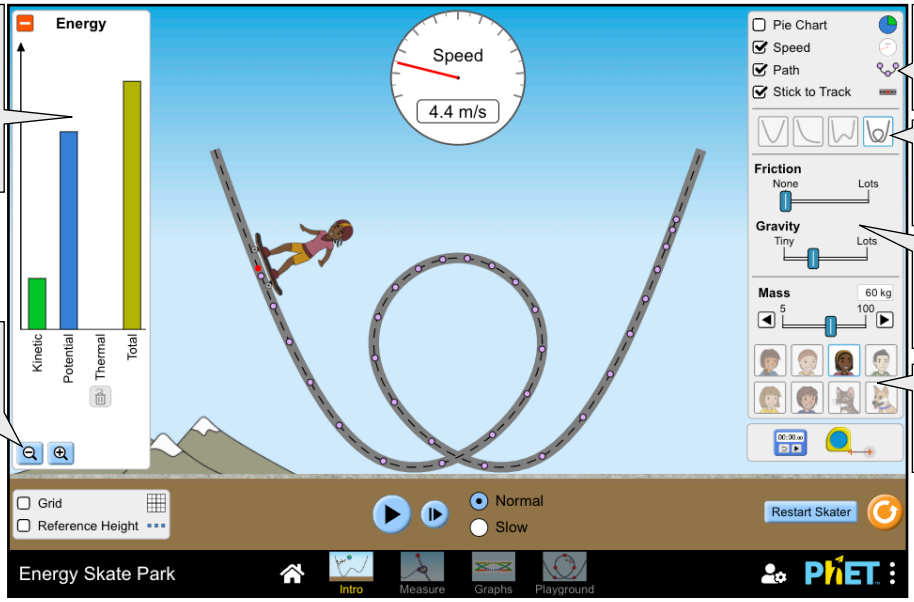
Energy Skate Park

Intro Screen

Explore different tracks and skaters, and investigate the relationship between the kinetic energy, potential energy, and thermal energy. Measure the speed and adjust the friction, gravity, and mass.

OBSERVE the energy in the system in real time

ZOOM to adjust scale



DRAW dot along path every 0.1s

EXPLORE different tracks

ADJUST friction and gravity

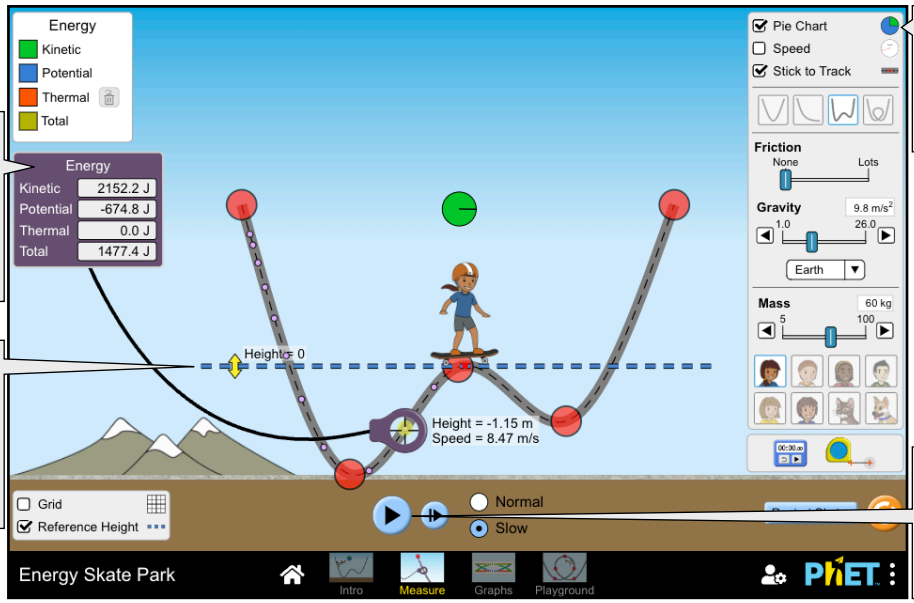
SELECT skater; **SET** their mass

Measure Screen

Measure the energy at points along the skater's path. Experiment with different tracks and adjust the shape of the track by dragging the control points.

MEASURE the energy at the dots along the path

SET the reference point for gravitational potential energy



VIEW the skater's energy in a pie chart

PAUSE to facilitate measurement

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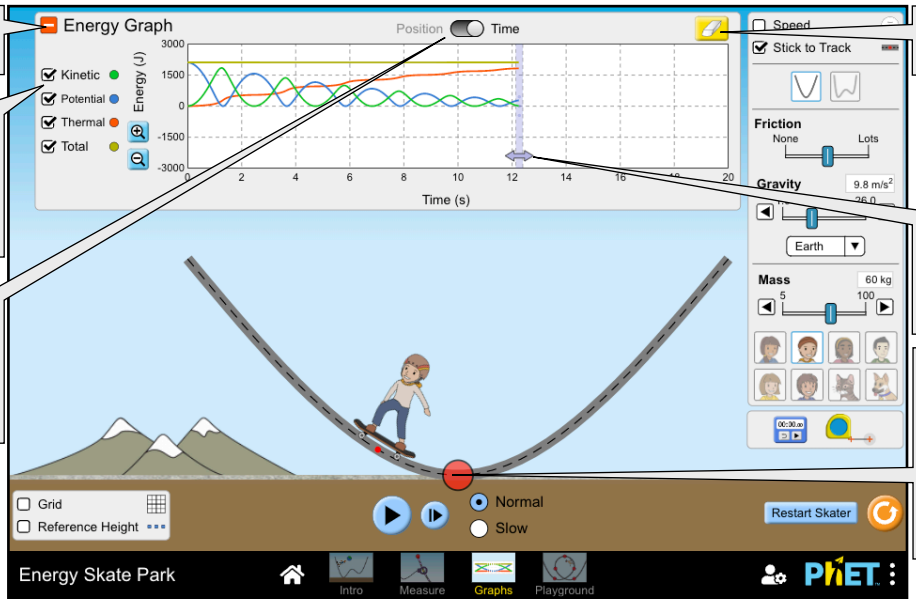
Graphs Screen

Plot the skater's energy vs. position or time, and explore the conservation of energy. Drag the control points on the track to alter its shape.

HIDE the graph

SELECT the data to display in the graph

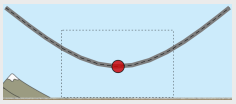
PLOT the energy vs. position or time



CLEAR data

DRAG tracer to replay data

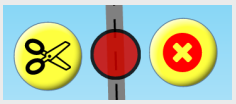
ADJUST the depth of the well



Playground Screen

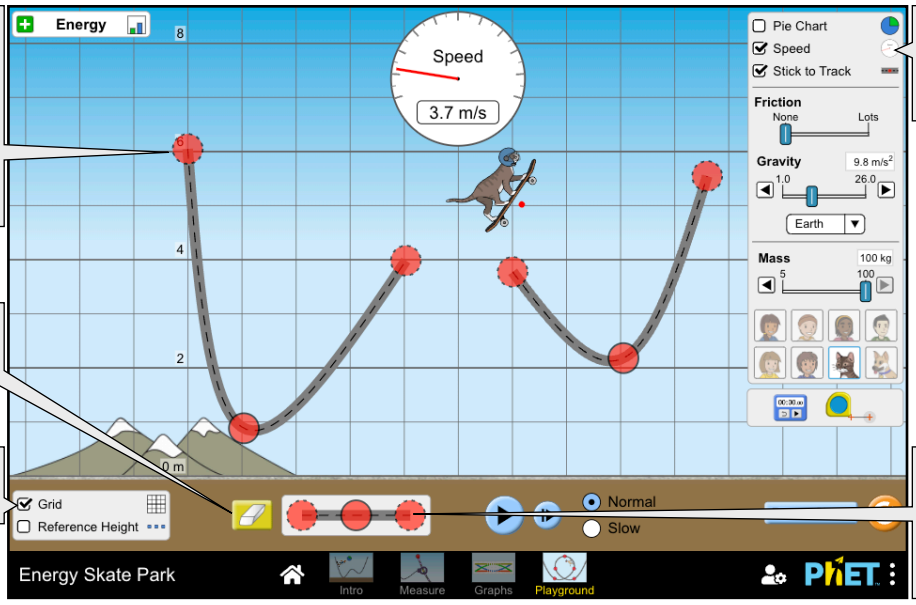
Build your own custom tracks, ramps, and jumps for the skater.

CLICK to edit the track



CLEAR the track

VIEW the grid



MEASURE the skater's speed

DRAG pieces up to build a custom track

Complex Controls

- When the skater exits the screen, two additional return skater buttons appear on the screen. Clicking on either button will return the skater to the location of the button. The green button appears where the skater was most recently released, and the red button appears on the ground at the skater's starting position.

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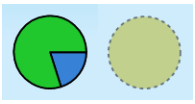
- The pie chart cannot display negative values. When the potential energy is negative, the pie chart displays only the total energy (right).
- The Stick to Track checkbox is on by default on all screens. When on, the track has a dashed midline. When off, the track midline is solid and the skater can fall off.



Customization Options

Query parameters allow for customization of the simulation, and can be added by appending a '`?`' to the sim URL, and separating each query parameter with a '`&`'. The general URL pattern is:
`…html?queryParameter1&queryParameter2&queryParameter3`

For example, in Energy Skate Park, if you only want to include the 1st and 2nd screens (`screens=1,2`), with the 2nd screen open by default (`initialScreen=2`) use:
https://phet.colorado.edu/sims/html/energy-skate-park/latest/energy-skate-park_all.html?screens=1,2&initialScreen=2

To run this in Spanish (`locale=es`), the URL would become:
https://phet.colorado.edu/sims/html/energy-skate-park/latest/energy-skate-park_all.html?locale=es&screens=1,2&initialScreen=2

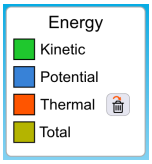
⚙ Indicates this customization can be accessed from the Preferences menu within the simulation.

Query Parameter and Description	Example Links
⚙ `altAccelerationUnits` - displays the units of acceleration due to gravity in N/kg. The units can also be toggled within the Preferences menu.	`altAccelerationUnits`

`screens` - specifies which screens are included in the sim and their order. Each screen should be separated by a comma. For more information, visit the Help Center.	`screens=1`
	
	`screens=2,1`

`initialScreen` - opens the sim directly to the specified screen, bypassing the home screen.	`initialScreen=1` `initialScreen=3`
`locale` - specify the language of the simulation using ISO 639-1 codes. Available locales can be found on the simulation page on the Translations tab. Note: this only works if the simulation URL ends in "_all.html".	`locale=es` (Spanish) `locale=fr` (French)
⚙ `regionAndCulture` - Select the portrayal of people, places, or objects in the sim. Images are not intended to represent the entire diversity of a region or culture. Possible values: `usa`, `africa`, `africaModest`, `asia`, `latinAmerica`, `oceania`	`latinAmerica`
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`

Insights into Student Use



- Students may not notice or use the remove heat button located in the bar graph and pie chart. This feature is particularly useful to remove the heat that is created by the skater's initial collision with the track when the goal is to consider only the PE and KE in a frictionless environment.
- When setting up an experiment, it may be helpful to first pause the simulation. The step forward button is a good way to incrementally analyze.
- The path dots are drawn every 0.1s and are cleared when the skater turns around. When collecting data on the Measure Screen, pause the simulation before the path dots are cleared.

Suggestions for Use

Sample Challenge Prompts

- Determine the factors that affect the skater's kinetic, potential, and thermal energy.
- Explain the Conservation of Mechanical Energy.
- Design an experiment to determine the relationship between kinetic energy and speed.
- Determine where along the track most of the energy get transferred to thermal energy.
- Compare the skater's energy for various reference heights. What changes? What stays the same?
- Build a track with a loop that the skater can complete.

Clicker Questions

- Match the skater's energy pie chart with their location on the track.
- If the skater's kinetic energy is getting larger, determine the direction of their motion.
- Determine if the skater can make it over a hill (or around a loop) given their starting position.

Model Simplifications

- When the skater lands on the track, the vertical component of their kinetic energy is converted to thermal energy. You can do experiments where there is no loss to thermal energy (only PE and KE conversions) by turning friction off and by making sure the skater doesn't leave the track.
- The height in the model is relative to the Reference Height, which is adjustable. When the Reference Height checkbox is off, potential energy will be zero at ground level.
- When the Reference Height is changed, the data in the Bar Graph, Pie Chart, and energy probe on the Measure screen will update dynamically. However, the data in the Energy vs. Position/Time graph on the Graphs screen will not be re-drawn.
- On the Measure screen, the data associated with the path dot represents the state of the model at the time it was drawn. If the mass, gravity, or friction is changed, the data associated with previously drawn dots will not retroactively change.
- The energy, height, and speed data displayed on the Measure screen is rounded to the nearest hundredths place. Due to rounding, calculations using the displayed values may result in small discrepancies.
- When Stick to Track is checked, the only factor that will affect the skater's ability to make it around the loop will be the energy in the system

See all published activities for Energy Skate Park here.
For more tips on using PhET sims with your students, see Tips for Using PhET.

Rouinfar, January 2024