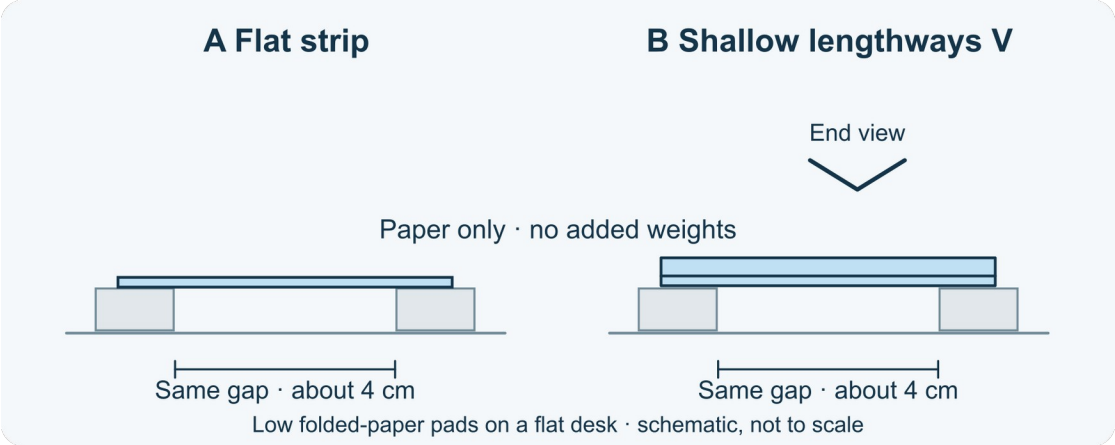
What can one fold change

How can I compare two paper shapes without claiming more than I tested?

Sketch or compare a flat paper strip and the same strip with a shallow fold. Define a small observation before drawing a conclusion.

Make | 15–25 minutes, or two labelled sketches | Three small pieces of scrap paper, Pen or pencil, Optional ruler; approximate sizes are sufficient

Start here Sketch a paper strip resting across two folded-paper pads on a flat desk. Label a gap of about 4 cm between the pads. You can complete the whole activity as a drawing.



Same paper and gap, different cross-section

1 Choose a small comparison

If making the model, fold two paper pieces into matching low pads, less than 1 cm high, on the same flat desk. Leave a gap of about 4 cm. Lay an approximately 8-by-4 cm paper strip across them with both ends supported. Use paper only and add no objects or weights.

2 Define the observation

Version A is flat. Before trying it, choose what to notice: whether the middle stays clear of the desk or touches it during a slow count of five. Record what happens, or leave the result unknown if you are sketching.

3 Change the shape

Use the same strip. Fold it once along its long centre line, then open it into a shallow V. Rest its ends on the same pads with the same gap. Keep the paper and supports unchanged; observe the same thing, with no added load.

4 Write a limited conclusion

Describe both versions, including an unchanged or uncertain result. Explain what you changed and what would need a different test. A paper model is not a design for a bridge anyone can use.

Fictional example two clear gaps

This is an invented recording example, not an experiment Horizon performed. It shows how an unchanged result can still be recorded honestly.

• A: flat strip; the fictional record says its middle stayed clear of the desk for a count of five.

• B: the same strip with a shallow lengthways V; the fictional record also says its middle stayed clear.

• The paper, pads and gap stayed the same. Only the strip's shape changed; the example shows no difference on this chosen observation.

What this example can show Neither entry establishes load capacity or a strongest design. Paper type, dimensions and observations matter; your model may behave differently.

A different way

Compare only the supplied sketches and fictional record. Describe the change or direct someone to add labels; construction is optional.

If you want to go further

Draw an alternative fold and predict what might change. Plan a comparison with the same paper and gap; no weights, larger structures or testing to failure are part of this activity.

Something to notice

Did my conclusion stay within the observation I actually made?

Read or explore more

Horizon topic Engineering

https://launchhorizonhq.com/learn/engineering/

Horizon topic Structures Bridges

https://launchhorizonhq.com/learn/structures-bridges/

Horizon topic Materials Constraints

https://launchhorizonhq.com/learn/materials-constraints/

TeachEngineering, University of Colorado Boulder Engineering Design Process

https://www.teachengineering.org/popular-topics/engineering-design-process

TeachEngineering, University of Colorado Boulder Bridge Types: Tensile & Compressive Forces

https://www.teachengineering.org/activities/cub_brid_lesson01_activity1

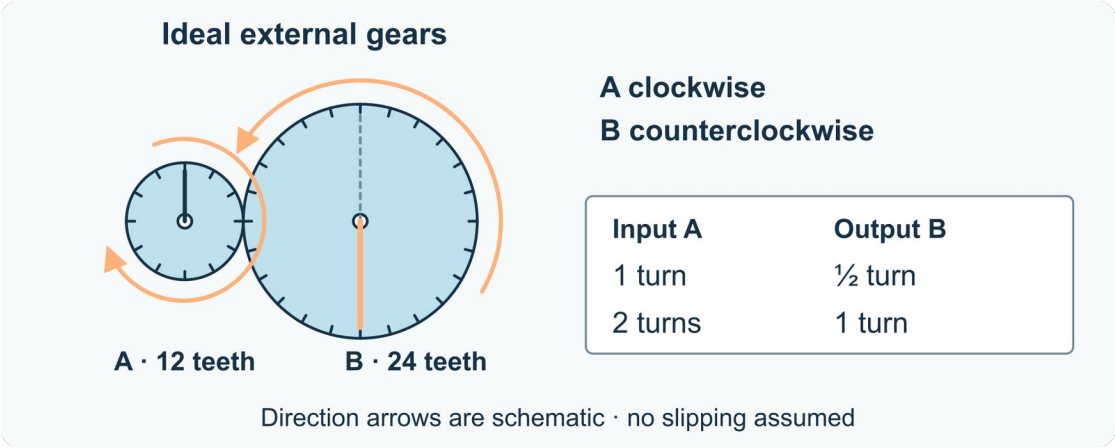
Explain an invented mechanism

How can a sequence of labelled drawings show where motion goes?

Trace the input and output of a fictional two-gear display without building a machine.

Investigate | 10-20 minutes, or one small comparison | Scrap paper and a pencil or pen, The supplied original model; no account, purchase or online search needed

Start here Draw two touching circles. Label the smaller input A: 12 teeth, and the larger output B: 24 teeth.



One input turn becomes half an output turn

1 Name the input

Choose which gear a fictional handle turns. Mark A with an arrow; this example uses clockwise input.

2 Follow the contact

For two external gears that mesh without slipping, the second turns in the opposite direction. Mark B counterclockwise.

3 Track a turn

One turn of A passes 12 teeth through the contact. That moves 12 of B's 24 teeth: half a turn. Show the same starting mark on a second sketch.

4 Explain the model

Add an input-to-output caption. Keep your explanation to direction and turns; the sketch does not prove a real mechanism will work.

Original model a rotating sign

These are ideal external gears in an invented desk-display drawing, not tested hardware.

• A has 12 teeth; B has 24. Their sizes and tooth counts stay fixed.

• A turns clockwise once; B turns counterclockwise half a turn.

• Two turns of A would move B through one complete turn.

What this example can show The model assumes gears mesh without slipping. It does not calculate friction, strength or the force needed.

A different way

Trace the contact with a finger, point to the labelled arrows, or describe the turns while someone else marks them.

If you want to go further

Draw an equal-sized third gear touching B. Work out its direction and turns before changing the drawing.

Something to notice

Which claim follows from the tooth counts, and which claim would require a real test?

Read or explore more

Horizon topic Mechanisms Machines

https://launchhorizonhq.com/learn/mechanisms-machines/

Horizon topic Engineering Drawings

https://launchhorizonhq.com/learn/engineering-drawings/

Horizon topic Engineering

https://launchhorizonhq.com/learn/engineering/

TeachEngineering, University of Colorado Boulder Get in Gear

https://www.teachengineering.org/activities/nyu_getingear_activity1

OpenStax, Rice University Simple Machines

https://openstax.org/books/physics/pages/9-3-simple-machines

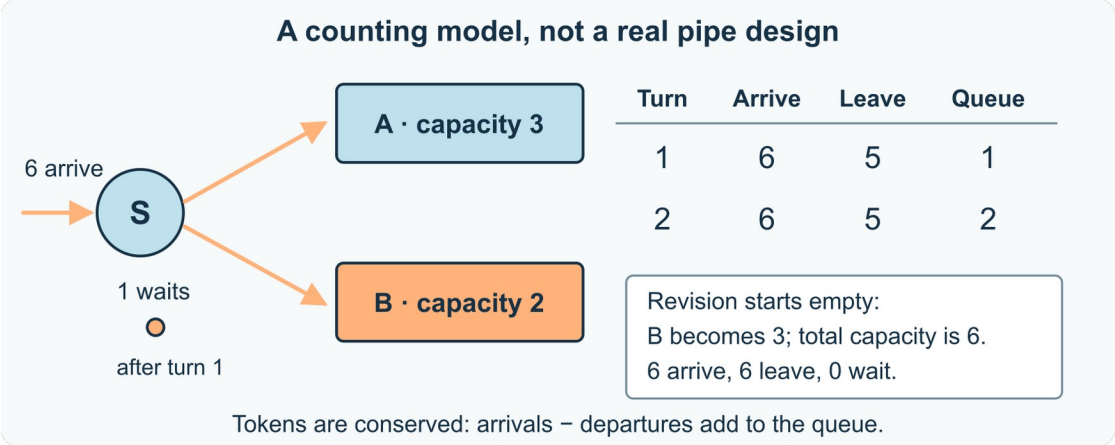
A flow network on paper

What does a branching network allow, and where could a bottleneck appear?

Use drawn tokens to explore a branching network with a limited capacity.

Investigate | 10–20 minutes, or one small comparison | Scrap paper and a pencil or pen, The supplied original model; no account, purchase or online search needed

Start here Draw a source S feeding two branches A and B. Write: six tokens arrive each turn.



Six arrive; five can leave

1 State the rules

Branch A can pass at most three tokens per turn; B can pass at most two. Tokens do not disappear or jump a branch.

2 Trace one turn

Send six tokens to S. Move three along A and two along B. Mark the remaining token as waiting at S.

3 Trace another turn

Add six new tokens. There are now seven waiting or arriving; five can leave. Two remain. Record arrivals, departures and the queue.

4 Change one limit

Raise B's capacity to three in a fresh model. From an empty start, all six incoming tokens can leave each turn. Explain the difference.

Original model two display channels

The tokens and turns are invented counting units, not measurements from a water system.

• Original limits: 3 + 2 = 5 departures for 6 arrivals; one token is left after turn 1.

• Turn 2 starts with 1 waiting plus 6 new tokens. Five leave and 2 remain.

• With B changed to 3, total capacity is 6. An empty-start turn has 6 arrivals, 6 departures and no queue.

What this example can show Real water networks involve pressure, losses and other constraints. A token model cannot establish safe pipe sizes or real flow rates.

A different way

Use six small pencil marks, move imagined tokens aloud, or ask a partner to record your counts. No counters are required.

If you want to go further

Choose an incoming rate of four tokens per turn. Describe more than one valid split that stays within both branch limits.

Something to notice

Did I keep every token accounted for?

Read or explore more

Horizon topic Water Networks

https://launchhorizonhq.com/learn/water-networks/

Horizon topic Feedback Control

https://launchhorizonhq.com/learn/feedback-control/

Horizon topic Engineering

https://launchhorizonhq.com/learn/engineering/

OpenStax, Rice University Flow Rate and Its Relation to Velocity

https://openstax.org/books/college-physics-ap-courses/pages/12-1-flow-rate-and-its-relation-to-velocity

TeachEngineering, University of Colorado Boulder Engineering Design Process

https://www.teachengineering.org/popular-topics/engineering-design-process