Isotopes: tracing the source

These activity notes are designed for use along with the accompanying slides which contain explanatory images etc.

Year Group: S1-S6

Length: 5-10 minutes, can be extended with discussion or if groups create isotopes for each other

Set-up time: time is required to measure out the 'isotopes' in advance unless getting pupils to create

Room requirements: A classroom space with desks for students to work at. This activity uses food products so any relevant allergies should be considered (or alternatives can be substituted).

Summary:

Isotopes are forms of an element that have the same number of protons but different numbers of neutrons, giving them a slightly different atomic mass. This activity demonstrates how isotopes differ and introduces the concept that the relative proportion of each isotope in an overall sample can be determined and is a useful geological measurement (with reference to the main isotopes of carbon).

Equipment:

- Blank paper (or paper plates)
- Pens/pencils
- Coloured sweets
- Extension: kitchen scales

Instructions:

Many elements have multiple isotopes but one of the most important examples is carbon. There are three main isotopes of carbon; ^{12}C which is the most abundant (98.93% of all C), ^{13}C (1.109%) and ^{14}C which has a natural abundance of only 1 part per trillion.

1. Choose two colours of sweet and decide which will represent protons and which will represent neutrons, then create atoms that represent two isotopes of carbon as follows;

   ^{12}C – 6 protons + 6 neutrons

   ^{13}C – 6 protons + 7 neutrons
2. Create 'samples' that are either all one isotope or a mixture of atoms of the two, using the table below **can be done by pupils then groups swap samples for next step, or done in advance**

Ratio of atoms		Total in sample	
^{12}C	^{13}C	protons	neutrons
3	0	18	18
2	1	18	19
1	1	12	13
1	2	12	26
0	3	18	21

3. Use the protons and neutrons in the sample to build atoms and determine which isotopes are present (remember each atom must be either 6 + 6 or 6 + 7). Pen and paper helpful!
4. Determine the ratio of the two isotopes in the sample (3:0, 2:1, 1:1, 1:2, 0:3 ?).

Note that for demonstration purposes, the ratios above are artificially high - in nature, the ratio of carbon isotopes is far lower and values are generally given as parts per thousand (‰).

Extension – isotope weight difference: weigh the 'all ^{12}C' and 'all ^{13}C' samples to show the difference in weight that even a few extra 'neutrons' can make.