LEARNING AS ONE NATION

Expanded Project

SHS LEARNING ACTIVITY

Name: _____ **Score/Mark:** _____

Grade and Section: _____ **Date:** _____

Strand: ☐ STEM ☐ ABM ☐ HUMSS ☐ ICT (*TVL Track*)

Subject: *Physical Science*

Type of Activity: ☑ Concept Notes ☑ Skills: Exercise/Drill ☐ Illustration ☐ Performance Task ☐ Essay/Report ☐ Others: _____

Activity Title: **LA02: Basic Concepts on Nuclear Reactions**

Learning Target: To describe and characterize the elementary particles, antiparticles, and types of radiation involved in nuclear reactions.

References: *(Author, Title, Pages)*

1) Chang, R. (2010). *Chemistry*, 10th edition, pp. 987-989;
2) Bernido, C. and Bernido, M. V. (2008). *Physics Essentials Portfolio*, pp. 142–150;
3) Sadudaquil, J. A. *CVIF–DLP Learning Activities*

Nuclear reactions – reactions involving changes in atomic nuclei.

Elementary particles in nuclear reactions:

1) **Proton** ($^{1}_{1}\mathrm{p}$) – found inside the atomic nucleus with a positive charge.
2) **Neutron** ($^{1}_{0}\mathrm{n}$) – also found inside the atomic nucleus, with a neutral charge, and is massless.
3) **Electron** ($^{0}_{-1}\mathrm{e}$ or $^{0}_{-1}\beta$) – in orbitals outside the nucleus.
4) **Alpha particle** ($^{4}_{2}\alpha$) – high-energy helium nucleus ($^{4}_{2}\mathrm{He}$).

Antiparticles in nuclear reactions:

1) **Positron** (denoted by $^{0}_{+1}\mathrm{e}$ or $^{0}_{+1}\beta$) – antiparticle of the electron (has the same mass, but bears a +1 charge).
2) **Neutrino** (denoted by $^{0}_{0}\nu$ or ν, the Greek letter 'nu') – an extremely tiny, almost massless particle, and is electrically neutral like the neutron.
3) **Antineutrino** ($^{0}_{0}\bar{\nu}$ or $\bar{\nu}$, 'nu bar') – antiparticle of the neutrino

Types of nuclear reactions:

1) **Nuclear transmutation** – result of the bombardment of nuclei by neutrons, protons, or other nuclei.
2) **Radioactivity** – spontaneous nuclear transmutation that results from the instability of an atomic nucleus (due to heavy nuclei or imbalance in nuclear forces holding them). The nucleus then emits particles and radiation spontaneously, forming stable daughter nuclides.
3) **Nuclear fusion** – formation of one or more new elements when two or more atomic nuclei combine.
4) **Nuclear fission** – splitting of atomic nuclei, thus forming new elements.

Types of radiation in nuclear reactions:

1) **Alpha (α) rays** – stream of positively charged particles.
2) **Beta (β) rays** – stream of negatively charged particles.
3) **Gamma (γ) rays** – electrically neutral radiation.

Exercise:

Illustrate the following nuclear reaction as described by drawing a series of atomic models (similar to **Fig. 1** in **LA01**) showing the involved atomic species. Use the same legend as that of **Fig. 1**. Differentiate the elementary particles by coloring them, according to your choice.

Beryllium-8 can capture an alpha particle, producing a proton and $^{11}_{5}\mathrm{B}$.

$$\boxed{^{8}_{4}\mathrm{Be} + ^{4}_{2}\alpha \rightarrow ^{1}_{1}\mathrm{p} + ^{11}_{5}\mathrm{B}}$$