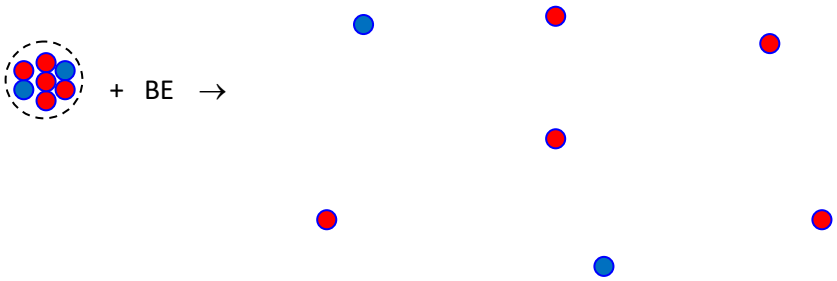
Teacher notes
Topic E

Whys is the mass of a nucleus smaller than the mass of its nucleons?

The definition of binding energy (BE) says that it is the minimum energy that must be supplied to a nucleus in order to completely separate the nucleons.

I.e.



But energy is equivalent to mass. Adding BE to the nucleus is equivalent to adding mass to it. So the separated nucleons have a greater mass than the nucleus itself, leading to the concept of the mass defect:

$\mu = Zm_p + (A-Z)m_n - M_{\text{nucleus}}$ or $\mu = Zm_{\text{H}} + (A-Z)m_n - M_{\text{atom}}$

Find the mass defect of an oxygen ($^{16}_{8}\text{O}$) nucleus. The atomic mass is 15.9949 u.

$\mu = (ZM_{\text{H}} + Nm_{\text{n}} - M_{\text{atom}}) = 8\times1.007825 + (16-8)\times1.008665 - 15.9949 = 0.137$ u.