

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.

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.

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 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

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

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 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=2</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>

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 (^3H , ^7Be , ^{10}Be , ^{14}C and ^{18}F) exist in trace amounts, so their abundance is listed as “trace” rather than 0%.
- The atomic mass is relative to ^{12}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 ^3He isotope and 999,999 ^4He 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](#).