PHET LAB: ENERGY SKATE PARK — DAY 9

See conservation of energy in action. Part 1: Ideal World (No Friction).

☐ Setup

Open the simulation:

```
phet.colorado.edu/en/simulation/energy-skate-park-basics
```

Turn ON:

- Bar Graph
- Speed display
- Grid (optional but helpful)

Keep OFF: Friction (for now)

PhET Energy Skate Park showing energy bars and skater position

What the bars mean:

- **Blue bar (K)** = Kinetic energy
- **Green bar (U)** = Gravitational PE
- **Total** = Mechanical Energy

PREDICT Before You Run

A skater starts from rest at height h with no friction. What happens to the bar chart as they roll down?

PART A: BASIC OBSERVATIONS

SIM A1: Release and Watch

Place the skater at rest on the left side, fairly high up. Release. Watch the bar graph.

Position	K bar	U bar	Total
Top (start)			
Bottom (fastest)			
Other side (high)			

Does the skater reach the same height on the other side? __________

SIM A2: Change the Mass

Use the slider to change the skater's mass. Release from the *same height*.

Does the skater still reach the same height on the other side?

What happens to the speed at the bottom?

PART B: THE KEY INSIGHT — PATH DOESN'T MATTER

SIM B1: Same Height, Different Path

Try two different tracks (use the track builder or switch tracks). Release the skater from the **same height** on each.

Track Shape	Release Height	Speed at Bottom
Steep / short path	________ m	________ m/s
Gentle / long path	________ m	________ m/s

Conclusion: The speed at the bottom depends on ______________, not on ______________.

WHY THIS WORKS

Energy conservation says: $mgh_i = \frac{1}{2}mv_f^2$ (when starting from rest).

The equation has no term for "path length" or "steepness." Only **vertical height** matters.

This is the power of energy methods: they let you skip the details of the journey.

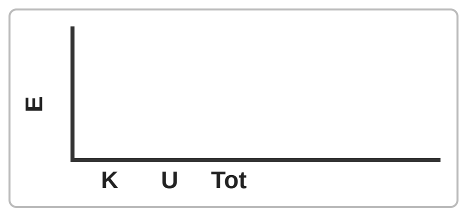
DRAW B2: Bar Charts at Three Moments

Sketch the energy bars for a skater released from rest at height h. Friction OFF.

Start (top, at rest)

Middle (bottom, fastest)

End (other side, stopped)



SIM B3: Check the Math

Use the simulation to get real numbers. Release from rest at a specific height.

Your data:

Release height: $h =$ __________ m

Speed at bottom: $v =$ __________ m/s

Check with equation:

$v = \sqrt{2gh} = \sqrt{2(9.8)(\_\_\_\_)} =$ __________ m/s

Does it match? __________

Common confusion: Students sometimes think "longer path = more speed" because "more time to accelerate." Energy methods show this is wrong—only height matters (when friction is off).

PART C: PUTTING IT TOGETHER

SIM **C1: The Loop**

Use a track with a loop. Find the **minimum release height** that lets the skater complete the loop without falling off.

Trial	Release Height	Completes Loop?
1	_________ m	Yes / No
2	_________ m	Yes / No
3	_________ m	Yes / No

Minimum height that works: approximately __________ m

Why can't you start from too low? (Think about speed at the top of the loop.)

WRITE **C2: Explain Like a Physicist**

Complete this explanation (use energy language):

"When friction is off, the skater always returns to the same height because..."

Up Next: In the real world, skaters eventually stop. Why? Because mechanical energy is not conserved when non-conservative forces act. Next, we turn friction on.

PART D: WITH FRICTION ON

OBSERVE Turn Friction ON & Watch

Release the skater from a high point. Watch the bar chart.

1. Does skater return to original height?

   ____

2. Does the **Total Energy** bar change size?

   ____

3. What is the new Red/Orange bar?

   ____

Sketch Final Chart (stopped)

ENERGY IS STILL CONSERVED

Total energy is **still conserved**. With friction on, some mechanical energy (K and U) is transferred to **thermal** energy; the total bar height never changes.

SIM Path Matters (Again)

Experiment: Create two tracks that drop the same height h. Turn friction ON.

- **Track A:** Straight steep drop.
- **Track B:** Long, shallow ramp.

Release skater from the top. **Which skater has more speed at the bottom?**

Explain: Why does the path length matter when friction is ON?

EXIT Exit Ticket

1. With friction OFF, if you double the height, does speed double? (Hint: $v \propto \sqrt{h}$)

2. With friction ON, where does the "missing" kinetic energy go?

3. True or False: "Total energy decreases when friction is on." Explain.