

## Isotopes Screen

Students build isotopes and investigate the atomic mass, mass number, and relative abundance of the isotope.

**TRACK** the number of subatomic particles.

**ADD** neutrons to the atom to create a new isotope.

**CHANGE** display on balance.

**CHOOSE** an element to investigate.

**VIEW** the atomic symbol for the isotope.

**DETERMINE** percent abundance of the isotope.

**My Isotope**

Lithium-7  
Stable



Periodic Table

Symbol: <sup>7</sup>Li

Abundance in Nature: This Isotope 92.41% Other Lithium Isotopes

Isotopes and Atomic Mass

Mass Number  
Atomic Mass (amu)

Isotopes Mixtures

PHET

## Mixtures Screen

Students create mixtures of isotopes, investigate how average atomic mass is calculated, and compare their mixtures to a view of an actual mixture of isotopes.

**CREATE** a mixture of isotopes.

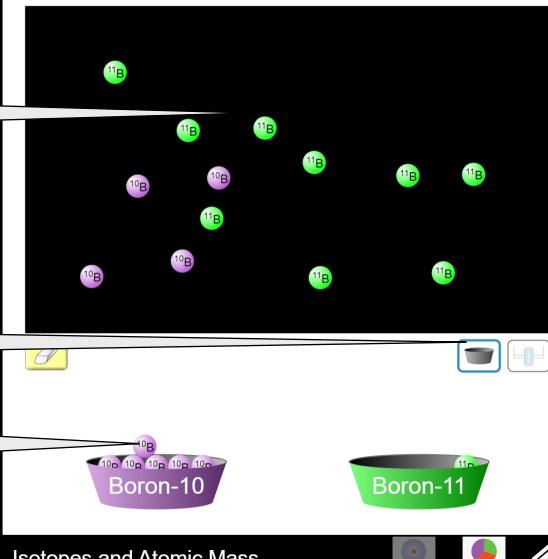
**CHOOSE** to add atoms using buckets or sliders.

**DRAG** atoms from buckets to make a mixture.

**DETERMINE** the percent composition of your mixture.

**VIEW** the average atomic mass of your mixture.

**CHOOSE** mixture to investigate.



Periodic Table

Percent Composition: <sup>10</sup>B 30.8% <sup>11</sup>B 69.2%

Average Atomic Mass: 10.70273 amu

Isotope Mixture: My Mix Nature's Mix

Isotopes and Atomic Mass

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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 Isotopes and Atomic Mass, if you want to change the screen order (`screens=2,1`), with the 2nd screen open by default (`initialScreen=2`) use:

[https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass\\_all.html?screens=2,1&initialScreen=2](https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass_all.html?screens=2,1&initialScreen=2)

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

[https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass\\_all.html?locale=es&screens=2,1&initialScreen=2](https://phet.colorado.edu/sims/html/isotopes-and-atomic-mass/latest/isotopes-and-atomic-mass_all.html?locale=es&screens=2,1&initialScreen=2)

| Query Parameter and Description  | Example Links   |
|--|---|
| <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 <a href="#">Help Center</a> .  | <code>screens=1</code><br><code>screens=2,1</code>                  |
| <code>initialScreen</code> - opens the sim directly to the specified screen, bypassing the home screen.  | <code>initialScreen=1</code><br><code>initialScreen=2</code>        |
| <code>locale</code> - specify the language of the simulation using <a href="#">ISO 639-1</a> codes. Available locales can be found on the simulation page on the <a href="#">Translations tab</a> . Note: this only works if the simulation URL ends in “_all.html”. | <code>locale=es</code> (Spanish)<br><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>                                       |

## Insights into Student Use

- In college interviews, students wanted to select other common elements such as gold; investigation into other elements could be incorporated as part of an activity.
- On the Mixtures screen, students attempted to match Nature's Mix using My Mix view. This is not possible for all elements shown in the simulation.
- Students who need additional practice in interpreting atomic symbols, calculating mass number, or identifying the number of protons, neutrons, and electrons can investigate these concepts using the *Build an Atom* simulation.

## Model Simplifications

- If you make an isotope that is not listed as stable in the NIST table, the nucleus shakes and the word “Unstable” appears under the nucleus.
- Unstable, but naturally occurring isotopes ( $^3\text{H}$ ,  $^7\text{Be}$ ,  $^{10}\text{Be}$ ,  $^{14}\text{C}$  and  $^{18}\text{F}$ ) exist in trace amounts, so their abundance is listed as “trace” rather than 0%.
- The atomic mass is relative to  $^{12}\text{C}$ , which has an atomic mass of 12 amu by definition. The atomic mass is shown only for stable isotopes, with the exception of naturally occurring unstable isotopes.

- In the Mixtures screen, the average atomic mass and percent abundance of each isotope are calculated based on the isotopes placed on the black screen using the buckets or sliders.
- In the Mixtures screen, Nature's Mix is not always shown as the exact ratio for some elements (for example, the exact ratio for helium would take 1  $^3\text{He}$  isotope and 999,999  $^4\text{He}$  isotopes).
- While the size of different atoms is not a main learning goal, the sim shows the relative electron cloud size for each element.

## Suggestions for Use

### Middle School

- What is an isotope? Be sure to include the following key terms in your explanation: mass number, protons, neutrons, electrons, element, atom.
- What particles determine the mass number of an atom? Why is the mass number always a whole number?
- Using the Mixtures screen, create a mixture of isotopes of boron that match the average atomic mass on the periodic table (10.811 amu). Which isotope is more abundant: boron-10 or boron-11?

### High School

- Calculate the mass number and write the name and atomic symbol for these isotopes of hydrogen: protium (0 neutrons), deuterium (1 neutron), and tritium (2 neutrons).
- Your friend claims, "The chance of finding a specific isotope of an element is the same for all isotopes of that element". Explain if you agree or disagree with your friend using evidence from the simulation.
- Explain the relationship between isotope stability and percent abundance. Are unstable isotopes very abundant? Why or why not?
- Write a mathematical expression to show how the average atomic mass of an element is calculated.
- Identify relationships between the number of neutrons in an atom and the stability of the atom. Why might an atom be stable or unstable?
- Two stable isotopes of bromine exist in nature, bromine-79 and bromine-81, and the average atomic mass of bromine is 79.901. Predict the percent abundance of each isotope of bromine.

See all published activities for Isotopes and Atomic Mass [here](#).

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