Three Languages, One Walk

Teacher Notes — run it cold in 40 minutes

Motion Foundations · Lab Activity 3 · ConceptArc Education (FundaFirst HS) · fundafirsths.com

What you need: *the same floor tape 0–8 m, a steady clap or metronome app, the activity file open (projector or shared link — offline once loaded, nothing to install, no accounts), one worksheet per student.* **The one rule:** *every prediction goes down in ink before any reveal. A changed answer beside a crossed-out one is the artefact you want. This is the* **capstone***: run it after Activities 1 and 2, or as consolidation before the diagnostic.*

Run of show — 40 minutes

0–5	Tape down (or re-use the marks). Declare +x aloud. Read **Story Zero** once, slowly: *start at the 2 m mark; stand still for two claps; walk steadily to the 6 m mark over four claps.* Class fills the checklist 1(a) before anyone moves.
5–13	**The dictation walks (no screens).** A volunteer walks Story Zero against the claps; the class judges each checklist line aloud. Then a second volunteer invents a walk; everyone writes its story (1(b)); sheets swap for the checklist audit (1(c)). Run Script 1.
13–21	**Scene 1 (projected).** Round 1: read the story aloud, students commit A–D in ink, tally, Reveal — the walk judges. Round 2 (the minus-side story): same protocol. Script 2 at the doubling-back graph.
21–27	**Scene 2.** The direction reverses: one graph, four stories. Commit in ink; tally; Reveal. For each wrong story, ask its voters to point at the exact clause the graph contradicts.
27–33	**Scene 3 (the dictation, screened).** A volunteer drives a 10-second walk; everyone writes the story and sketches the graph in ink (worksheet Part 4); Replay confronts. Collect three stories aloud; audit them against the checklist.
33–40	**Scene 4.** Five cards, commit each in ink (Part 5), reveal one by one — Script 3 on Cards 1 and 3. **Homework hook:** send the file/link — Builder (story edition) challenges 1–3: the Builder reads your model back as words; make it tell the card's story. Layer C for the students who ask for more.

Running short? Cut Scene 2 (its worksheet Part 3 moves to homework) — never the dictation, and never the ink-commit step. Individual-device rooms: students run Scenes 1, 2 and 4 self-paced (~20 min); you run Scenes 3 and the debrief together.

The three scripts, in lesson order — plus one standing rule

Script 1 — The checklist (the dictation): Four questions every story must answer: *where did she start? which way first? any holds? where and when did she end?* Every answer is a claim. A story that names no start position cannot be drawn — ask the class to try, and let them discover the stranger can put it anywhere. **Then spring the catch:** "starts at 0, goes right, no holds, ends at 6 m at 4 s" fits one steady walk at 1.5 m/s *and* fits 1 m/s for two seconds then 2 m/s for two seconds — no turn, no hold, same four answers. Four answers are the minimum, not the whole: a new stretch begins whenever *how fast* or *which way* changes, and each stretch needs its duration and its signed rate — the Builder's own grammar, and the gap is worksheet C1. **Keep the qualifier honest:** that grammar fits walks made of a few steady stretches. A hand-driven walk may have none, and the Builder holds eight — then a story is a close description, not the walk. That is worksheet C2.

Script 2 — No hills, no time machines (Scene 1–2): When "downhill" or the doubling-back graph appears: *where is she when the line is high?* Far from zero — on the level floor. And the line can never run back toward earlier clock readings: walking back changes the position numbers, never the clock.

Script 3 — At is not for (Scene 4): Card 1 and Card 3 break the two rules of the game: one position per clock reading, and clock readings only increase. Say the pair aloud and connect them to worksheet B3: *"at 2 s" names one clock reading; "for 2 s" names an interval.* One is a point on the graph; the other is a stretch of it.

Standing rule — language guard (whole lesson): keep to *position, clock reading, event, interval, velocity, speed, direction, sign*. Stories written by students will drift into looser words — that is the material: put the loose word on the board and ask which checklist line it fails to pin down.

Fit with the FundaFirst HS toolkit

- This is the **translation capstone** across all eight bands rather than one block: it consolidates Activity 1 (*The Graph That Looks Like a Hill*, E1 → E4 → E7) and Activity 2 (*The Negative That Doesn't Mean Less*, E3 → E5 → E6) by making the class move one motion between words, graph and walk. The numbers here deliberately differ from the diagnostic's items.
- Verbal translation is where graph-as-picture and instant/interval confusion resurface after remediation — the Mistake Museum traps re-armed in words (#2, #4). If the diagnostic follows, this lesson is the consolidation pass; if it preceded, watch the Scene 1–2 tallies against the class heatmap's E4 and E2 rows.
- The Builder's **story read-back** is the homework anchor: a student who can make the read-back match a challenge card has translated words → model → words and closed the loop.

Why this lesson exists (provenance)

That students who compute correctly still cannot translate between a motion, its graph and a verbal description is a persistently documented finding in physics education research: McDermott, Rosenquist & van Zee, *Am. J. Phys.* 55 (1987) documented the difficulties in connecting graphs to physics; Beichner, *Am. J. Phys.* 62, 750 (1994) built the standard graph-interpretation test on them; the underlying velocity concepts are Trowbridge & McDermott, *Am. J. Phys.* 48, 1020 (1980), and the teaching moves follow Arons, *A Guide to Introductory Physics Teaching*, Ch. 2. Real-time motion↔graph work follows Thornton & Sokoloff, *Am. J. Phys.* 58, 858 (1990); commit-before-reveal is the Interactive Lecture Demonstration tradition; step-level checking of student constructions goes back to the Andes physics tutor (VanLehn et al., *Int. J. Artificial Intelligence in Education* 15, 2005). What is FundaFirst-specific: the stories, candidate graphs and reveals are wired to the same misconception bands as your class heatmap, so the lesson and the report speak one language.