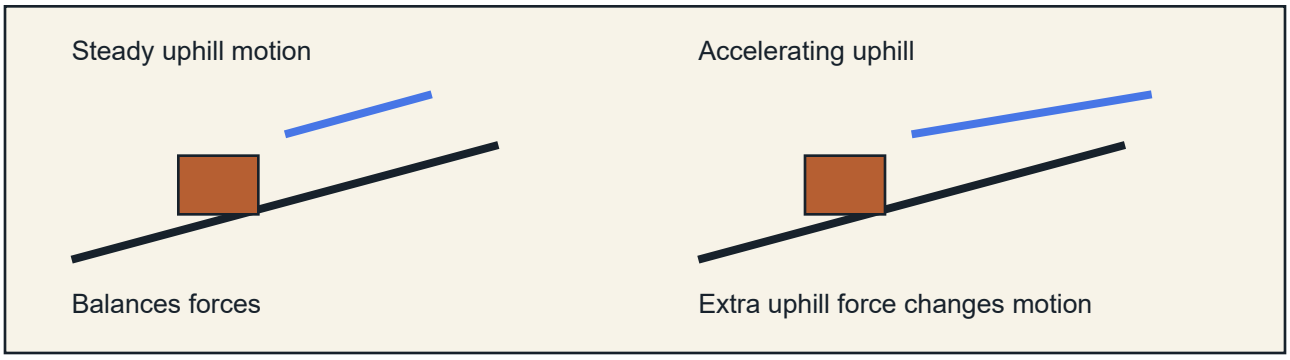
Why Did the Luggage Scale Readings Wander?



Question: Why Did the Luggage Scale Readings Wander?

What you can explain: Explain two ways the pull itself can change and distinguish that from uncertainty in measuring it.

The books are the same. The board is the same. Why would the number move?

A scale in the pulling connection measures tension: the pull along that connection. That is not automatically the load's weight, or just gravity's pull down the ramp.

If you speed the load up uphill, your pull must also change its motion. With other forces unchanged, that takes more tension than steady motion. Slowing it can reduce the required tension. A changing reading can therefore reflect a real changing force, even with a working instrument.

Same load. Same slope.

Steady motion ->

Uphill pull balances downhill forces.

Speeding up uphill ->

Extra uphill force changes motion.

Concept comparison - no measured readings.

Pull direction matters too. If the strap tilts away from the board, the scale still reads along the strap; only part of that pull acts along the slope. Contact resistance may change as wheels meet different parts of a board. These are possible causes, not a diagnosis of Quinn's unrecorded readings.

Measurement has uncertainty too: the indicated value does not tell you the force with unlimited precision. But a moving number alone cannot tell you how much came from instrument uncertainty and how much from a changing pull. You would need evidence about the setup and the actual instrument.

Try the reasoning

You compare two ramp lengths. In one trial you tug sharply; in the other you pull steadily. Can the readings isolate the effect of length? What would you keep alike?

Answer guidance

No. The motion changed too. Keep load, rise, surface and pulling direction alike, and compare repeated steady-moving portions. Accept explanations that identify the changed acceleration. Repetition helps compare conditions; averaging different kinds of motion does not make them equivalent.

https://thisworldexplained.com/okay-but/fair-repeated-trials/

This is a thought comparison, not a request to pull heavy loads. For extra practice with controlling a comparison, Fair, Repeated Trials addresses a different question: comparing repeated releases.

The question behind this lesson

https://thisworldexplained.com/okay-but/the-long-way-up/#scale-readings

Return to Quinn’s question in The Long Way Up: his luggage-scale readings wandered as he compared boards. This lesson explores what might change a pull; the story does not settle which cause produced each reading.

https://thisworldexplained.com/okay-but/

Sources

https://openstax.org/books/university-physics-volume-1/pages/6-1-solving-problems-with-newtons-laws

Newton’s laws and tension

https://webhome.phy.duke.edu/~kolena/physics/labs/a7sfrict.htm

Duke-hosted friction lab: direction and motion phase

https://www.nist.gov/glossary-term/39291

NIST glossary: measurement uncertainty

Print source: OBML-008 candidate_v1. Optional lesson, no experiment required.

If the Work Stays the Same, Why Does a Ramp Help?

Same 40 lb weight, 2 ft rise - ideal calculation

8 ft sloping route	16 ft sloping route
10 lb x 8 ft = 80 ft-lb	5 lb x 16 ft = 80 ft-lb

Steady parallel pull; negligible resistance. Smaller force, longer travel.

Question: If the Work Stays the Same, Why Does a Ramp Help?

What you can explain: Explain how a ramp can reduce the force needed while preserving ideal work for the same load and rise.

A heavy box has to reach a higher surface. You cannot sustain the force needed to lift it straight up. Why would a ramp help if the work stays the same?

Force is a push or pull. Work counts force acting through distance in its direction. They answer different questions: how hard must you pull, and over how far?

The load’s weight still points down. The ramp supports it, so your uphill pull balances the part of gravity along the slope, plus resistance. Make the route gentler at the same height and that climbing part becomes smaller.

Same 40 lb weight. Same 2 ft rise.

Calculated: steady pull along slope, negligible resistance. Pounds are force.

Here is a hypothetical capability limit: suppose someone can sustain a 6-pound pull along either route. The 10-pound requirement is beyond that limit; the 5-pound requirement is within it. A longer route can make this ideal job manageable. That does not predict a particular person’s fatigue or ability to use a wheelchair.

The payment is distance. Half the force over twice the travel gives the same ideal work: 5 × 16 = 10 × 8 = 80 foot-pounds. Real resistance adds work. Space, surface and the user’s needs can change which route is useful. Equal ideal work does not mean equal ease, speed or tiredness.

Try the reasoning

A longer ramp would lower the ideal force, but its end blocks a doorway. Has the calculation proved it is the better route? Explain.

Answer guidance

No. It answers the ideal force question, not the whole layout question. The route still needs usable space and access. Accept another workable layout or a decision to seek a different solution; do not assume turns remove landing and width requirements.

https://thisworldexplained.com/okay-but/force-what-are-you-asking-the-pull-to-do/

Unlike the Force micro-lesson, this lesson focuses on force through distance. It is an uphill lifting comparison, not a prediction of a rolling object’s finishing speed.

See it in action

https://thisworldexplained.com/okay-but/the-long-way-up/#force-distance-work

The Long Way Up: Quinn compares the same load and rise on longer boards, then makes room for a gentler access route instead of shortening it to fit.

https://thisworldexplained.com/okay-but/

Sources

https://openstax.org/books/college-physics-2e/pages/9-5-simple-machines

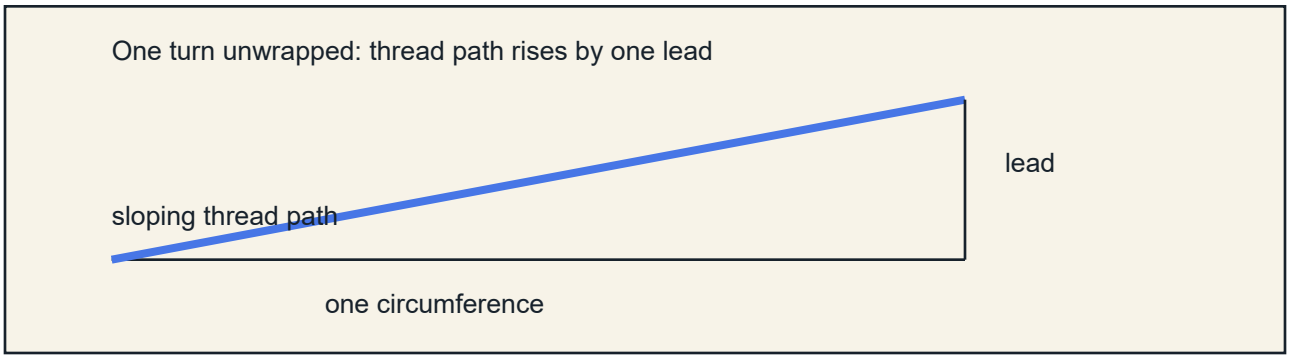
OpenStax: ideal work and simple machines

https://www.pa.uky.edu/sciworks/FME/fme/truck4.htm

University of Kentucky: incline force and sloping distance

Print source: OBML-009 candidate_v1. Optional lesson, no experiment required.

How Is a Screw a Ramp?



Question: How Is a Screw a Ramp?

What you can explain: Explain how one turn follows a helical path and how lead connects rotation to axial advance in a mating screw-and-nut model.

A screw turns in a circle. Its thread climbs around the shaft. Where is the ramp?

Imagine unwrapping one turn of a thread from a cylinder. The curved path becomes a sloping line. Across the flat picture is one trip around the cylinder; up the picture is the distance the thread advances along the shaft in one turn. That advance is called lead.

One turn, unwrapped

Sloping line = thread path. Model not to scale.

Turn screw (turn) + engaged nut held from turning -> axial advance.

A loose screw spinning in the air does not climb through space. It needs matching engagement. In a simple screw-and-nut model, hold the nut from turning and rotate the screw: their relative rotation makes them advance along each other.

Pitch is the spacing along the shaft between neighboring threads. With one continuous thread, called single-start, pitch equals lead. With multiple starts, one revolution advances farther: lead equals pitch multiplied by the number of starts.

Turning effort is described by torque, the turning effect of a force. It is different from the force along the shaft. In an ideal comparison, a smaller lead requires less torque for the same axial force, but more turns for the same advance. The turning journey pays for the small forward movement.

Real thread friction increases input effort. Whether a screw resists turning backward depends on its geometry and friction, including lubrication; “all screws lock themselves” is not a safe rule. This model does not establish a fastener’s holding strength or explain cutting a thread into wood.

Try the reasoning

Two otherwise comparable ideal single-start screws have different leads. The smaller-lead screw must move the same axial load the same distance. What does it trade for less required torque?

Answer guidance

More turns. Each turn advances less, so the same journey needs more revolutions. Accept “a longer turning journey” with that explanation. Do not equate torque with axial force, or assume less torque means less ideal work.

Think about a screw-operated clamp; do not test a loaded mechanism or use sharp screws or tools for this comparison.

The question behind this lesson

https://thisworldexplained.com/okay-but/the-long-way-up/#screw-question

Return to Quinn’s screw question in The Long Way Up: he notices the thread climbing around the shaft. This lesson follows that question into a screw-and-nut model.

https://thisworldexplained.com/okay-but/

Sources

https://www.grc.nasa.gov/www/k-12/Summer_Training/KaeAvenueES/The_Screw.html

NASA Glenn: wrapped inclined-plane geometry

https://www.thomsonlinear.com/en/support/tips/difference-between-screw-pitch-and-lead

Thomson: pitch, lead and starts

https://www.thomsonlinear.com/downloads/screws/Lead_Screws_cten.pdf

Thomson lead-screw catalog: torque and friction limits

Print source: OBML-010 candidate_v1. Optional lesson, no experiment required.