Clouds

Earth & Space Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- A tall tower crane with a vertical mast (tower) and horizontal boom arm
- Steel lattice/truss construction throughout the structure
- Multiple cable supports (guy-wires) connecting boom to mast
- A counterweight or cab visible at the base of the boom
- Cumulus clouds in background (indicating outdoor construction site context)

Reasonable Inferences

1. From the lattice structure: The crane is built with a framework design rather than solid material—this suggests that engineers chose a design that is both strong enough to lift heavy loads AND light enough to be stable and economical.

2. From the guy-wire cables: The horizontal boom extends far from the vertical mast, creating leverage and tipping forces. The cables are necessary to keep the structure from toppling, implying that balance and support systems are critical to tall, cantilevered structures.

3. From the overall height and isolation: Construction cranes operate in open air and must withstand wind forces, suggesting that structural stability under environmental stresses is a real engineering constraint.

Engineering Task

K-2 Challenge:

"Build a Tall Tower That Doesn't Fall Over"

Can you use straws, blocks, or sticks to build a tower as tall as a ruler? Make it stand by itself without tipping. Try adding string or yarn to help hold it up like the ropes on a real crane. What happens if you make one side heavier—does it fall? Can you fix it?

3-5 Version
"Design and Build a Stable Tower Crane Model"

Design a tower structure at least 30 cm tall using only wooden craft sticks, plastic straws, or cardboard tubes. The structure must:
- Hold a 200g weight (bean bag or washers) suspended from a horizontal boom arm that extends at least 15 cm from the tower
- Remain standing without toppling when the weight is attached
- Include at least 2 cable supports (string or fishing line) connecting the boom to stabilize it
- Be built within a 20 cm × 20 cm base footprint

Test your design and measure: Does it tip? Does the boom sag? Redesign to improve stability or reduce sag by 1 cm.

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EDP Phase Targeted

Ask / Define Problem

This phase is ideal because the photo shows a real-world solution to a real problem—how to build a tall structure that lifts heavy loads without falling over. Students see the "why" (construction work) before they build. They're not just copying the crane; they're identifying the core challenge: "How do we make something tall that stays balanced?" This naturally leads them to observe, ask questions, and then experiment with solutions.

Suggested Materials

1. Wooden craft sticks or popsicle sticks (or plastic drinking straws) – for the tower frame
2. String, yarn, or fishing line – for guy-wire cable supports
3. Tape or hot glue – for assembly
4. Small bean bag, washers, or paper cup with sand – for the suspended load
5. Ruler or measuring tape – for height and distance measurements

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Estimated Time

Two 40-minute sessions
- Session 1: Observe real crane photos, brainstorm design, and sketch plan (15 min). Build prototype (25 min).
- Session 2: Test and observe failures (10 min). Redesign and rebuild (25 min). Share results (5 min).

Alternative (single session): 50–60 minutes for K-2 with simpler, faster-building materials.

Why This Works for Teachers

This task directly addresses NGSS ETS1.A: Defining and Delimiting Engineering Problems by asking students to identify the constraint (keep a tall, cantilevered structure stable) and ETS1.B: Developing Possible Solutions by testing how different support systems (cables, base size, materials) affect stability—all grounded in a photograph of real engineering they can see and understand.