We made the Isotope sim to follow the [Build an Atom](http://phet.colorado.edu/en/simulation/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](http://phet.colorado.edu/en/simulation/nuclear-fission), [Alpha Decay](http://phet.colorado.edu/en/simulation/alpha-decay), [Beta Decay](http://phet.colorado.edu/en/simulation/beta-decay) or [Radioactive Dating Game](http://phet.colorado.edu/en/simulation/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 14C 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](http://phet.colorado.edu/en/simulation/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](http://physics.nist.gov/cgi-bin/Compositions/stand_alone.pl?ele=&ascii=html&isotype=some), the nucleus shakes and the word “**Unstable**” appears under the nucleus.
* The atomic mass is relative to 12C, which is defined as 12 amu. The sim only shows the atomic mass for stable isotopes (the exceptions are 3H and 14C).
* 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 4H 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**](http://phet.colorado.edu/teacher_ideas/contribution-guidelines.php)and [**Using PhET Sims**](http://phet.colorado.edu/teacher_ideas/classroom-use.php)
* 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**](http://phet.colorado.edu/phet-dist/publications/Teaching_physics_using_PhET_TPT.pdf)
* For activities and lesson plans written by the PhET team and other teachers, see: [**Teacher Ideas & Activities**](http://phet.colorado.edu/teacher_ideas/index.php)