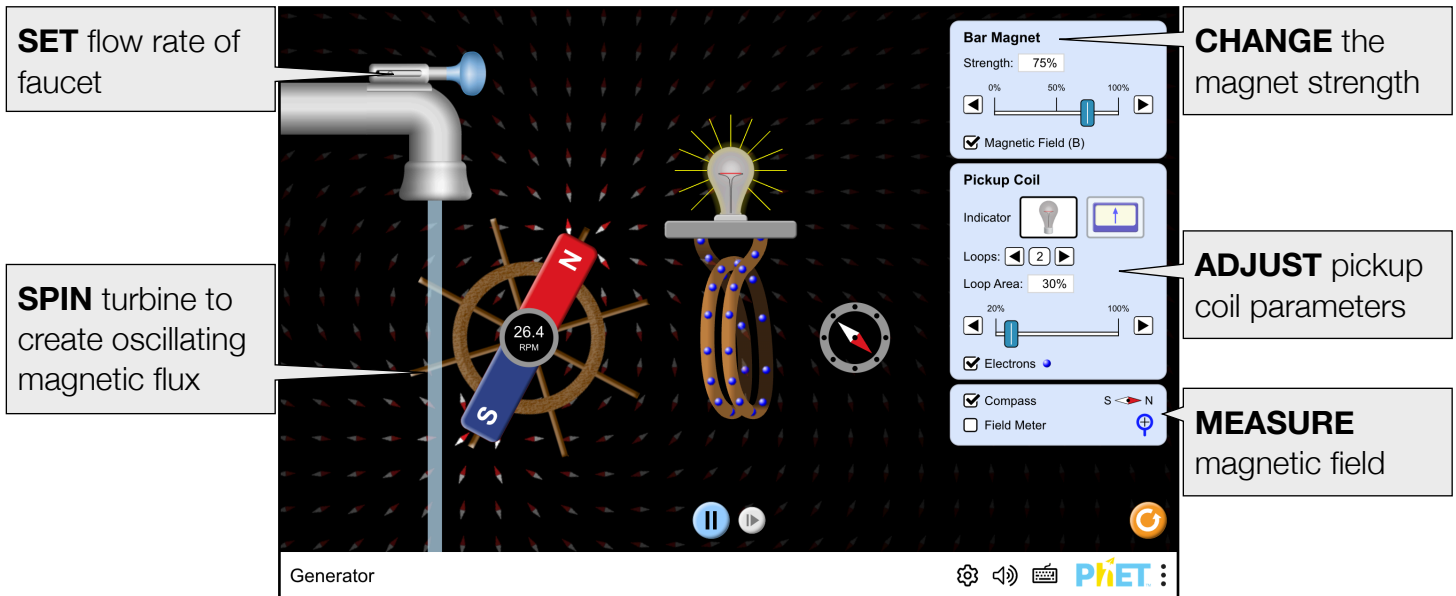The **Generator** simulation allows students to generate electricity with a bar magnet and discover the principles of an electric generator.

SET flow rate of faucet

CHANGE the magnet strength

SPIN turbine to create oscillating magnetic flux

ADJUST pickup coil parameters

MEASURE magnetic field

Model Simplifications

- We display the flow of electrons, which follow the **left-hand rule**. Electrons travel in the opposite direction of the convention current, which is defined as the flow of (imaginary) positive charges. To view the conventional current instead, use the Current Flow Preference. ⚙
- The model operates entirely on induced EMF. There is no resistance in the coils.
- The Field Meter appears to be in front of the magnet and coils, but measures inside of them. It is layered on top to ensure that the readouts are always visible.
- The Compass needle displays the direction of the magnetic field and aligns with the field immediately. Due to the oscillating nature of the magnetic field, we do not model the kinematics typical of a compass.
- To simulate the drag on the turbine caused by the pickup coil ("back EMF"), we apply a drag factor to the turbine's rotation that is linearly proportional to generated EMF. The maximum drag factor is 0.2.

Suggestions for Use

Sample Challenge Prompts

- Find all of the ways to make the light bulb brighter.
- Predict what happens to the brightness of the bulb when the number of turns in the pickup coil is reduced by half, but the speed of the magnet remains the same.
- Compare and contrast how both a light bulb and voltmeter can be used to show characteristics of the induced current.
- Explain what causes induction.
- Describe how a generator produces electricity.

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 Generator, if you only want to display magnetic values in Tesla (`magneticUnits=T`), and mute the audio by default (`audio=muted`) use:

https://phet.colorado.edu/sims/html/generator/latest/generator_all.html?magneticUnits=T&audio=muted

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

https://phet.colorado.edu/sims/html/generator/latest/generator_all.html?locale=es&magneticUnits=T&audio=muted

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

Query Parameter and Description	Example Links
⚙ `magneticUnits` - specifies magnetic units, `T` for Tesla or `G` for gauss (default).	`magneticUnits=T`
⚙ `currentFlow` - specifies the current representation, either `conventional` or `electron` (default).	`currentFlow=conventional`
⚙ `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)
⚙ `colorProfile` - changes simulation colors for easier projection.	`colorProfile=projector`
`audio` - if muted, audio is muted by default. If disabled, all audio is permanently turned off.	`audio=muted` `audio=disabled`
`allowLinks` - when `false`, disables links that take students to an external URL. Default is `true`.	`allowLinks=false`
`supportsPanAndZoom` - when `false`, disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is `true`.	`supportsPanAndZoom=false`

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