

PhET Tips for Teachers: Isotopes and Atomic Mass

We made the Isotope sim to follow the [Build an Atom](#) sim. The Build an Atom sim allows students to make isotopes, but the Isotope sim shows the abundance and how it relates to the average atomic mass of an element. For *applications* of isotopes, see our suite of nuclear chemistry sims: [Nuclear Fission](#), [Alpha Decay](#), [Beta Decay](#) or [Radioactive Dating Game](#).

Tips for controls:

Make Isotopes Tab (Isotopes atoms with same # of protons and different # of neutrons.)

- Select an element in the first **2** rows of the periodic table; the most abundant isotope of that element appears on the scale.
- Add *or remove* neutrons, but select element on periodic table to change the number of protons.
- The scale shows the mass number or the atomic mass.

Second Tab: Mix Isotopes

- Select an element in the first **3** rows of the periodic table; the stable isotopes of that element appear in buckets (the unstable isotopes ^3H and ^{14}C are not included).
- Add isotopes to the chamber in two ways: you can drag in the isotopes (up to 10 of each) or click the **More** button to use sliders (up to 100 of each isotope); the **Less** button returns the buckets.
- Select **Nature's mix** to see the actual composition and average atomic mass. The ratio of isotopes is represented by 1000 isotopes in the chamber.
- To make the background WHITE to help with projection or black-line masters, use **Options** menu.

Insights into student use / thinking:

- The mass number is the sum of the protons and neutrons in the atom. If students need review of this use [Build an Atom](#)
- In college interviews, students wanted to select other common elements, like gold; you could add more elements in an activity.
- In middle school interviews, students liked to draw pictures with the isotopes.
- In all interviews, students try to match Nature's mix using **My mix**; this is not always possible.

Important modeling notes / 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.
- The atomic mass is relative to ^{12}C , which is defined as 12 amu. The sim only shows the atomic mass for stable isotopes (the exceptions are ^3H and ^{14}C).
- The sim computes the average atomic mass of the isotopes in the chamber (shown on a line chart), and the percentage of each isotope (shown as a pie chart).
- The sim is not able to show 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 sim use:

- For tips on using PhET sims with your students see: [Guidelines for Inquiry Contributions](#) and [Using PhET Sims](#)
- The simulations have been used successfully with homework, lectures, in-class activities, or lab activities. Use them for introduction to concepts, learning new concepts, reinforcement of concepts, as visual aids for interactive demonstrations, or with in-class clicker questions. To read more, see [Teaching Physics using PhET Simulations](#)
- For activities and lesson plans written by the PhET team and other teachers, see: [Teacher Ideas & Activities](#)