

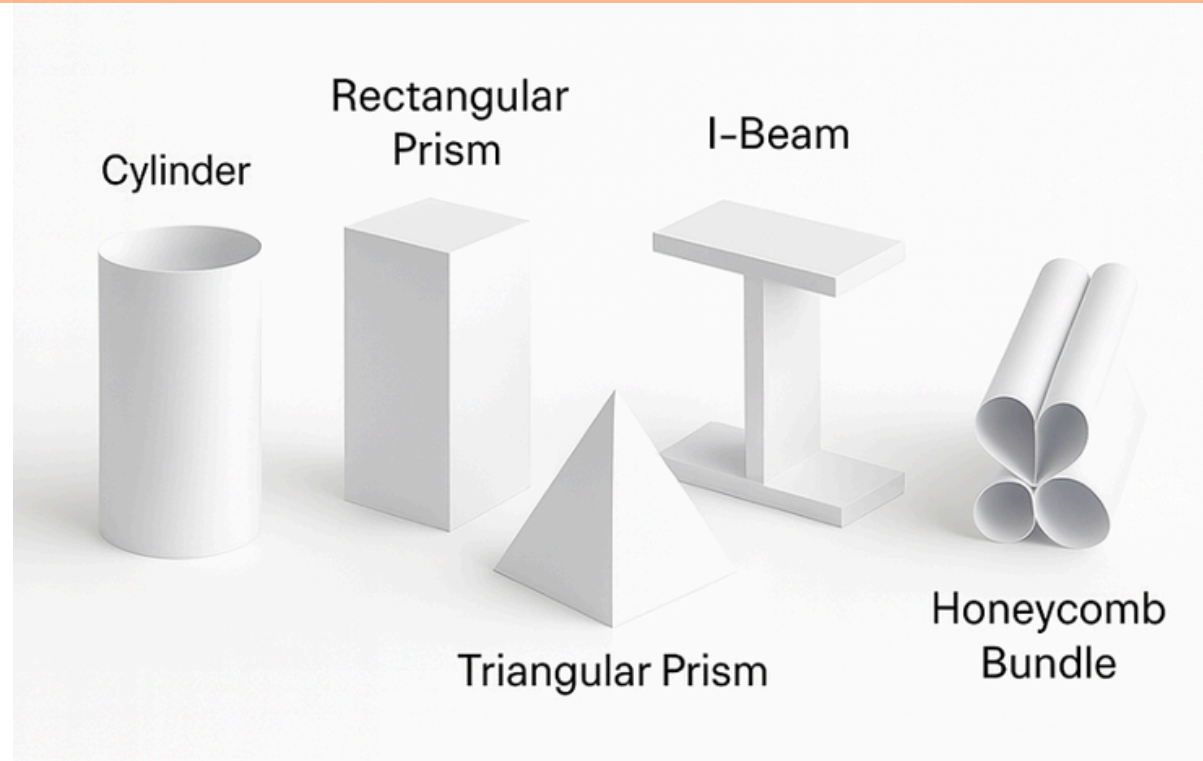
Paper Table STEM Lab

Shape and Support

Scientific Method • Variables • Data & Graphing

✓ Classroom-Ready

✓ Data tables + bar graph templates included



Paper Table STEM: Scientific Method Activity

Purpose

Perform an investigation comparing how support shape changes the maximum load a paper table can hold.

Learning Objectives

- Identify independent, dependent, and controlled variables.
- Build consistent specimens (same height, material, and tape allowance) to make a fair comparison across shapes.
- Record one measured result per shape and construct a simple comparison graph.
- Explain why some cross sections are stronger (buckling resistance, curvature).

Safety

- Load gradually; hands and faces clear as the table nears failure.
- Use only books or small weights, no standing on tables.

Materials

- Printer paper or cardstock (same type for all), Clear tape (limit 20 cm per support), scissors, ruler
- Top surface: 1 sheet of corrugated cardboard or hardcover book (same for all)
- Masses: identical books or washers to stack (same increment)

Background Science

Columns fail mainly by buckling; shapes with higher second moment of area resist buckling better. Cylinders and multi-cell bundles spread material away from the center, increasing stiffness.

Standardized Build Rules

- Support height = 10 cm for all shapes (pre-cut 10 cm strips).
- One sheet per support, ≤ 20 cm tape per support, 4 identical supports per test.
- Leg placement under tabletop; equal spacing each time.
- Load in equal steps; record the maximum mass that holds for 5 seconds.

Rectangular Prism
Cylinder I-Beam

Test Conditions (Five)

- Cylinder
- Square Column
- Triangular Prism
- I-Beam
- Honeycomb Bundle

Build Notes

- Cylinder: roll and tape
- Square Column: fold and tape
- Triangular Prism: fold and tape
- I-Beam: center w/ tape
- Honeycomb: tape

Answer Key

- Greatest load: Square 6, Triangular 5, I-Beam 4, Cylinder 3, Honeycomb 2.
- Why it was so: Multi-cell load, Curved walls, Stable footprints, delaying buckling.

Rubric

Category	4 — Exceeds	3 — Meets	2 — Approaches	1 — Beginning	0 — Not Evident
Experimental Design & Build Fidelity	All build rules followed: 10 cm height, one sheet/support, ≤20 cm tape, three identical supports, equal spacing; tabletop and loading increments standardized; clean, repeatable method.	Minor slips but fair test preserved.	Multiple inconsistencies (uneven heights, tape amounts, spacing) that may affect results.	Major inconsistencies; procedure not repeatable.	Not attempted or unsafe.
Variables & Fair-Test Controls	IV (support shape), DV (max load for 5-sec hold) and all key controls (paper type, height, tape, number/spacing, tabletop, loading increment) correctly stated and maintained.	IV/DV correct; most controls named and applied; one weak.	IV/DV partly correct; several controls missing or not applied.	Variables unclear; controls absent.	Not addressed.
Data Quality & Recording	One clear measurement per shape in consistent units; table complete; anomalies noted; legible.	All shapes recorded; units consistent; minor omissions or messiness.	One shape missing or units inconsistent; unclear notes.	Two or more shapes missing; data unreliable.	No usable data.
Graphing & Communication	Bar graph of Max Load vs Support Shape with title, labeled axes, y-axis starts at zero; accurate bars; strongest shape highlighted with value.	Graph present with title and axes; small labeling/scaling issues.	Graph present but missing key elements or hard to read.	Incorrect graph type or major errors.	No graph.
Claim—Evidence—Reasoning	Clear claim naming strongest shape; cites specific data; reasoning uses buckling/second moment/curvature or multi-cell load-sharing and connects to build rules.	Claim with data and partial reasoning.	Claim or data present; reasoning generic/weak.	Vague statement with no evidence.	No CER submitted.
Collaboration & Safety	Roles shared; slow, safe loading; workspace clear; full cleanup.	Mostly safe/organized; occasional reminders.	Uneven participation; repeated reminders needed.	Off-task or unsafe behaviors.	Unsafe / removed from activity.

Paper Table STEM (Quick Lab): Scientific Method Activity

Driving Question

How does the support shape affect the maximum load a paper table can hold?

Hypothesis

Predict which shape will hold the greatest mass and why (buckling resistance, curvature, material distribution).

Variables

Type	Describe for This Experiment
Independent Variable	Support shape (Cylinder, Square, Triangle, I-Beam, Honeycomb)
Dependent Variable	Maximum load before failure (books or kg) for a 5-second hold
Controlled Variables	Paper type; support height (10 cm); tape allowance (≤ 20 cm/support); number of supports (3); support spacing; tabletop; loading increment; room conditions

Procedure (One Trial per shape)

- Build three identical supports of the chosen shape (10 cm tall). Use four shapes under the tabletop as supporting legs.
- Add load in equal steps. Stop when any support buckles or the tabletop tilts. Record the maximum mass that held for 5 seconds.
- Repeat Step 2 for each shape.

Data Sheet

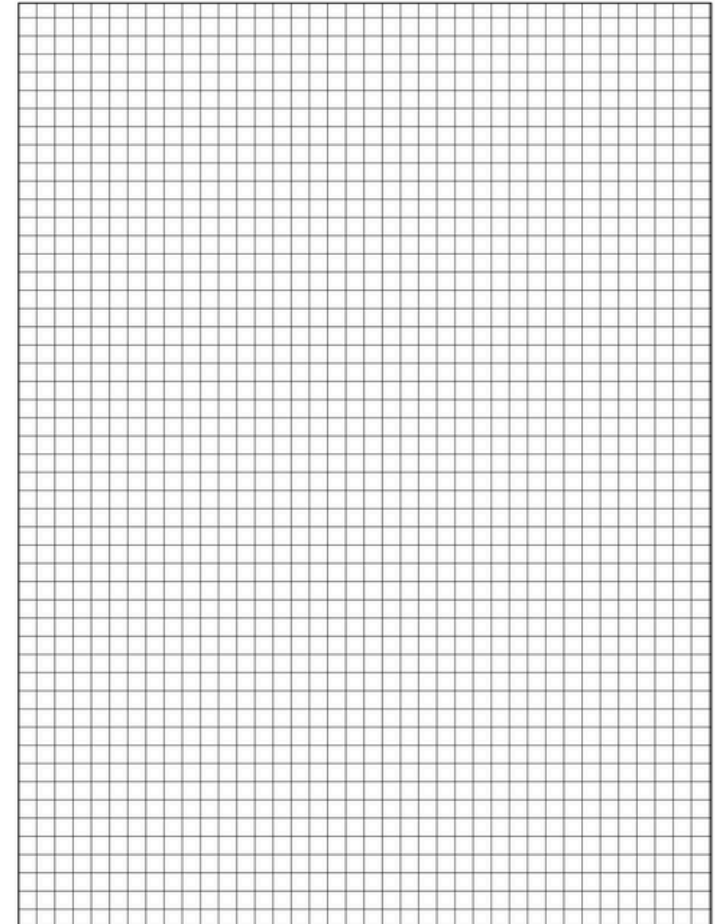
Support Shape
Cylinder
Square Column
Triangular Prism
I-Beam
Honeycomb

Quick Graph

- Create a bar graph.
- Start y-axis at zero.
- Circle the strongest shape.

Analysis Questions

- Which shape held the most mass?
- What design features contributed to its strength?



What You Get

- **Teacher Guide:** setup, safety, pacing, build rules, and background science.
- **Student Packet:** clear, step-by-step build/setup instructions and a one-trial data sheet for up to 5 support shapes.
- **Printable Build Aids:** fold/trace guides for Cylinder, Rectangular Prism (Square Column), Triangular Prism, I-Beam, and Honeycomb Bundle.
- **Summary & Graphing Pages:** comparison table and bar-graph template (Max Load vs Support Shape) with printable graph paper.
- **Analysis & Model Answers:** sample data reflecting the expected trend plus exemplar responses to the analysis prompts.
- **Rubric & Extensions:** detailed 24-point rubric.