# Binding energy of nuclei

Looking for patterns

You will use the data in a spreadsheet to calculate the binding energy of a set of nuclei. You will then produce a plot to show how the binding energy per nucleon varies with mass of the nucleus.

You will need

* computer running a spreadsheet
* data provided in spreadsheet format

Building the spreadsheet

Take a look at the four columns in the spreadsheet data. The first is simply the name of some of the stable elements. This is followed by a column showing the atomic number (*Z*, the number of protons in the nucleus) and a column giving the mass number (A, the total number of nucleons, i.e. protons plus neutrons). Finally there is a column giving the actual atomic mass. The units of this column are atomic mass units, which are defined as **exactly one-twelfth of the mass of a carbon-12 atom**. The atomic mass unit (u) is also called the unified atomic mass constant, and has a value of 1.660 5402  10–27 kg.

Use this information to calculate the binding energy of each nucleus. The binding energy is simply the difference in energy between a nucleus and its constituent parts. This energy change can be measured as a change in the mass of the nucleus. A useful shortcut is that a mass difference of 1 atomic mass unit is equivalent to 931 MeV (million electron volts) of energy.

To find the binding energy you will need to subtract the mass of the constituents from the atomic mass. The constituents are Z protons, (A – Z) neutrons and Z electrons (electrons are included in the atomic mass). The masses of these in atomic mass units are:

* mass of neutron = 1.008 665 u
* mass of proton = 1.007 277 u
* mass of electron = 0.000 548 u

Create new columns in the spreadsheet giving the number of neutrons and the mass of the constituents. Now calculate the binding energy of the entire nucleus and the binding energy per nucleon. Plot this last quantity against mass number (not atomic number).

Double click on the chart below, you will need a computer running Excel.