidifier** breathing visible mist. Kids apply the three test questions and name each state of the SAME substance. Precision moment: the mist is tiny liquid droplets — watch single wisps **vanish mid-air**; where a wisp disappears the water is still there, now invisible **water vapor**, the true gas.

Say: “Same stuff — three disguises. The only difference between them is how much heat energy it has.”

E2 • Reading Real Temperatures — Card 2

11:15 · 20 min · kids hands-on · card: 02-reading-real-temperatures.pdf · Number Log

Stick thermometers in ice water (watch the line fall) and warm water (watch it climb); the IR gun goes around the circle — each child points and reads one thing. Numbers land in the binder **Number Log**. Say the two magic water numbers out loud, pointing at the log’s boxes: **32 °F** freeze-and-melt line, **212 °F** boil line. Tease the afternoon: after lunch the gun points at the hot plate and water crosses both lines.

Say: “Hot and cold aren’t magic — they’re a NUMBER. And water keeps its promises: it always melts at the same number and boils at the same number.”

E3 • Metal That Melts in Your Hand — Card 3

11:35 · 20 min · kids hands-on · card: 03-metal-that-melts-in-your-hand.pdf

A fridge-cold gallium piece in each waiting palm (over a ceramic plate) turns into a bright silver puddle from body heat alone — a real metal whose melting number (≈ 86 °F) is lower than a person (≈ 98 °F, from Card 2). Tip the puddles back into the vial — liquid metal beads and flows like fast silver water. Vial into the fridge over lunch; show it solid again after: **freeze is melt run backwards**. Wash hands. **Never near aluminum**; never for mouths.

Say: “You are warmer than this metal’s melting point. To gallium, your hand is what the stove is to butter.”

E4 • One Ice Cube, All Three States — Card 4 — THE CENTREPIECE

12:40 · 25 min · adult-only heat, kids behind the tape line · card: 04-one-ice-cube-all-three-states.pdf

One single cube climbs the whole ladder: **SOLID** in the cold pan →  **worksheet BACK §1 prediction circled NOW** → heat on, it slumps and **MELTS** (32 °F) to **LIQUID** → keeps heating to a roaring **BOIL** (212 °F) — point at the **clear gap** just above the water: THAT is water vapor, the invisible gas; the white puff above it is already-condensed droplets → boil it **bone dry** and show the empty pan: the cube is now in the room’s air as invisible **GAS**. IR-gun the pan as it climbs; kids call the numbers crossing 32 and 212. Close the loop: cool it back down and it would be drops, then ice, again — A-8 will do exactly that later this year.

Say: "Nothing is gone. Every bit of that ice cube is flying around this room right now, invisible. Temperature ran it up the ladder — and temperature could run it all the way back down."

Failure modes: impatience — a single cube takes ~15 minutes to dry; narrate the thresholds rather than rushing the dial. Steam scalds silently: mitt mandatory, kids seated, hot plate off at dry.

E5 • The Melt Race — Card 5

1:05 · 25 min · kids predict & time · card: 05-the-melt-race.pdf · worksheet BACK §2

Six equal pea-size racers in a ring on the lowest-heat griddle: **ice cube · coconut oil · chocolate · butter · gummy bear · crayon**. Ordinal predictions (1st–6th) written BEFORE the heat goes on; kids call each racer the moment it runs like a liquid; a timekeeper reads the stopwatch and the group records order + seconds. Expected order $\approx$ ice (32 °F) → coconut oil (~76) → chocolate (~88) → butter (~95) → gummy bear (~100+, it slumps) → crayon (~130) — but narrate the order you SEE. Then the **cheese spoiler** goes on last: it softens, bubbles, scorches — and never runs. **Not everything melts.**

Say: "Same griddle, same heat — different finish times. Every material carries its own secret melting number, and the race just read those numbers out loud."

Failure modes: unequal pieces ruin the race — pre-cut matched pea-size pieces the night before. Too-hot griddle melts everything at once — start at the lowest setting and creep up. Scorching cheese smokes — crack a window, pull it before it blackens.

E6 • The Disappearing Spoon — Card 6

1:30 · 10 min · teacher demo · card: 06-the-disappearing-spoon.pdf

Pass a Field's-metal spoon and a steel spoon cold — they clink the same. IR-gun the mug of hot (NOT boiling, ~170 °F) water; above or below 144? Stir with steel: nothing. Swap in the Field's spoon and mid-stir it folds and **melts away**, pooling silver at the bottom of the clear mug. The spoon went nowhere — there it is, in its liquid costume; cooled, it is a solid lump again (recast it in its mold for next year). Metal obeys the same rule as butter — it just has its own number.

Say: "Steel and Field's metal are both metal — but each has its own melting number. This water is hot enough for one and nowhere near the other."

E7 • Dry Ice: Solid Straight to Gas — Card 7 — THE FINALE

1:40 · 10 min · teacher demo, ventilated room · card: 07-dry-ice-solid-straight-to-gas.pdf

Side by side: the ordinary cube already puddling on its plate (melting — solid to liquid), and a chunk of **dry ice** lifted with tongs — smoking faintly, never dripping. Into the warm-water bowl: it roars into thick fog that spills over the rim and **pours DOWN** off the table — and the table under it stays dry. No puddle, ever. Solid straight to gas: **sublimation** — say the big word together. Precision: the visible fog is water droplets from the air chilled by the escaping gas; the gas itself is invisible and pours down because cold gas is heavy. Leftovers sublime outdoors on a plate.

Say: "Watch the table under each one. The ice cube leaves a puddle — solid to liquid. The dry ice leaves nothing at all — solid straight to gas. That skip has its own name: sublimation."

Failure modes: fog weakens as the water chills — refresh with warm water for a second roar. Bought too early = arriving with nothing (it sublimates in storage): buy the morning of. **Safety is absolute:** tongs + insulated gloves, never bare skin; ventilate; never seal in any airtight container.

STRETCH (ranch, adult-run — NOT part of the core day): melting aluminum is feasible but genuinely hazardous (660 °C; a proper mini propane foundry with graphite crucible, never a handheld torch; kids seated well back behind a barrier; every scrap can bone-dry — trapped moisture spatters molten metal). The outline's own recommendation: gallium + Field's metal + dry ice already deliver the same payoff with essentially no risk. No student sheet references this.

Prompts, Send-Home & Prep

PROMPTS & QUESTIONS (USE ALL DAY; BOOK PP. 54–56)

- What is the one word that includes all solids, liquids, and gases? (Matter.)
- It takes the shape of its container but doesn't fill it — which is it? It fills the whole container no matter the size? It has weight — which is it? (All of them!)
- Is the bottle a liquid? Careful — the juice is the liquid; the bottle is a solid.
- Sugar pours — so is it a liquid? What happens when you sweep a spill into a pile?
- What are we really observing when ice melts? Is water “really” a solid or a liquid?
- If nothing is heated and nothing is cooled, will anything change state? (No.)
- What about a pillow? A sponge full of water? Your own body? (Combinations!)
- Is a flame matter? Can you weigh light? Can heat fill a jar? (Energy — C-1 ahead.)
- Look at the whole Earth: land, oceans, atmosphere — solid, liquid, gas.
- If matter did not exist, what would the world be like?
- Could a living thing be made entirely of one state of matter? What would it be like?

WHAT TO WATCH FOR IN DAILY LIFE (SEND HOME — FROM THE BOOK'S “TO PARENTS”)

- Kitchen, bathroom, grocery store: point out solids, liquids, gases — with the reason. (Any smell is a gas!)
- Butter melting in the pan; a crayon left in a hot car; an ice cube shrinking in a summer drink — what is heat doing?
- The freezer turning water to ice; a puddle skimmed with ice on a cold morning — what is cold doing?
- Body parts: solid bones and teeth, liquid blood and spit, air in the lungs. (Urine is a liquid — guaranteed laugh, p. 56.)
- On outings or with a globe: the whole world is land (solid), water (liquid), atmosphere (gas).
- Play “20 Questions” starting with: is it solid, liquid, gas — or a combination?

PREP-AHEAD CHECKLIST

Order ahead (a week out)

- ☐ Gallium + Field's-metal spoon (ship slowly — order first), hot plate/griddle, IR gun, stick thermometers, silicone molds, humidifier — see Supply List.md. IR gun may already be owned from A-8; check before buying twice.
- ☐ Print + cut + laminate sort-card sheets and zone labels (game-components/, color); one paste strip per child.
- ☐ **Locate the dry-ice source now** (grocery chest / welding-gas supplier); plan to buy on lesson morning.

The night before

- Freeze the silicone-mold shapes (one distinct shape per child + a plain control cube) AND ordinary cube trays (oration, E1, E4, E7 comparison).
- Pre-cut melt-race pieces to matched pea size into a labeled muffin tin; fridge (butter and coconut oil must start cold and solid). Peel the crayon.
- Gallium vial into the fridge (fully solid at go time).
- Fill and test-puff the humidifier; check the hot plate at its spot; tape the kid line.
- Batteries: IR gun, digital thermometers; stage the stopwatch.
- Print worksheets/copywork if binder stock is low (student-binder/ PDFs).

The morning of — DRY ICE (it cannot be bought early)

- Buy 2–4 lb of dry ice that morning — it sublimates ~5–10 lb/day even in a cooler; buying the day before can mean arriving with nothing.
- Transport in a hard cooler, **lid resting loose — NEVER latched airtight**, car windows cracked; store ventilated, away from the kids, until 1:40.
- Pull the oration cube and shaped ice only at go time; stage buckets + card deck for G1; kettle ready by 1:25 for E6.

REVIEW HOOKS

- **Back:** A-B-1 — this whole lesson is that sorting game, played on everything that exists.
- **Forward:** A-3 (air is a substance — today’s gas bucket gets weighed and squeezed); A-4 (WHY the states behave as they do — particles holding tight, sliding, flying free; the acting game becomes the particle model); A-8 (evaporation/condensation — where the boiled-away water went and how it comes back); C-1 (light and heat, the not-matter things, get their name: energy).
- The A-6 kit borrows this lesson’s IR thermometer — keep it findable.

Opening Oration — Water Is a Shapeshifter

Solids, Liquids, and Gases — and Change with Temperature • read aloud, ~3 minutes

Prop: A tray with three things side by side: an **ice cube on a small plate**, a **clear jar of water**, and an **“empty” lidded jar** (full of nothing but air). Keep the tray covered with a cloth until the marked moment. *(Prep: freeze the cube the night before and pull it out just before you sit down, so it is still sharp-cornered when the cloth comes off.)*

Before we start, I want to tell you about a shapeshifter. A real one. It is in this room right now. A shapeshifter is something that can change its disguise — the same thing, wearing different costumes. And the greatest shapeshifter in the whole world is something you drink every single day.

Water.

(Pull the cloth off the tray.)

Look at these three things. This cold, hard cube — you could stack it, you could hold it, it keeps its corners all by itself. This jar of water — try to stack THAT! It slides, it flows, it lies down flat in its jar. And this jar here... what’s in this one?

Nothing? Are you sure? It’s not nothing. It is full to the very top — with air. Air you can’t see, pressing out to fill every corner of its jar, the way it fills every corner of this room.

Here is the secret: **everything you will ever touch is one of these three**. A thing that keeps its shape by itself — we call that a **solid**. A thing that flows and takes the shape of its container — a **liquid**. A thing that spreads out to fill all the space it can find — a **gas**. Every toy, every drink, every breath. Rocks are solid. Milk is liquid. The wind is a gas. Today, nothing in the world is safe from our sorting.

And water? Water can be **all three**. This ice cube is water in its solid costume. This jar is water in its liquid costume. And floating in the air of this very room — invisible — there is water in its gas costume, too.

So what is the magic word that changes the costume? It isn’t *abracadabra*. It is **temperature**. Warm the ice cube and it melts into water. Warm the water enough and it flies off into the air as gas. Cool it back down... and it comes all the way back, drop by drop, all the way to ice. The shapeshifter never loses itself. It only changes its state.

Today we are going to melt things you have never seen melt. We will read the secret numbers where the changes happen. We will melt a real metal in the palm of your hand. And at the very end, I will show you a solid so strange it skips being a liquid altogether and vanishes straight into fog.

But first — the whole world is waiting to be sorted. Solid, liquid, or gas: let’s find out where everything belongs.

A-2 Supply List — Solids, Liquids, and Gases

Everything for the full 9:30–2 day. Prices are rough. **Order-ahead flags matter:** gallium and the Field's-metal spoon ship from small suppliers (order a week out), and **dry ice can only be bought the morning of the lesson** — it sublimates away in storage.

ALREADY HAVE (TYPICAL HOUSEHOLD)

☐	ITEM	USED IN
☐	Three buckets / boxes / taped floor zones	G1 sort
☐	Painter's tape + marker	G1 zones, G2 baseline, E4/E5 kid line
☐	Scissors + glue sticks (per kid)	G2 worksheet paste
☐	Ice cube trays — freeze plenty the night before	Oration, E1, E4, E7
☐	Small plates (one per kid + spares)	Oration prop, A1 shapes, E7
☐	Clear jar of water + "empty" lidded jar + tray + cloth	Oration prop
☐	Bowl of water	E1 trio
☐	Saucepan (small, light-colored helps)	E4 centrepiece
☐	Glass mug or heat-proof clear cup	E6 spoon
☐	Kettle / hot tap for hot (not boiling) water	E6
☐	Muffin tin (staging pre-cut melt-race pieces)	E5
☐	Melt-race foods: butter, chocolate, gummy bears, cheese, coconut oil	E5
☐	One crayon (peeled — sacrifice a broken one)	E5
☐	Two clear glasses (ice water / warm water)	E2
☐	Stopwatch or phone timer	A1, E5
☐	Oven mitt	E4, E5
☐	Hard-sided cooler (dry-ice transport, lid loose)	E7
☐	Fridge + freezer	E3 re-solidify, A1, prep

TO BUY

☐	ITEM	QTY	~PRICE	WHY	ORDER AHEAD?
☐	Gallium sample (30–50 g, sealed vial)	1	\$15–25	E3 — a real metal that melts in a child's warm hand (~86 °F); non-toxic, reusable forever	YES — ships slow, order first
☐	Field's-metal "disappearing spoon" (Bi-In-Sn — NOT lead/cadmium Wood's metal)	1	\$25	E6 — a metal spoon that melts away in hot water (144 °F) and re-solidifies to use again	YES — ships slow
☐	Dry ice	2–4 lb	\$3–5/lb	E7 — sublimation showstopper: solid straight to gas, no puddle	Morning-of ONLY — grocery chest or welding-gas supplier; call ahead
☐	Small electric hot plate or griddle	1	\$25	E4 centrepiece + E5 melt race (griddle = best for the race)	Yes
☐	Infrared no-touch thermometer gun	1	\$18	E2 — point-and-read temperatures (see note below: may already be owned)	Yes
☐	Kid stick thermometers	3–4	\$12	E2 — every child reads a real number	Yes
☐	Silicone ice molds, fun shapes	1–2 sets	\$8	A1 — one distinct shape per child for the melt race on the windowsill	Yes
☐	Mini ultrasonic humidifier	1	\$20	E1 — the proven vapor prop (skip if you already own one that works)	Yes
☐	Insulated gloves + kitchen tongs	1 pr + 1	\$15	E7 — dry ice is never touched with bare skin	Yes
☐	Cardstock + lamination for the sort-card sheets	—	~\$5	G1/G2 — print game-components/ in color; laminate to survive the year	Yes

Total new spend: ~\$150–170 ($\approx$ \$135 durable + \$10–20 dry ice + consumables).

CHECK-YOU-OWN-IT NOTES

- **Infrared thermometer** — also on the A-8 supply list (\$18). If A-8's shopping was already done, you own one; buy only once. (A-6 will borrow it from this kit too.)
- **Humidifier** — A-4 uses one; if you already own one that runs, strike it from TO BUY.
- **Gallium safety notes:** non-toxic, but it wets and stains skin faintly gray (washes off) and it **destroys aluminum** — keep it off aluminum foil, pans, and jewelry. Store the re-solidified pellet in its plastic vial, never an aluminum container.
- **Dry-ice handling (E7 card has the full safety box):** tongs + insulated gloves, never bare skin; ventilated room; **never sealed in an airtight container** (gas pressure bursts it); cooler lid rests loose; leftovers sublime away outdoors, never in a sink or closed room.

STRETCH PURCHASES (ONLY IF PURSUING THE RANCH ALUMINUM MELT — SEE TEACHER GUIDE STRETCH)

☐	ITEM	~PRICE	FOR
☐	Mini propane foundry + graphite crucible + PPE	~\$120+	Melting aluminum at 660 °C — adult-only, honestly not recommended; gallium + Field's metal + dry ice already deliver the payoff

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