SPRING-LAUNCHED PROJECTILE

Elastic potential energy, launch speed, and projectile range

Name: _____	Period: _____	Date: _____

INVESTIGATION QUESTION **Is horizontal range directly proportional to spring compression?**

TIME 30 minutes	SIMULATION BuildPhysics > Spring-launched projectile	UNIT 3 Work, Energy & Power

Learning targets

- Relate spring compression to elastic potential energy and launch speed.
- Test how compression changes horizontal projectile range.
- Separate the launch-energy stage from the projectile-motion stage.

Model before you measure

The launcher has spring constant k and compression x. The projectile leaves the table horizontally. Use the custom h = 0 reference shown in the preset.	$U_s = \frac{1}{2}kx^2$ $\frac{1}{2}kx^2 = \frac{1}{2}mv^2$ $R = v_x t$

Important: Use g = 9.8 m/s². Keep mass, k, table height, and launch height constant in Part A. Reset before each run.

Pre-lab prediction | 4 minutes

1. If compression doubles, by what factor does the spring's stored energy change?

_____

2. Predict how launch speed depends on compression.

_____

3. Predict whether flight time changes when only compression changes.

_____

PART A Change spring compression

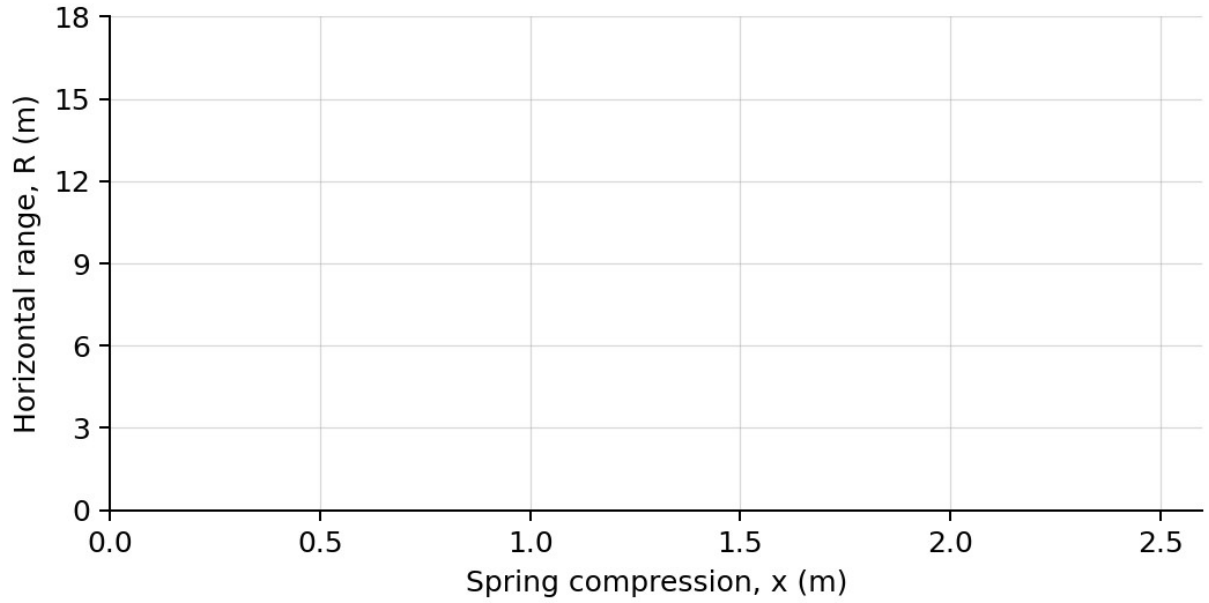
Setup | 3 minutes

- ☐ Load Spring-launched projectile. Confirm friction is off and the projectile mass is 5.0 kg.
- ☐ Select the launcher and record k. Change the natural length to create the listed compression.
- ☐ Graph speed and horizontal position. Turn on Energy and momentum totals.
- ☐ Reset, run through the landing, and record the table-edge speed, flight time, and horizontal range.

Consistent trials: Measure compression immediately before release. Use the same table edge and landing-height reference in every trial.

Data table | 10 minutes

Compression x (m)	x^2 (m^2)	Spring energy (J)	Edge speed (m/s)	Flight time (s)	Range R (m)
0.75					
1.25					
1.75					
2.25					



4. Plot horizontal range versus compression. Draw a best-fit line.

PART B Change mass at fixed compression

Mass test | 7 minutes

Fixed input: Choose one compression from Part A and keep k and the table geometry unchanged.

Projectile mass (kg)	Measured edge speed (m/s)	Measured range (m)
2.5		
5.0		
7.5		
10.0		

Analysis | 7 minutes

5. Was range directly proportional to compression? Use your graph and at least two trials.

6. Why was flight time approximately constant in Part A?

7. How did increasing mass affect edge speed and range at fixed compression?

8. Explain why the energy equation predicts v is proportional to x when k and m are constant.

Claim-Evidence-Reasoning conclusion

Evaluate this claim: Doubling spring compression doubles the projectile's horizontal range.

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 spring is compressed three times as far while k, mass, and table height stay fixed. Predict the factors by which spring energy, launch speed, and range change.