

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](#). For tips on using PhET sims with your students and for lesson plans written by the PhET team and other teachers, see our [For Teachers](#) page.

First Tab: Make Isotopes

Periodic table: You can select an element in the first **2** rows of the periodic table; the most abundant isotope of that element appears on the scale. The sim shows the relative electron cloud size for each element; this is not a main learning goal of the sim, but we do not want to give students the idea that all atoms are the same size.

Neutrons: You can add *or remove* neutrons, but you must select a new element to change the number of protons. The goal is to learn that isotopes are atoms with the same number of protons and different numbers of neutrons. 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.

Mass: The scale shows the mass number or the atomic mass of the isotope. The mass number is the sum of the protons and neutrons. The atomic mass is relative to ^{12}C , which is defined as 12 amu. Students may think the atomic mass is the *average* atomic mass because of the decimal places. The sim only shows the atomic mass for stable isotopes (exceptions are ^3H and ^{14}C).

Second Tab: Mix Isotopes

Periodic table: You can 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). In college interviews, we saw that students want to select other common elements, like silver and gold; you could add more elements in an activity.

“Chamber”: You can 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. 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). In middle school interviews, we saw that students like to draw pictures with the isotopes! The **Options** menu includes the ability to change the box to white for ease in photocopying.

Nature’s mix: You can select **Nature’s mix** to see the actual composition and average atomic mass. The sim shows a maximum of 5 decimal places for the mass; less than 5 reflects variability in the composition. The ratio of isotopes is represented by 1000 isotopes in the chamber. The sim is not able to show the exact ratio for some elements (for example, helium would take 1 ^3He isotope and 999,999 ^4H isotopes). In all interviews, we saw that students try to match Nature’s mix using **My mix**; this is not always possible.