Physics – 6th Grade High School
Project 3 – November 2017
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During the past century, applications of nuclear physics have had enormous effects on humankind, some beneficial, some catastrophic. Many people have strong opinions about applications such as bombs and reactors. Ideally, those opinions should be based on understanding, not on prejudice or emotion. How can some key properties of atomic
nuclei, including radii, densities, spins, and magnetic moments can help the humanity to build a better future?. How can we analyze some important types of nuclear reactions?

1. Modern Physics- Nuclear Physics.

What will you achieve at the end of this purpose?

Synthesize, analyze, interpret, and evaluate qualitative and/or quantitative data; Solve problems related to Einstein's theory of special relativity in order to calculate the effects of relativistic motion on time, length, and mass.

Analyze the development of the two major revolutions in modern physics and assess how they changed scientific thought.

Use appropriate terminology related to quantum mechanics and special relativity, including, but not limited to: quantum theory, photoelectric effect, matter waves, time dilation, and mass–energy transformation.

Pool of Knowledge: 11/03/2017 **Due Date: 11/06/2017**

Activities:

1.1 Respond the following questions.

a. What's Nuclear Physics?
b. What's Nuclear Density?
c. Explain the properties of the Nuclei.
d. What's Nuclear Stability?
e. What's Radioactivity?
f. Explain the Decay Processes.
g. Explain the biological effects of Radiation.
h. What's Nuclear Fission?
i. What's Nuclear Fusion?

1.2 Write the Equivalences of the following Nuclear Units:

a. 1eV= _____ joules.
b. 1MeV= _____ eV.
c. 1GeV= _____ eV.
d. 1TeV= _____ eV.
e. 1fm= _____ m.
f. 0.1nm= _____ Angstrom= _____ m.
g. 1u= _____ kg= _____ MeV= _____ eV= _____ Joules.

1.3 Solve the exercises and answer the conceptual questions:

Exercises:

a. Find the nuclear radii of (a) $^{2}_{1}H$, (b) $^{60}_{27}Co$, (c) $^{197}_{79}Au$, and (d) $^{239}_{94}Pu$.
b. How many protons and how many neutrons are there in a nucleus of the most common isotope of (a) silicon $^{28}_{14}Si$, (b) rubidium $^{85}_{37}Rb$, (c) thallium $^{205}_{81}Ti$.

Conceptual questions:

c. If no more people were to be born, the law of population growth would strongly resemble the radioactive decay law.'' Discuss this statement.
d. Why do nearly all the naturally occurring isotopes lie above the N = Z line in Figure 44.4?

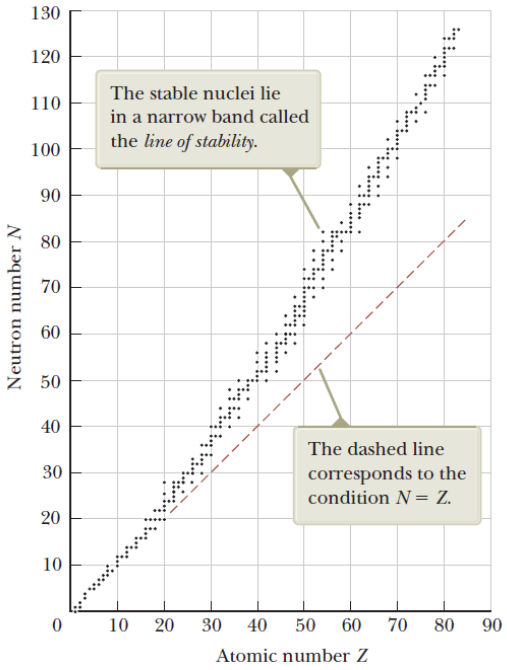

Figure 44.4 Neutron number N versus atomic number Z for stable nuclei (black dots).

e. Why are very heavy nuclei unstable?
f. Explain why nuclei that are well off the line of stability in Figure 44.4 tend to be unstable.

2. Modern Physics- Relativistic Physics.

What will you achieve at the end of this purpose?

Analyze the development of the two major revolutions in modern physics and assess how they changed scientific thought.

Describe the contributions of scientists to the fields under study.

Identify Einstein's two postulates for the theory of special relativity, and describe the evidence supporting the theory.

Pool of Knowledge: 11/10/2017 **Due Date: 11/13/2017**

Activities:

2.1 Explain the following.

a. The Principle of Galilean Relativity.
b. The Michelson–Morley Experiment.
c. Einstein's Principle of Relativity.
d. Consequences of the Special Theory of Relativity.
e. The Lorentz Transformation Equations.
f. The Lorentz Velocity Transformation Equations.
g. Relativistic Linear Momentum.
h. Relativistic Energy.
i. The General Theory of Relativity.

2.2 Complete the following chart.

Einstein's postulates for the theory of special relativity	**What does it state?**	**Applications to Classical Mechanics**
1st Postulate (principle of relativity)		
2nd Postulate (invariance of c)		

2.3 Answer the conceptual questions:

a. **(i)** Does the speed of an electron have an upper limit? (a) Yes, the speed of light c (b) yes, with another value (c) no.
(ii) Does the magnitude of an electron's momentum have an upper limit? (a) Yes, $m_e c$ (b) yes, with another value (c) no.
(iii) Does the electron's kinetic energy have an upper limit? (a) Yes, $m_e c^2$ (b) yes, $\frac{1}{2} m_e c^2$ (c) yes, with another value (d) no.

b. In several cases, a nearby star has been found to have a large planet orbiting about it, although light from the planet could not be seen separately from the starlight. Using the ideas of a system rotating about its center of mass and of the Doppler shift for light, explain how an astronomer could determine the presence of the invisible planet.

c. List three ways our day-to-day lives would change if the speed of light were only 50 m/s.

d. The speed of light in water is 230 Mm/s. Suppose an electron is moving through water at 250 Mm/s. Does that violate the principle of relativity? Explain.

e. Give a physical argument that shows it is impossible to accelerate an object of mass m to the speed of light, even with continuous force acting on it.

3. **Applied Physics and Astrophysics.**

What will you achieve at the end of this purpose?

Analyze the efficiency and the environmental impact of one type of electrical energy production and propose ways to improve the sustainability of electrical energy production.

Use appropriate terminology related to planetary physics.

Identify Newton's laws, and use them to explain planetary motion.

Pool of Knowledge: 11/17/2017 Due Date: 11/20/2017

Activities:

3.1 Answer the following conceptual questions:

a. What's Particle Physics?
b. What's Cosmology?
c. What is a Quark? What's its symbol? What's its electric charge? What's its spin? And when was discovered?
d. What's a Kaon? What's its symbol? What's its electric charge? What's its mass? And when was discovered?
e. What interactions affect protons in an atomic nucleus? More than one answer may be correct. (a) The nuclear interaction (b) the weak interaction (c) the electromagnetic interaction (d) the gravitational interaction.
f. The W and Z bosons were first produced at CERN in 1983 by causing a beam of protons and a beam of antiprotons to meet at high energy. Why was this discovery important?
g. What are the differences between hadrons and leptons?
h. Neutral atoms did not exist until hundreds of thousands of years after the Big Bang. Why?
i. Describe the properties of baryons and mesons and the important differences between them.
j. In the theory of quantum chromodynamics, quarks come in three colors. How would you justify the statement that "all baryons and mesons are colorless"?
k. Describe the essential features of the Standard Model of particle physics.
l. How many quarks are in each of the following: (a) a baryon, (b) an antibaryon, (c) a meson, (d) an antimeson? (e) How do you explain that baryons have halfintegral spins, whereas mesons have spins of 0 or 1?
m. Name the four fundamental interactions and the field particle that mediates each.
n. How did Edwin Hubble determine in 1928 that the Universe is expanding?
o. Kaons all decay into final states that contain no protons or neutrons. What is the baryon number for kaons?

3.2 Investigate the following:

a. Laser
   - Definition.
   - A brief historical review.
   - Properties.
   - Applications.
   - Draw parts and components of a typical Laser.

Closing Activity. November 24 2017.

Home Generator project

With the previous knowledge acquired in class get in teams to construct your own **Home Generator project**.

The goal of the project is to create a device that converts mechanical energy to electrical energy and Analyze how a DC Motor can be converted into a Generator to produce electrical energy using the principles of Nuclear Physics.

	Requirements	**Total points**
Construction of the project	• Quality of design and materials, safety considered. • The rocket works only using mechanical energy.	**3 pts**
Performance of the project	• The generator must work by lighting the LED bulb. • The rocket works only using mechanical energy. • Ability to work anytime as desired.	**2 pts**
Team Work	• All students must participate in the construction of the project.	**2 pts**
Written Report	• Explain your reasons for your design. • Explain the physics found in your project. • Discuss any potential problem(s) and how you remedy this.	**3 pts** Creative cover page, name of students, class period, course, date. Organization includes the requirements with drawings, labels, pictures, formulas and calculations if needed.