SPRING LAUNCH UP A CURVED RAMP

Elastic energy, gravitational potential energy, and turning-point height

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **Is maximum vertical height proportional to the square of spring compression?**

TIME 30 minutes	SIMULATION BuildPhysics > Spring launch up a curved ramp	UNIT 3 Work, Energy & Power

Learning targets

- Track energy from a compressed spring to a gravitational turning point.
- Test the relationship between compression squared and maximum height.
- Determine how projectile mass changes the turning-point height.

Model before you measure

The projectile begins from rest against the launcher and momentarily stops at its highest point. Friction and drag are off.	$\frac{1}{2}kx^2 = mg\Delta h$ $\quad \Delta h = kx^2/(2mg)$

Important: Use g = 9.8 m/s². Measure Δh from the projectile's starting center to its maximum center height.

Pre-lab prediction | 4 minutes

1. If compression doubles, by what factor should maximum vertical rise change?

_____

2. At the turning point, what are the projectile's kinetic energy and speed?

_____

3. Predict how doubling mass affects maximum rise at fixed compression.

_____

PART A Change compression and measure maximum rise

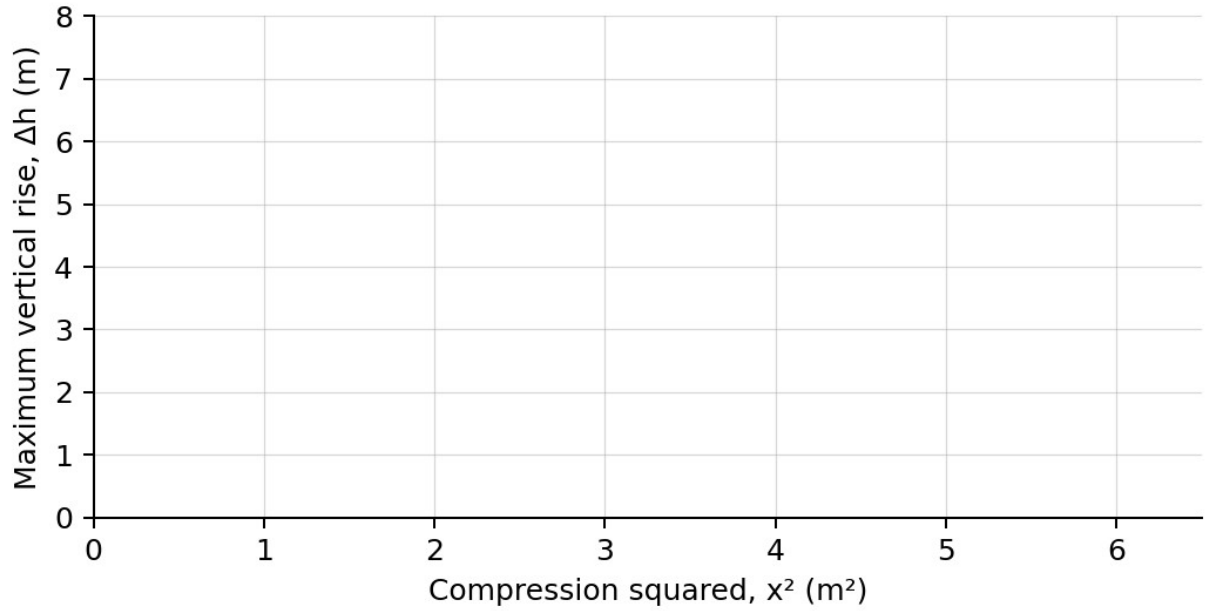
Setup | 3 minutes

- ☐ Load Spring launch up a curved ramp. Confirm friction is off.
- ☐ Select the launcher and record k. Set each compression by changing natural length.
- ☐ Graph y-position, kinetic energy, spring energy, and gravitational potential energy.
- ☐ Reset, run until the projectile turns around, pause, and record the maximum center height.

Measurement: Record the initial center height once, then calculate Δh = y_max − y_initial for each trial.

Data table | 10 minutes

Compression x (m)	x² (m²)	Spring energy (J)	Maximum y (m)	Vertical rise Δh (m)
0.75				
1.25				
1.75				
2.25				



4. Plot maximum vertical rise versus compression squared. Draw a best-fit line.

PART B Change mass at fixed compression

Mass test | 7 minutes

Fixed input: Use x = 1.75 m and keep k and the ramp geometry unchanged.

Mass (kg)	Predicted Δh (m)	Measured Δh (m)
2.5		
5.0		
7.5		
10.0		

Analysis | 7 minutes

5. What relationship did your graph show between Δh and x^2?

6. What physical quantity should the graph's slope represent?

7. How did mass affect maximum height at fixed compression?

8. Describe the energy transformations from release to the turning point.

Claim-Evidence-Reasoning conclusion

Evaluate this claim: Maximum vertical rise is directly proportional to spring compression.

CLAIM	Accept, reject, or revise the statement.
EVIDENCE	Cite at least two measured trials or graph features.
REASONING	Connect your evidence to the energy model and controlled variables.

Exit ticket

A launcher with the same k fires the same mass with twice the compression. Predict the new maximum vertical rise relative to the original.