

## Vocabulary: The Strong Nuclear Force

- Alpha particle – a particle consisting of two *protons* and two *neutrons* that is emitted by some radioactive atoms.
  - An alpha particle is equivalent to a helium nucleus.
- Antimatter – matter made up of *antiparticles*; particles with opposite charge but the same mass as their matter equivalents.
  - For example, the *positron* is the antiparticle for an *electron*.
    - Electrons have a charge of  $1^-$  and a mass of 0.00055 universal mass units (u).
    - Positrons have a charge of  $1^+$  and a mass of 0.00055 u.
  - If a particle and its equivalent antimatter particle collide, they will annihilate each other in a burst of energy.
- Baryon – a particle made up of three *quarks*.
  - Baryons include protons, neutrons, and many other unstable particles.
- Electron – a negatively charged particle that moves around the nucleus.
  - An electron is a fundamental particle that is classified as a lepton.
- Force carrier particle – a particle that carries a force between other particles.
  - Each fundamental force is associated with one or more force carrier particles.
  - The force carrier particle for the strong force is the *gluon*.
- Hadron – a family of particles that are made of quarks.
  - Hadrons are classified as either *mesons* or baryons.
    - Mesons are made up of a quark and an antiquark.
    - Baryons are made up of three quarks.
- Lepton – a family of elementary particles that may be charged or uncharged.
  - There are six leptons, classified in three generations:
    - Generation 1: electrons ( $1^-$ ) and electron neutrinos (uncharged)
    - Generation 2: muons ( $1^-$ ) and muon neutrinos (uncharged)
    - Generation 3: tauons ( $1^-$ ) and tauon neutrinos (uncharged)
  - In addition, there are antiparticles for each lepton.
- Neutron – a particle with no charge located in the nucleus of an atom.
  - Neutrons have slightly more mass than protons.
  - A neutron consists of two down quarks and one up quark.

- Nucleus – the positively charged, dense center of an atom.
  - The nucleus contains protons and neutrons.
- Particle accelerator – the buildup of excess electric charge (positive or negative) on the surface of objects.
  - Static electricity is often produced by friction. For example, rubbing a balloon on hair causes electrons to be transferred from the hair to the balloon. This gives the balloon a net negative charge and the hair a net positive charge.
- Proton – a positively charged particle located in the nucleus of an atom.
  - Protons have slightly less mass than neutrons.
  - A proton consists of two up quarks and one down quark.
- Quark – an elementary particle that makes up protons, neutrons, and other baryons.
  - Quarks have fractional charge, either  $+\frac{2}{3}$  or  $-\frac{1}{3}$ .
  - There are six types, or “flavors,” of quarks in three generations:
    - Generation 1: up (charge  $+\frac{2}{3}$ ) and down (charge  $-\frac{1}{3}$ ).
    - Generation 2: charm ( $+\frac{2}{3}$ ) and strange ( $-\frac{1}{3}$ ).
    - Generation 3: top ( $+\frac{2}{3}$ ) and bottom ( $-\frac{1}{3}$ ).
- Strong nuclear force – the force responsible for binding protons and neutrons together within the nucleus of an atom.
  - The strong nuclear force is also known as the strong force or the strong interaction.
  - The strong force is the most powerful of the four fundamental forces but only acts at very small distances within the nucleus of the atom.
  - The strong force is a byproduct of the *color forces* that bind quarks together within hadrons.