OFFICIAL CURRICULUM REVIEW SAMPLE PACK

The Civilizations Engine

Book Two: Living STEM Master Omnibus (Grades 8–10)

What's Inside This Complete 3-in-1 Living STEM Verification Pack:

1. **Component 1 · The Living Core Narrative**: Complete chapter prose with first-principles physical bottleneck resolution.
2. **Component 2 · The Student Field Investigation Log**: Hands-on inquiry sheet, Cadet Scratchpad calculation workspace, and zero-answer-leak scaffold.
3. **Component 3 · The Parent Quick-Start & Facilitator Guide**: 30-second science decoder, 3 dinner-table conversation prompts, and full step-by-step diagnostic answer key.
4. **Component 4 · Gradient Assessment Matrix**: Foundation, Modeling & Open Inquiry rubric-based items.

* Designed for Grades 6–9 / 8–10 · Faith-Neutral & Secular · Verified NGSS & CCSS-M Aligned · ADHD / 2e Friendly.

COMPONENT 1 · LIVING NARRATIVE SPINE

Chapter 1: The Fish Mouth Divide

The alarm came up through the ground before it came through the air — a long, low shudder climbing the survey path and into their shinbones, as if something enormous had cleared its throat three ridges away.

"Not a bell," Pang Hu said, already running. "That's the earth. The earth doesn't ring twice."

Three hundred meters upstream of the fish-mouth levee, the Min River had delivered its opening argument. Three spruce trunks lay jammed across the outer river's intake throat. Each one thicker than Lin Qi was tall, diameter past 1.2 meters, weight in the tens of tons. Every pulse of the flood drove them a little deeper into the bedrock. Lin Qi braced the binoculars against his knee and counted the shifts instead of the seconds. The intervals were shrinking. The river was learning the jam's rhythm and pushing on the beat.

Every inch the trunks wedged deeper shrank the outer channel's flow area, and every cubic meter they turned away had to go somewhere. Downstream, deep in the Baopingkou — BAO-ping-koh — gorge, the rock had started to answer — a fine, continuous creak, like cloth tearing in the next room.

"Everybody behind the tooth wall! Now!" Pang Hu roared it at the junior crew, and then he went over the warning cable himself, the wrong way, toward the water.

By the manual, everyone should have waited for data. Pang Hu did not wait for data. He went out flat on the wet stone sill on the upstream face of the divide. He wormed along it to the biggest trunk — the one canted half out of the current, root ball hanging over the throat like a fist. There he pressed his ear to the bark. Spray whipped over the sill in cold little lashes; by the time his ear was flat, both sleeves were soaked through.

Lin Qi slid down the bank to the survey table. A minute later, Pang Hu's report came back over the roar, shouted word by word: inside the trunk, a thin metallic shriek. And under it, a wet, fibrous sound, like rope strands letting go one bundle at a time.

"The stress in this beam is at the ceiling!" he bellowed. "Give it half an hour and the whole jam chain-sinks — goes down link by link. The outer throat plugs solid, and then nothing we own will move it!"

Su Wei was already seating her pitot — PEE-toh — tube into the current. Ye Qing stood over the connecting-tube level, eye down, running the zero check for the third time.

"Third zero this hour, Inspector," Pang Hu had said earlier, at the truck, not quite a question.

"The river checks me constantly," she had answered. "I return the courtesy."

Now, while the numbers were still being born, Pang Hu's hands moved first. Two low-carbon steel rods off the gear sledge, one set of movable pulleys, the Kevlar line off his harness. With all of it he walked the sill, seated the rods under the high side of the half-airborne trunk. He took its load onto the tackle before the first secondary collapse could be born. The trunk shuddered, ground against the sill, and held. Half the creaking downstream died.

Lin Qi let out his breath and felt his vision do what it always did under overload: the spray, the noise, the shouting fell away, and clean lines remained. Levers. Areas. A balance with one pan heavier than the other. The orange cube rode his chest plate — M-00-Anchor, orange titanium, warm from his body — and he was distantly aware of it tapping his collarbone with each breath, the only loose thing left in a world that had narrowed to lines.

"Pang Hu — thanks. Now the numbers talk." He spread the record paper on the table and weighted its corners with stones.

[Sampling start. Pitot dynamic-head differential calibrated; connecting-tube level zero re-verified — Ye Qing requested an added water-temperature drift correction; executed.]

Su Wei called the two channels' velocities and flow areas item by item, her voice gone flat the way it went when she was listening to the river instead of to it. Ye Qing appended a systematic-error column to every reading, pencil small and surgical, and once she reached over and tilted Lin Qi's staff gauge a finger's width. "You were reading off-axis. The meniscus lies from that angle." When the numbers finally gathered into one line, everyone went quiet at once.

[Total discharge 3000 cubic meters per second. Inner river 2460 cubic meters per second — 82%. Outer river 540 cubic meters per second — 18%. Inner-river safe-flow ceiling: 1200 cubic meters per second.]

"The split is upside down." Lin Qi stared at the two figures until they stopped being figures and became a lever with the fulcrum on the wrong side. "This system has run 2,300 years on four-six. Dry season, the inner river takes six parts in ten, because the fields are thirsty. Flood season, the outer river takes six parts in ten, because the gorge isn't. No gates, no operators, no judgment calls — the fish-mouth's angle and the flying-sand weir's crest height do all the deciding, and they have never once needed to be told."

"And right now?" Pang Hu asked.

"Right now the outer throat is plugged, so 82 percent of the flood is going where the ceiling is 1200. Baopingkou is a natural rock throat. It can't be widened. It can't be blasted. It was never meant to take this. Forty more minutes of it, and the gorge's tension face lets go."

[Flood-peak countdown: 110 minutes. Manual clearing window: under 90 minutes.]

"Target?" Pang Hu wiped a sheet of dried mud off his jaw.

"Target state: inner 1200, outer 1800 — inner four, outer six." Lin Qi flipped the workboard and wrote the one law the river couldn't argue with:

$Q = A_1v_1 + A_2v_2$ = constant = 3000 m^3/s

"What comes in the front leaves at the two ends, and the total doesn't care about our opinions. The inner river has to give up 2460 minus 1200. That's 1260 cubic meters a second. The outer has to take it: 540 up to 1800." He drew a hard line under the subtraction. "So where does the river find 1260? At the flying-sand weir. Broad-crested free-weir discharge scales with crest head to the three-halves power — Q proportional to b times h to the three-halves. Not twice the head for twice the water. Head and a half for twice the water. That curve is the whole machine, and it's on our side."

He sketched the weir section, laid the dry-season and flood-season bed gradients over it, and back-solved in the margin, the numbers small and stubborn: the outer river standing on the weir crest at only about 0.33 meters of head, and under the three-halves law that head had to grow to 0.33 × (1800/540)^(2/3) — about 0.74 meters — before the outer channel could swallow its share.

Pang Hu wiped grit from his palm and held the hand out flat, as if the whole lever law should fit on it. "In plain words," he said.

"In plain words: we don't fight the flood for a single cubic meter. We clear the jam. The outer crest head climbs about 0.4 meters on its own, the three-halves law does the rest, and the outer river finds 1800 without being asked. The ancestors already built the automatic splitter. We're not redesigning it. We're repairing it."

"Then it's not us against the water." Ye Qing signed the zero-calibration record — three zeros, one signature. "It's us against wood. Good. Wood can be audited. The numbers can carry my signature."

"Prying wood is my event." Pang Hu had the tackle hooked to a steel rod before the sentence was out.

They started with the outermost trunk, the one already snapped in two — the one most likely to move, and most likely to move wrong. Steel rod into the jam gap. Pulley set drawn to tension. The Kevlar line's stretch-sang wound through the river's roar like a fourth voice. Every bite of the rod into wet wood shuddered up through his wrists, and the wind kept throwing spray until his eyes stung. Pang Hu didn't pull blind: he worked along the trunk with the pry bar, tapping, listening, mapping the hollows, and chose only the points where the fibers had already let go, keeping every strike out of the live wood's rebound sector.

"Sound first, then force," he said, half to himself. "Wood tells you where it's willing to leave."

Lin Qi counted the creaks for him, because counting was what his hands did when they couldn't be useful. Between one shove and the next the fibers spoke less. The trunk was running out of argument.

Forty minutes after the first bite of the rod, the most dangerous trunk rolled out of the main current whole, and the river carried it off downstream like a cherry pit.

The second trunk had wedged itself into a groove in the bedrock, seated like a tenon in a mortise. Pang Hu changed the plan — lever plus sideways shove, no more lifting — and made the flood do the extraction. He freed the upstream end, and the current took it, walking the trunk out of the groove the way you draw a splinter from skin, one lurch at a time, while Ye Qing called the load line back off the fairlead every time it jumped.

The third was the smallest. Steel rods, a quarter turn, and the current claimed it without asking them.

The moment the outer throat reopened, the weir crest head began to climb. Su Wei read the staff gauge against the current line and called it as it moved: 0.2 meters. 0.3. 0.4.

On the oscilloscope watch buckled over her sleeve, the real-time back-test assembled itself line by line: inner river 1210 m³/s — 40.3 percent. Outer river 1790 m³/s — 59.7 percent. Inside the four-six band, closing on center like a door finding its frame.

"Held it!" Pang Hu came off the stone sill in a jump that would have cost a stranger an ankle.

Down in the gorge, the tearing creak simply stopped. In Su Wei's pack, the olm Mo Ying — curled tight as a fiddlehead since the first shudder — let go one ring. She laid the inner-river gauge against its marks and read the drop: 0.4 meters, and the flood peak still 47 minutes out. The window had been met, with margin left over to sign.

"Inside the band," Ye Qing said, looking at the watch, then at the river, as if daring either to move. "And I'll sign the band."

It was Su Wei, afterward, who crouched at a seam in the fish-mouth's foundation stones and went still. The flood had polished something sitting in the crack until it shone like a coin. She lifted it out with tweezers: a small bronze casting, a positioning tooth, its profile crisp enough to have come off a machine, its flank engraved with four ancient characters.

天工·水律。

"Heaven's Craft. Water's Law," Lin Qi read, and the two halves sat together like they'd been waiting for each other.

Ye Qing ran the alloy through her portable spectral colorimeter — solution channel first, then the emission channel — and the composition spectrum stepped out on the screen line by line. "Not a modern alloy. The trace elements are wrong for anything smelted in the last century, and the casting structure is old. Old the way archaeology is old. Not the way inventory is old."

"Under the fish-mouth," Pang Hu said slowly. "Somebody stamped the foundation 'inspected.'"

Lin Qi photographed it against a scale card, assigned it a specimen number, and sealed it into the evidence roll. "Today we repaired Li Bing's splitter. But this tooth says someone stood on this exact stone 2,300 years ago and signed the work off. We didn't build the four-six split." Behind them the peak went past in a wall of brown noise, and the fish-mouth took it the way it had taken two thousand years of the same argument. "We just re-ran their acceptance test."

Water has its own geometry. It always walks the geodesic of least resistance — and somebody had drawn that geodesic a very long time ago, and drawn it correctly.

COMPONENT 2 · STUDENT FIELD INVESTIGATION LOG

Card 1 · The Fish Mouth Divide

> ***Code**: Continuity equation Q = ΣAv, and weir scaling Q ∝ b·h^(3/2)*

Code Book

1. Flood-season target split, inner : outer = _____ (inner river _____ m³/s).

2. Imbalanced state: the inner river runs 2460 m³/s — that is _____ % of the total.

3. The inner river must shed ΔQ = _____ m³/s.

Draft Zone

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[Fish-mouth 4:6 rebalance scaffold]
Step 1 · Qualitative: total flow is conserved — Q_total = Q_inner +
Q_outer = 3000 m³/s
Step 2 · Skeleton: target inner = [      ] × 3000 = [      ] m³/s
        ΔQ = imbalanced − target = [      ] − [      ] = [      ]
Step 3 · Weir scaling: Q ∝ b·h^(3/2) → once the outer-river head is
raised, its conveyance goes [ up / down ]
Compute slot: ΔQ = _____ m³/s
[☑] Checkpoint: at the 4:6 split the inner river should land exactly on
its own cap — verify your cap and ΔQ values against the Parent Answer
Key; clearing the logjam = raising the outer-river weir head
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Error Reflection: The pitot-tube dynamic-pressure reading drifts with water temperature and viscosity — why did Ye Qing run the zero-point calibration three times?

Maker Lab: Invert a plastic bottle and seat two straws at different heights — one high, one low — so the outflow splits in two; tune the height offset until the split reproduces "inner 4, outer 6." *Safety line: parents handle all scissors work.*

Observation Matrix — Split-Ratio Rebalance

Variable	Imbalanced	Target	Unit	Meaning
:--	:--:	:--:	:--:	:--
Inner-river flow	2460		m³/s	continuity allocation
Outer-river flow	540		m³/s	weir-head raise

Split ratio	82:18	40:60	%	self-regulating recovery

COMPONENT 3 · PARENT QUICK-START & FACILITATOR GUIDE

Gate 1 · The Fish Mouth Divide

** 30-Second Decode**: A checkout line splitting toward two registers takes its shares by lane shape, not by a boss with a whistle — the wide lane draws the bigger crowd. The fish-mouth levee is *shaped* so the inner channel takes 4 shares and the outer takes 6 (1200 vs 1800 m³/s). Clearing the logjam works like tilting the far end of a table: it raises the outer river's weir head, so the outer side accepts more flow and the inner river drops by 1260 m³/s from 2460 down to its 1200 cap. Weir scaling — Q ∝ b·h^(3/2) — says a slightly higher upstream lip passes a lot more water.

** Three Table Questions**: (1) Where does our house or street split one big flow into two smaller ones without any valve — gutters, faucets, a stream fork on a trail? (2) Why might a rigid 50:50 split be the wrong goal for a river in flood? (3) If you wanted the inner channel to carry *more* water without ever touching a gate, what could you change about shapes alone?

** Common Misconception**: Kids assume the 4:6 ratio is dialed in by hand-operated gates. It isn't — the geometry self-regulates. Correct it by asking, "What did the crew actually *remove* to fix the ratio?" (Jammed logs — obstructions, not valves.)

COMPONENT 4 · GRADIENT ASSESSMENT BANK & KEY

Gate 1 Assessment Questions

Gate 1 · The Fish Mouth Divide

1. **[Foundation]** With a total flood flow of 3000 m³/s, how much water does the inner river carry at the 4:6 split?

2. **[Modeling]** Suppose the split ran 75:25 instead (same 3000 m³/s total). What would the inner river carry? Show your setup.

3. **[Open Inquiry]** Sketch and describe a valveless device that splits one stream into two shares automatically.

Official Parent Answer Key

Gate 1 — 1. **1200 m³/s** (4/10 × 3000). 2. **2250 m³/s** (0.75 × 3000; continuity Q = ΣAv). 3. *Guidance*: any no-power hydraulic splitter — a fish-mouth baffle, a side weir, a level-sensitive gate; credit any design that names the physical quantity it watches. *Card checkpoint:* at the 4:6 split, the inner river's cap = **1200 m³/s**, so ΔQ = **1260 m³/s**.