Railroad

Physical Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- Two parallel steel rails running straight into the distance with visible rust and oxidation
- Wooden railroad ties (sleepers) spaced evenly beneath the rails
- Gravel ballast (small stones) supporting the ties and rails
- Dense deciduous tree canopy on both sides of the track
- Clear sky visible above the trees

Reasonable Inferences

1. From the rails and ties: The track is designed to distribute heavy train weight evenly across the ground and prevent rails from shifting or warping under load.
2. From the gravel ballast: The stones absorb vibration and water, and allow for minor adjustments to track alignment—suggesting the structure must handle both weight and movement.
3. From the overgrown vegetation: This section may be abandoned or rarely used, raising the real-world engineering question: How would you maintain or rebuild this track for modern use?

Engineering Task

K-2 Challenge:

Build a strong railroad track using craft sticks and small stones. Your track must support a toy train or block rolling across it without the sticks bending or breaking. Test it by rolling your toy across it 5 times.

3-5 Challenge:

Design and build a 2-foot section of railroad track using wooden craft sticks (as rails) and your choice of materials for ties and ballast. Your track must:
- Support a 2-pound weight placed on it without any rail bending more than ½ inch
- Remain stable when the weight is rolled across it at least 10 times
- Use only materials found in nature or recycled items (no plastic)

Document which ballast material (sand, gravel, crushed shells, etc.) works best and why.

EDP Phase Targeted

Ask / Define Problem — This phase fits best. The photo shows an existing solution (a real railroad), but students must first identify why that design works: What problem does the gravel solve? Why are ties spaced the way they are? What happens if you remove the ballast? This discovery drives curiosity and problem-finding before jumping to building.

Suggested Materials

- Wooden craft sticks or popsicle sticks (for rails and ties)
- Small pebbles, gravel, or sand (for ballast)
- String or wire (to bind ties together, optional)

- Blocks or weights (2-3 pounds, to simulate train load)
- Toy train or rolling block (for testing)
- A meter stick or measuring tape (for alignment and stability checks)

Estimated Time

K-2: 45–60 minutes (includes building, testing, and rebuilding)
3-5: Two 40–50 minute sessions (Session 1: design & build; Session 2: systematic testing of different ballast materials and data recording)

Why This Works for Teachers

This task directly addresses NGSS ETS1.A: Defining and Delimiting Engineering Problems by having students recognize how each part of the track (rails, ties, ballast) solves a specific problem—weight distribution, alignment, and vibration absorption—making the "why" behind real-world engineering visible and testable.