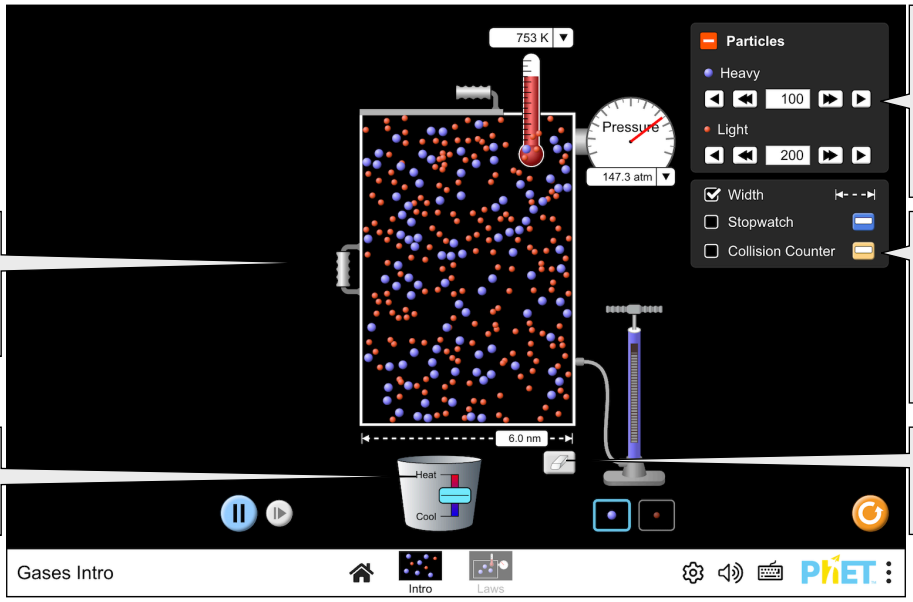
PhET Tips for Teachers

Gases Intro

Intro Screen

Pump gas molecules into a box and discover what happens as you change the volume, add or remove heat, and more.



ADD or **REMOVE** particles 50 at a time or 1-by-1

COUNT the number of particle-wall collisions

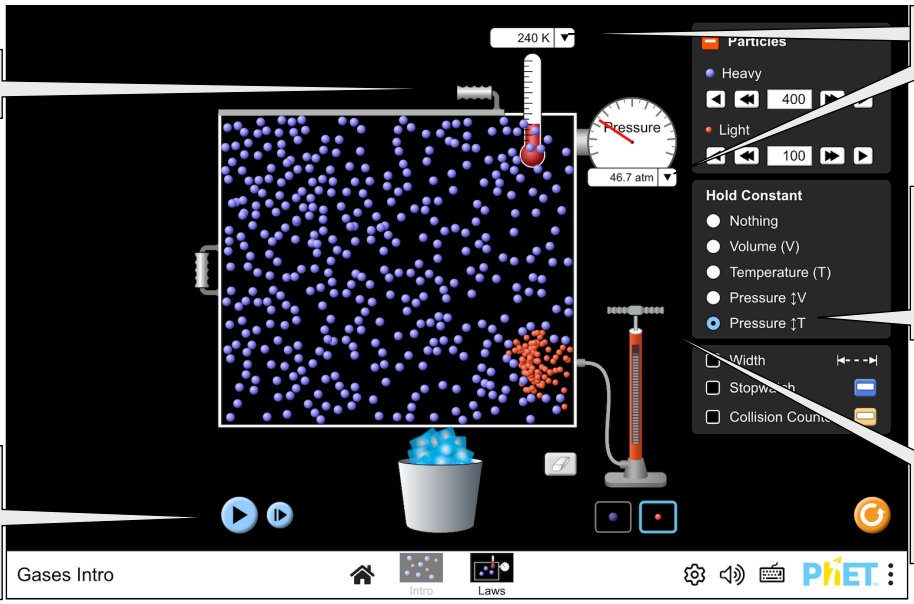
EMPTY the container

RESIZE the container (no work done)

ADD or **REMOVE** heat

Ideal Screen

Explore how properties of the gas vary in relation to each other, and experiment by holding one parameter constant.



TOGGLE units

HOLD a parameter constant

PUMP particles into the container

OPEN the lid

PAUSE and **STEP** forward frame-by-frame

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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 Gases Intro, if you only want to include the 1st screen (screens=1), with projector mode on (colorProfile=projector) use:
https://phet.colorado.edu/sims/html/gases-intro/latest/gases-intro_all.html?screens=1&colorProfile=projector

To run this in Spanish (locale=es), the URL would become:
https://phet.colorado.edu/sims/html/gases-intro/latest/gases-intro_all.html?locale=es&screens=1&colorProfile=projector

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

Query Parameter and Description	Example Links
⚙ pressureNoise - adds artificial noise to the pressure gauge. By default the pressure gauge displays the exact pressure in the model, derived from the ideal gas law. Also found in the PhET menu under Options > Pressure Noise.	pressureNoise=true
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)
colorProfile - changes simulation colors for easier projection. Also found in the PhET menu under Options > Projector Mode.	colorProfile=projector
allowLinks - when false, disables links that take students to an external URL. Default is true.	allowLinks=false

Model Simplifications

- The particle-particle collisions are modeled as hard sphere collisions. All inter-molecular forces are ignored. A detailed description of the model can be found here.
- The container depth (4 nm) and height (8.75 nm) are constant, so volume varies linearly with width.
- The light particles have a mass of 4 AMU and the heavy particles have a mass of 28 AMU. While these masses respectively correspond to He and N_2, the radii differ to optimize the visual size difference.

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- The pressure in the model is derived from the ideal gas law, $P = \frac{NkT}{V}$. The pressure will be non-zero as soon as N > 0, and remains constant until N, T, or V is changed. The pressure displayed on the pressure gauge may vary from the model value under certain circumstances.
  - The pressure gauge will display zero pressure until the first particle-wall collision.
  - If the Pressure Noise preference is on, the pressure reading will fluctuate every 0.75 ps by a maximum of 50 kPa. The amount of pressure noise is inversely proportional to the pressure, and for T ≤ 50K it will linearly decrease until it becomes 0 kPa when T ≤ 5K.
- Moving the container wall will not do any work on/by the system. When the container wall is grabbed, the simulation will pause. Upon release, the particles will instantaneously redistribute in the container, and their speeds will remain unchanged.
- The container lid will blow off if the pressure gauge reaches its maximum reading, unless the lid is already open beyond a crack.
- Adding particles to the container will not change the temperature of the system, as the newly-added particles are given the appropriate velocity to match the temperature of the gas in the container.
- When the system temperature is below 0.5 K, the display will show 0 K. Particle motion will eventually stop if the container is cooled further, though this may take some time.

Suggestions for Use

Sample Challenge Prompts

- Describe the relationship between particle-wall collisions and pressure.
- Predict how changing temperature will affect the speed of the gas molecules.
- Design an experiment to determine the relationship between two gas properties, such as pressure and temperature.
- Identify the relationship between pressure, volume, temperature, and number of gas molecules.

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

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