

Intro Screen

Interact with blocks of different materials, including a custom option. Modify their mass and volume to explore the effect on the density and discover the conditions for sinking or floating in water.

OBSERVE the blocks' density value; **BUILD** blocks with the density indicated on the marks

MEASURE the displaced volume

MODIFY the blocks' material, mass and volume

COMPARE two blocks at the same time.

Compare Screen

Compare the similarities and differences of four blocks that have the same mass, volume, or density.

OBSERVE if the blocks sink or float in water

INTERACT with blocks with the same mass, volume, or density

MODIFY the density and the extensive properties of the blocks

Mystery Screen

Play detective to determine the material of each block by comparing its density with the values in the table.

COMPARE the density of the block to identify its material

MEASURE the block's mass

CHOOSE which set of blocks to explore

In the Random option, **RESET** to get new challenges

Random

Material	Density (kg/L)
Wood	0.40
Gasoline	0.68
Apple	0.83
Ice	0.92
Human	0.95
Water	1.00
Glass	2.70
Diamond	3.51
Titanium	4.50
Steel	7.80
Copper	8.96
Lead	11.34
Gold	19.32

19.30 kg

102.80 L

1A 1B 1C 1D 1E

Density Table

Blocks

Set 1 Set 2 Set 3 Random

Reset

Density Intro Compare Mystery PiET

Insights into Student Use

- Students do not need to be told to put the block in the water; it is often their first move.
- Students who do not already know the density of water can figure it out by playing with the sim.
- Some students notice that when objects float, they displace their mass, but when objects sink, they displace their volume.
- Students learn that density is what determines whether an object sinks or floats.
- Students are sometimes confused by the neutrally buoyant behavior of the blue block in the Compare Screen, “Same Mass” option; later, they discover the block has the density of water.
- Students discover that they can measure a block's volume by placing it in the pool, but some may not realize the block must be fully submerged in the water to measure the volume correctly.

Suggestions for Use

Sample Challenge Prompts

- Describe how the mass and volume are related to the density of a material.
- Explain why changing the volume or mass of a material doesn't change its density.
- Find a way to measure the block's volume.
- Describe how two blocks can have the same mass but different volumes and vice versa.
- Use the tools in the sim to discover how to calculate the block's density.
- Find the condition that establishes if a block floats or sinks in water.
- Build a block that has the same density as titanium. Is there only one right answer to the challenge?
- Identify the unknown materials of the blocks in the Mystery Screen by calculating their density and comparing them with the materials in the Density Table.

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 an '&'. The general URL pattern is:

```
...html?queryParameter1&queryParameter2&queryParameter3
```

For example, in Density, 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/density/latest/density_all.html?screens=1,2&initialScreen=2

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

https://phet.colorado.edu/sims/html/density/latest/density_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
⚙ <code>volumeUnits</code> - specifies units used to display volume, <code>decimetersCubed</code> or <code>liters</code> (default). The Preferences menu also includes a control to toggle the units.	<code>volumeUnits=decimetersCubed</code>
<code>screens</code> - 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 .	<code>screens=1</code> <code>screens=2, 1</code>
<code>initialScreen</code> - opens the sim directly to the specified screen, bypassing the home screen.	<code>initialScreen=1</code> <code>initialScreen=3</code>
⚙ <code>locale</code> - 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”.	<code>locale=es</code> (Spanish) <code>locale=fr</code> (French)
<code>allowLinks</code> - when <code>false</code> , disables links that take students to an external URL. Default is <code>true</code> .	<code>allowLinks=false</code>
<code>supportsPanAndZoom</code> - when <code>false</code> , disables panning and zooming using pinch-to-zoom or browser zoom controls. Default is <code>true</code> .	<code>supportsPanAndZoom=false</code>

Complex Controls

- On the Intro Screen, adjusting the mass of a given substance (such as Brick) will result in a change to its volume to maintain a constant density, and vice versa. To independently adjust the mass and the volume, use the Custom option.

- Sudden changes in the aspect ratio of the simulation can result in blocks being shifted around. In extreme situations, it is possible for blocks to be lost off-screen, but they can be restored with the Reset All button.

Model Simplifications

- The density of water is purposefully not included in the Density readout on the Intro screen, as we saw that it leads to more student engagement with the sim.
- The materials labeled in the Density readout on the Intro screen do not appear in the block drop-down menus. This implicitly challenges students to build custom blocks with these labeled densities.
- The color of an object in one mode does not imply the same density in other modes. This was done to challenge students to use other characteristics to understand density.
- On the Compare screen, the color of the blocks changes when using the slider to change the mass, volume, or density. The darker the color, the larger the value. This was done to provide a visual indication that the blocks have changed when the slider is adjusted. During interviews with students, we observed that students build the correct association of density, mass, and volume with the combination of the Intro and Compare screens.

See all published activities for Density [here](#).

For more tips on using PhET sims with your students, see [Tips for Using PhET](#).