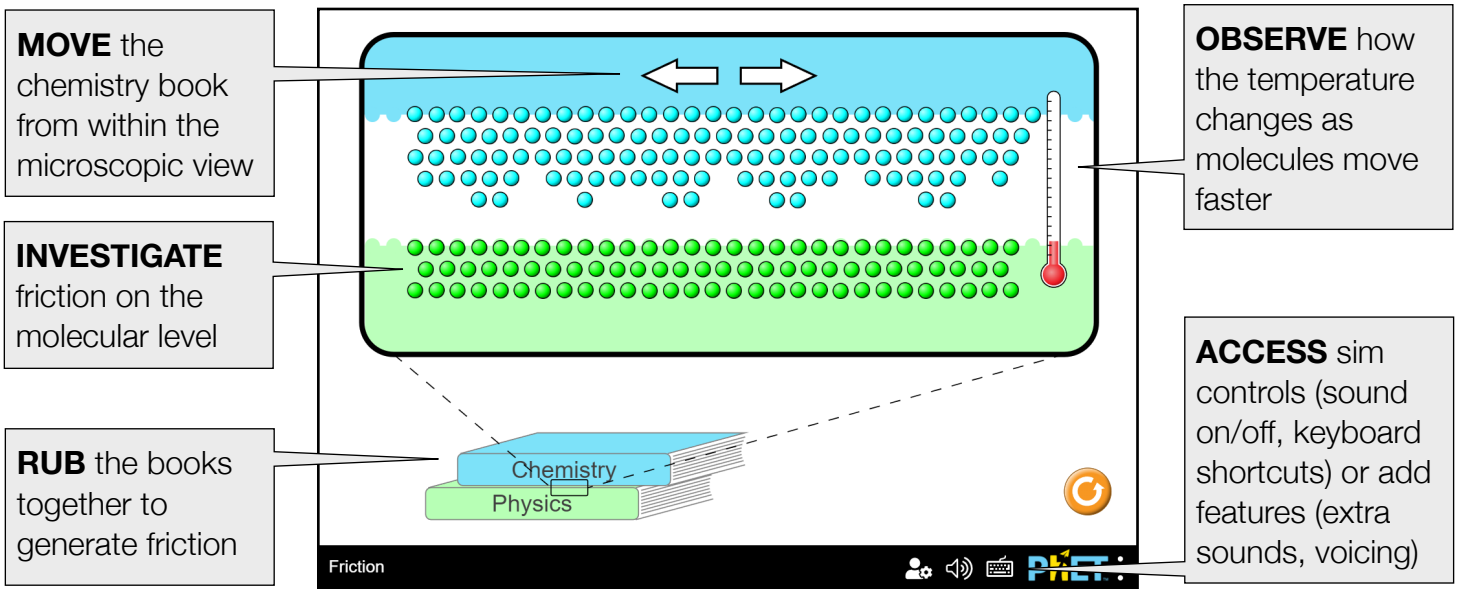
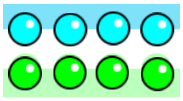
Friction

Observe what happens on an atomic level when you rub two objects together, and explore how friction causes a material to heat up.



Model Simplifications

- The position of the Physics book is fixed, and will not move in response to the motion of the Chemistry book.
- The Physics book is made of a harder material than the Chemistry book, and therefore will not lose any of its molecules.
- The layer of molecules at the edge of the book are tightly bound. No amount of heat will remove them.



Suggestions for Use

- **Lecture Demo:** Have students rub their hands together and sketch what they think is happening on a molecular level. Compare to the simulation.
- **Challenge Prompt:** Use Kinetic Molecular Theory to explain what happens to the molecules in the books when the temperature increases.

Inclusive Features

Sound and Sonification

- Extra attention can be drawn to the cooling process by enabling Extra Sounds in the Audio tab of the Preferences menu. A cooling “hiss” is heard as molecules begin to lose energy to the environment and the thermometer level drops.
- Molecules “jingle” with increasing volume as they gain energy. With enough rubbing, the molecules “ping” as they leave the surface of the Chemistry book.

- See the Sound Features Video for more useful tips on how concepts and sound are integrated in this sim. See the published Sound Design Documentation for more details on all sounds in this simulation.

Interactive Description

- This simulation features interactive description to support non-visual access, delivered only while using screen reader software. See the Introduction to Interactive Description video for more info on how to use this feature.
- Teachers can access the A11y View here to decide if this sim's interactive description meets their instructional needs. *Reminder: A11y View is not intended for student use and will not provide a good experience for learners using screen reader software.*

See the simulation page for all supported inclusive features.

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 Friction, if you want to mute audio (`audio=muted`), and disable pan and zoom (`supportsPanAndZoom=false`) use:
https://phet.colorado.edu/sims/html/friction/latest/friction_all.html?audio=muted&supportsPanAndZoom=false

To run this in Spanish (`locale=es`), the URL would become:
https://phet.colorado.edu/sims/html/friction/latest/friction_all.html?locale=es&audio=muted&supportsPanAndZoom=false

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

Query Parameter and Description	Example Links
⚙ `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)
`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 Friction here.
For more tips on using PhET sims with your students, see Tips for Using PhET.