Sunrise

Earth & Space Science | Engineering Design Process

Engineering Challenge

Visible Elements in Photo

- Urban skyline with approximately 8–10 tall buildings of varying heights and shapes (glass, metal, stone facades)
- A concrete highway overpass/bridge structure in the foreground
- Dense green vegetation (trees and shrubs) along the riverbank below the bridge
- A river or waterway running beneath the bridge
- Golden-hour sunlight casting shadows and glare across the scene

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Reasonable Inferences

1. From the bridge structure: The concrete overpass must span the water and support heavy vehicle traffic; it demonstrates load-bearing engineering and the need for stable foundations in soft ground (soil/water).

2. From tall buildings clustered together: Cities are designed to maximize space vertically; tall structures must resist wind forces and distribute weight safely to foundations deep underground.

3. From vegetation near water and bridge: Natural landscapes coexist with human structures; engineers must design projects that account for natural features like water flow and root systems.

Engineering Task

K-2 Challenge:

"Build a Strong Bridge for the River"

Imagine you need to build a bridge so cars and people can cross a river safely. The bridge must:
- Span across a gap (use a shoe box or two blocks as the "river")
- Hold the weight of toy cars driving over it
- Use materials you can find (popsicle sticks, straws, string, paper)

Can you make a bridge that doesn't break?

3-5 Challenge:

"Design a Tall City Building That Stands Strong"

You are a structural engineer designing a skyscraper for a busy city. Your building must:
- Be at least 30 cm tall
- Support a 500-gram weight (books, sand bag) placed on top without tipping or buckling
- Use only paper, cardboard tubes, tape, and string
- Have a stable base that keeps it standing even when someone gently pushes it sideways
- Be designed to resist "wind" (you'll test it with a gentle fan or by blowing on it)

Success criteria:
- Building stands upright for 2 minutes with weight on top
- Does not fall when pushed gently or exposed to wind
- Uses the fewest materials possible (less waste = better design)

EDP Phase Targeted

Ask / Define Problem

This photo shows real infrastructure solving real problems (spanning water, supporting weight in a dense urban environment). Starting with "Ask" lets students observe the visible structures, wonder why they're designed this way, and identify the challenges engineers face (tall buildings sway in wind, bridges must not collapse under traffic, natural areas must be preserved). This authentic problem-identification phase motivates deeper engagement than jumping straight to building.

Suggested Materials

- Paper tubes (paper towel rolls, wrapping paper cores)
- Cardboard (cereal boxes, shipping boxes, poster board)
- Tape (masking tape, duct tape, or clear packing tape)
- String or yarn (for bracing/support)
- Weights (textbooks, sand bags, or stacked weights to represent building load)
- Optional: wooden craft sticks (popsicle sticks) or plastic straws for bridge spans

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Estimated Time

- K–2 Bridge Challenge: 45–60 minutes (including design sketch, building, and 2–3 test trials)
- 3–5 Tall Building Challenge: Two 40-minute sessions (Session 1: observe photo, sketch design, build; Session 2: test, refine, document results)

Why This Works for Teachers

This task directly addresses NGSS 3-5-ETS1-1 (Define a problem that can be solved by designing a new object or tool) and K-2-ETS1-1 (Ask questions, make observations, and gather information about a situation people want to change) by anchoring the design challenge in a real cityscape where students can see how engineers balance height, strength, and stability.