Intro Screen

Explore how heating and cooling iron, brick, water, and olive oil adds or removes energy. See how energy is transferred between objects.

STACK blocks and beakers on the stands

SEE the energy in the system

SYNC heaters, so they heat/cool together

MEASURE the temperature
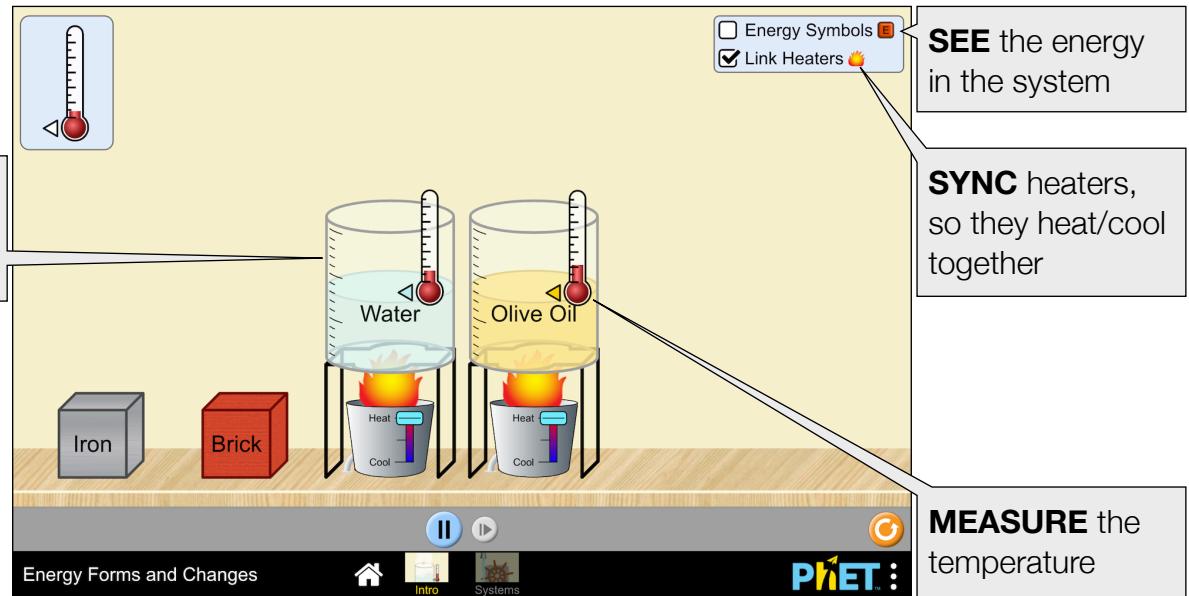
Systems Screen

Build your own system, with energy sources, changers, and users. Track and visualize how energy flows and changes through your system.

ADJUST the rate of energy production

SELECT energy source, converter, and user

OBSERVE energy move the the system; **DISCOVER** how it is converted along the way
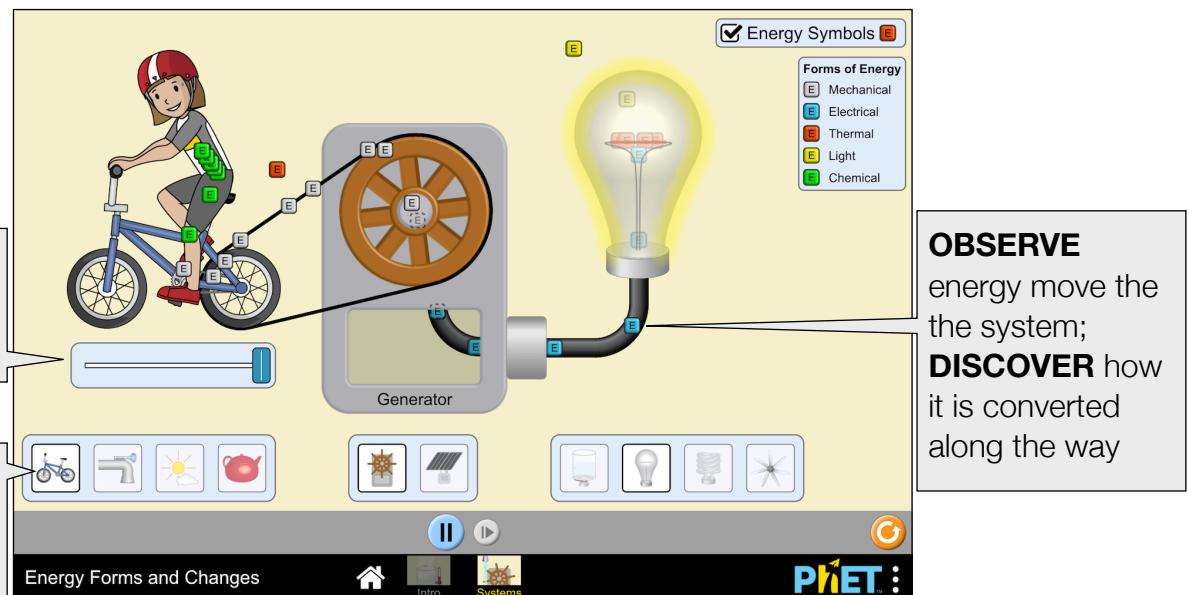
Customization Options

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 Forms and Changes, if you only want to include the 1st screen (`screens=1`), and reduce the amount of burners to 1 (`burners=1`) use:

https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_all.html?screens=1&burners=1

To run this in Spanish (`locale=es`), the URL would become:

https://phet.colorado.edu/sims/html/energy-forms-and-changes/latest/energy-forms-and-changes_all.html?locale=es&screens=1&burners=1

Query Parameter and Description	Example Links

`elements` - specifies the combination of blocks and beakers on the Intro screen. There can be up to four total elements (max 2 beakers, max 4 blocks).
 	
 Values: iron, brick, water, oliveOil
	`elements=iron,iron,iron`
	
	 `elements=brick,iron,water,water`

`burners` - specifies the number of burners on the Intro screen (maximum 2).	`burners=1`
`stickyBurners` - used to make the burner's slider position stick in place	`stickyBurners`

`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=2`
`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)
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`

Complex Controls

- The color of the small triangle next to the thermometer indicates which object is currently being measured (left). For simplicity, the model treats the beaker's shape like a rectangle. In some cases, the thermometer will appear to be on the water, but will not be reading its temperature. This will be evident from the color of the thermometer's triangle (right).
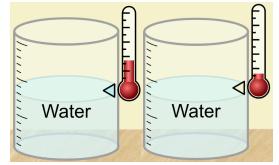
Model Simplifications

- The goal of this sim is to help students develop qualitative "energy stories" with generalized vocabulary. The sim is not designed to be used as a comprehensive tool for learning about all forms of energy.
- When the Energy Symbols are turned off, the sim behaves as it would in real life, with a continuous flow of energy. When the Energy Symbols are on, that continuous energy is split up into little packets (energy chunks) to allow for visual representation of the energy, so nothing is hidden.
- Energy Symbols represent the energy in the system in discrete amounts, and the number of chunks is proportional to amount of energy. The chunks are large enough to provide concept building, but represent a wide range, so quantitative analysis is not appropriate.
- The air energy is not shown because the chunks represent too large of a value to be realistic, however, when it makes sense for energy to go into or out of the air, chunks are shown.
- Energy conversion efficiency is not modeled.
- The brick and iron blocks have the same volume, but not the same mass, which is why brick heats up ~20% faster, despite its larger specific heat.
- The thermometer maxes out at 300 °C, and major tick marks correspond to 50 °C.

Insights into Student Use

The heat bucket will add or remove thermal energy. However, constraints were designed based on student interviews:
- Showing water freezing is too complex for this sim, so energy flowing into the tool stops near the freezing point of water. This can be explained to students by saying that the cooling mechanism is ice, so it can't cool things past the freezing point of water.
- When the water is at boiling temperature, you can still add thermal energy and steam is shown. The energy going into the water is not enough to significantly change the volume of the water. In other words, the water will never boil off.

Suggestions for Use

Sample Challenge Prompts
- Predict what happens to the energy of an object when it is heated or cooled.
- Heat up the brick and iron at the same time. Which one can hold more energy?
- Build an energy system and describe what happens to the energy as it moves through the system.
- Describe how energy can change from one form of energy into another.
- Determine if some energy sources and changers are incompatible. What makes them incompatible?
- Compare the the two light bulbs. Which bulb do you think is more energy efficient? Explain.

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