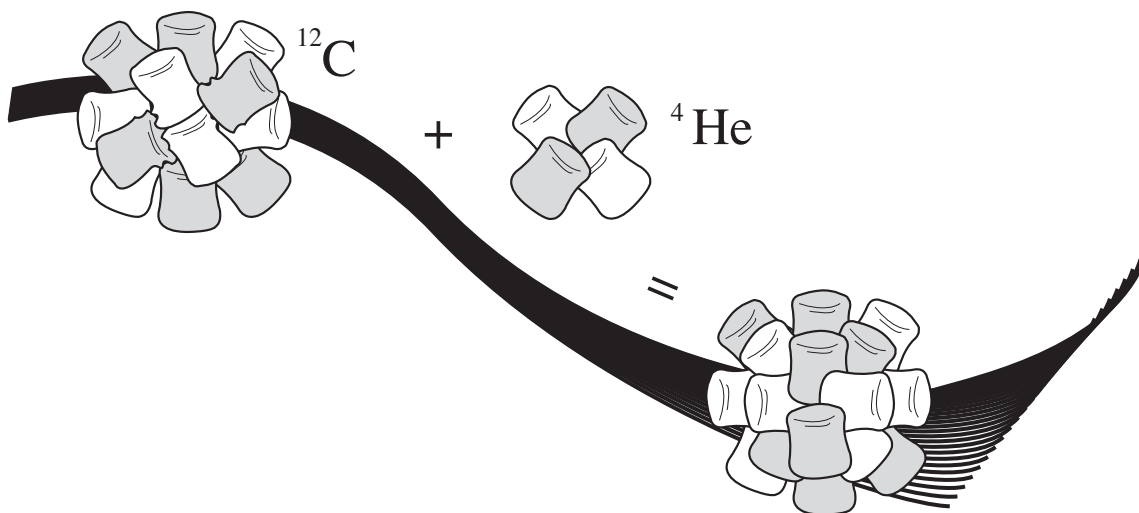


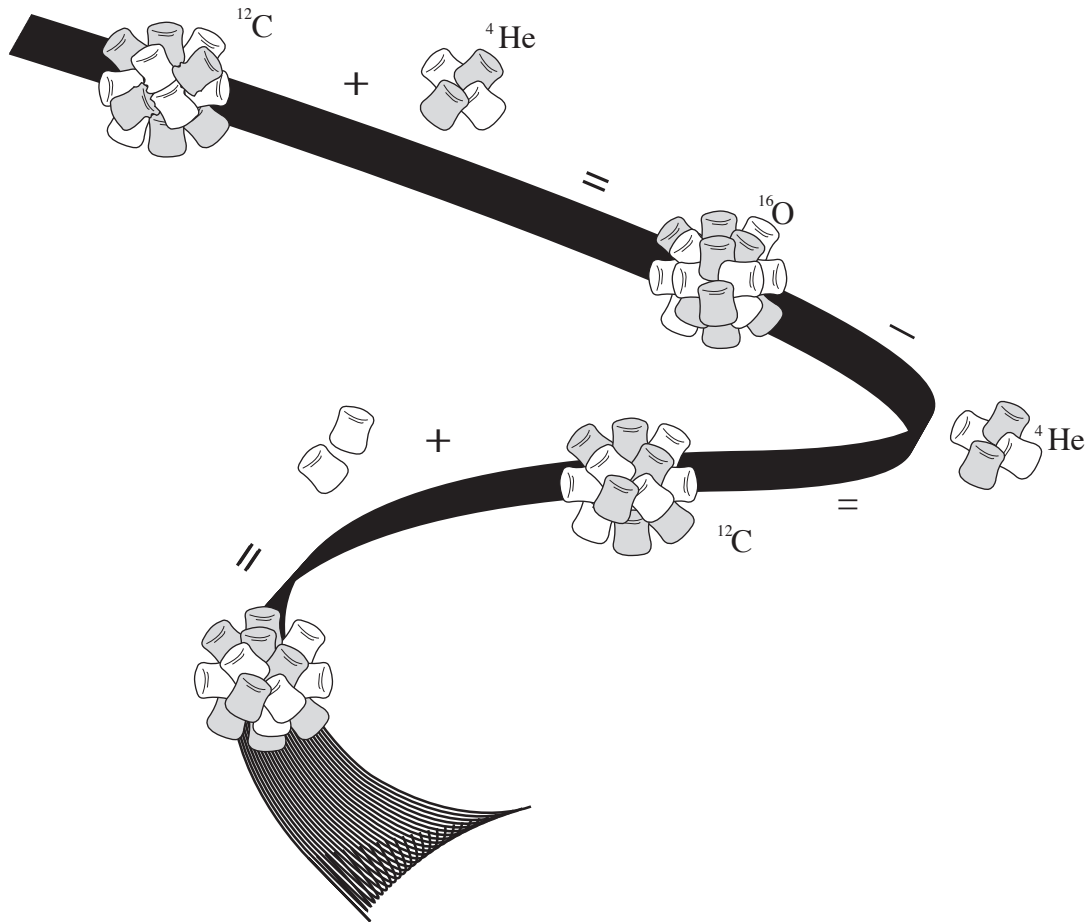
Marshmallow Nuclei

Using white marshmallows for **protons**, and colored marshmallows for **neutrons**. *Be courteous, use the spoon to take the marshmallows.*



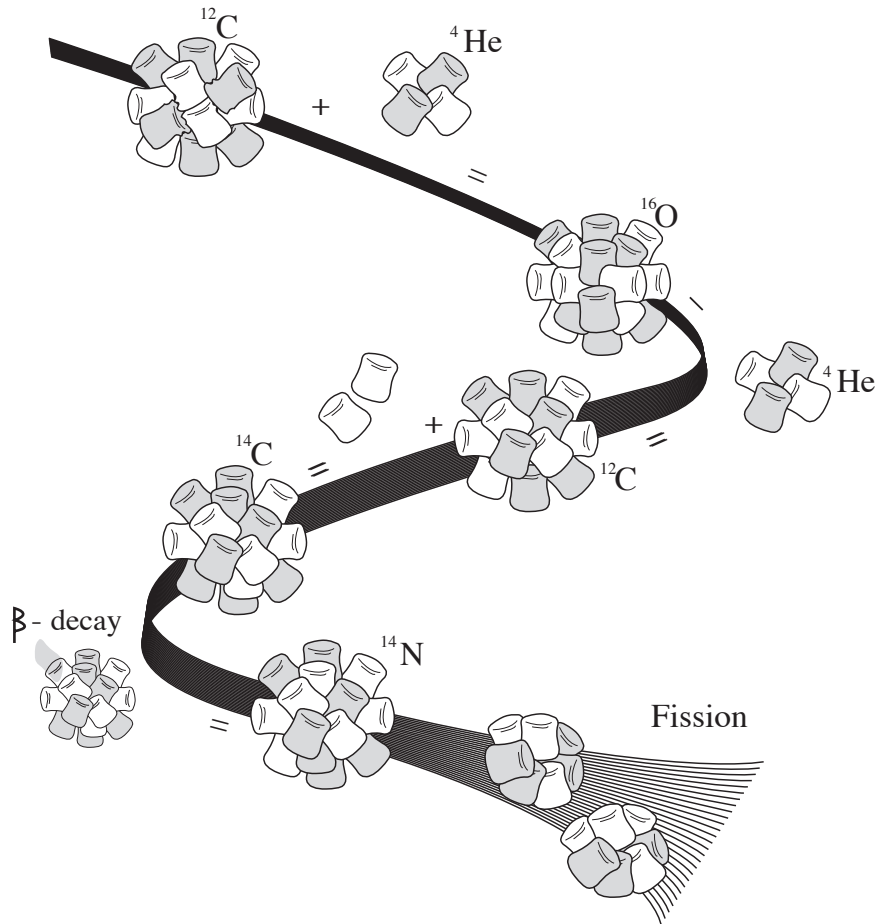
- ❁ Make the **nucleus** for Carbon-12 using six neutrons and six protons. Find Carbon on the **Periodic Table** of the Elements.
- ❁ **Nuclear forces** are short ranged. (Try licking the marshmallows to get them to stick together.)
- ❁ **Alpha particles** are **Helium** nuclei - make an alpha particle with two neutrons and two protons. Find Helium on the Periodic Table.
- ❁ New elements can be made by adding nuclei together. Add the alpha particle to the Carbon-12 particle - What element have you made? Find it on the Periodic Table.

Marshmallow Nuclei



- ☼ Heavy elements like Uranium are **Radioactive**. The spontaneous emission of a alpha particle is called **Alpha decay**. Remove the alpha particle from Oxygen-16, (you may eat the alpha particle).
- ☼ **Isotopes** of an element have the same number of protons and different numbers of neutrons. Add two neutrons to your Carbon -12 nucleus. What isotope have you made?

Marshmallow Nuclei



- ❁ The radius of a Carbon-12 nucleus is about 3 Fermi. One **Fermi is 10^{-13} cm**. If the most probable radius of the Carbon atom is about .3 Angstroms, (one **Angstrom is 10^{-8} cm**). The ratio of the size of the atom to the size of the nucleus is 10,000.
- ❁ Heavy element nuclei such as Californium-252 will undergo **spontaneous fission** by separating into two almost equal parts. Fission your Nitrogen-14 nucleus.
- ❁ Note that your nucleus may not separate exactly in half. You may eat the **fission products**. In real life fission products such as strontium-90 or cesium-137 are harmful because they are radioactive beta particle emitters.