Course Title: THE PRINCIPLES OF PHYSICAL SCIENCE

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Cycle/Division: High School

Grade Level: Grade 9

Credit Unit: 1

Duration: 2 semesters / 5 periods per week

Department’s Vision: Create Innovators who can link to life, with scientific understanding and learning.

Department’s Mission: Provide students with the proper knowledge, skills and scientific principles through hands on activities, research and experimentations, and thus creating young innovators who are ready for real life challenges and problem solving.

COURSE DESCRIPTION:

This course introduces basics of chemistry and physics courses preparing students for grads 11 and 12. Topics include measurement, atomic and molecular structure, periodicity, chemical reactions, chemical bonding, thermochemistry, acids/bases, Newton’s Laws, one and two dimension motion, circuits, electric and magnetic fields, electromagnetic theory and many of its applications. The laboratory work is based on research and application with a term lab theoretical and practical assessment.

General Academic Goals:
Understand matter on the macro and the micro level and be able to identify the changes taking place physically and chemically.
Understand the structure of the atom and its ability to form different bonds and eventually forming different compounds and how its nucleus can form radioactive decay.
Write chemical reactions and be able to apply the law of conservation of mass through balancing.
Describe the properties of pure and impure matter and understand the physical internal interactions in the formation of different impure substances.
Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe...
and predict the gravitational and electrostatic forces between objects.
Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.
Measure, calculate, and graph the speed of an object’s position as a function of time. Describe the motion of an object by its position and velocity as functions of time and by its average speed and average acceleration during intervals of time.
Study basic Forces in Nature Objects can interact with each other by “direct contact” (e.g., pushes or pulls, friction) or at a distance (e.g., gravity, electromagnetism, nuclear). Calculate net Forces specifying magnitude and direction and applying Newton’s First Law.
Apply Newton’s Third Law.
Understand forces and acceleration as a change of speed happens.
Understand energy Transformation and study specifically energy converted to thermal energy.
Understand, analyze, and relate Kinetic and Potential Energy.
Understand the different properties of circuits and their types and apply Ohm’s Law.
Understand nuclear Reactions and the related changes in atomic nuclei that can occur through three processes: fission, fusion, and radioactive decay.
Understand radioactive decay that occurs naturally in the Earth’s crust (rocks, minerals) and can be used in technological applications (e.g., medical diagnosis and treatment).

**General Skills:**
- **Evaluation skills**: making judgment about knowledge by introducing new text to solve and tackle problems using the related knowledge taught.
- **Comprehension**: given scientific text or diagrams to analyze and answer questions about, summarize, compare, relate, or experiment...
- **Communication and social skills**: Making movies, ppt., projects, interviews, and presenting the work either individually or with a peer or as a group.
- **Investigative skills**: lab work, research, journals, experimentation...
- **Mathematical skills**: related to investigations in the lab and application in projects.
- **Technological skills** used in science and computer labs.
- **Knowledge skills**: list, define, show, demonstrate, invent, relate etc... using the taught concepts.

**GENERAL COURSE LEARNING OBJECTIVES:**
- Distinguish between extensive and intensive properties
- Distinguish between physical and chemical properties.
- Distinguish between physical and chemical change.
- Distinguish between the properties of solids, liquids and gases.
- Distinguish between mixtures and pure substances.
- Distinguish between types of mixtures.
- Distinguish between elements and compounds.
- Indicate how the law of conservation of energy applies to changes of matter.
- Use a periodic table to name elements.
Use a periodic table to write the symbols of elements.
Describe the arrangement of the periodic table.
List the characteristics of metals, nonmetals and metalloids.
Define atom
Explain what isotopes are
Define atomic number and mass number and describe how they apply to isotopes.
Determine the no. of protons, neutrons and electrons
Define: mole, Avogadros no., Molar mass and how are they related.
Relate the no. of sublevels corresponding to each of an atom’s main energy levels, the number of orbitals per sublevel and the number of orbitals per main energy level.
Describe electron configurations and electron notation and noble gas notation.
Describe periods and groups,
Locate and name the four blocks of the periodic table,
Describe electronegativity, bond energy across the group and the period.
Describe the relationship between electron in sublevels and the length of each period of the periodic table.
Locate and name the four blocks of the periodic table. Explain the reasons for these names.
Define chemical bond
Explain why most atoms form chemical bonds
Describe ionic and covalent bonding
Explain why most chemical bonding is neither purely ionic nor purely covalent
Classify bonding type according to electro negativity differences
Define molecule and molecular formula
Explain the relationships among potential energy, distance between approaching atoms, bond length, and bond energy.
List the six basic steps used in writing lewis structures
Explain how to determine lewis structures for molecules containing single bonds, multiple bonds, or both.
Explain why scientists use resonance structures to represent some molecules
Compare and contrast a chemical formula for a molecular compound with one for an ionic compound.
Discuss the arrangements of ions in crystals
Define lattice energy and explain its significance
List and compare the distinctive properties of ionic and molecular compounds.
Explain the significance of a chemical formula.
Determine the formula of an ionic compound formed between two given ions.
Name an ionic compound given its formula
Using prefixes, name a binary molecular compound from its formula.
Write the formula of a binary molecular compound given its name.
List three observations that suggest a chemical reaction has taken place
List three requirements for a correctly written chemical equation.
Write a word equation and a formula equation for a given chemical reaction
Balance a formula equation by inspection
Define and classify general equations for synthesis, decomposition, single replacement, and double replacement
List 5 general properties of aqueous acids and bases
Name common binary acids and oxy acids, given their chemical formulas.
Define acid and base according to Arrhenius’s theory of ionization.
Explain the differences between strong and weak acids and bases
Define temperature and state the units in which it is measured.
Define heat and state its units.
Perform specific heat calculations.
Explain enthalpy change, enthalpy of reaction, enthalpy of formation, and enthalpy of combustion.
Explain the concept of reaction mechanism.
Use the collision theory to interpret chemical reactions.
Define activated complex.
Relate activation energy to enthalpy of reaction
List basic SI units and the quantities they describe.
Convert measurements into scientific notation.
Distinguish between accuracy and precision
Describe motion in terms of frame of reference, displacement, time, and velocity.
Calculate the displacement of an object traveling at a known velocity for a specific time interval.
Construct and interpret graphs of position versus time.
Describe motion in terms of changing velocity.
Compare graphical representations of accelerated and non-accelerated motions.
Apply kinematic equations to calculate distance, time, or velocity under conditions of constant acceleration.
Relate the motion of a freely falling body to motion with constant acceleration.
Calculate displacement, velocity, and time at various points in the motion of a freely falling object.
Compare the motions of different objects in free fall.
Describe how force affects the motion of an object.
Interpret and construct free-body diagrams.
Explain the relationship between the motion of an object and the net external force acting on the object.
Determine the net external force on an object.
Calculate the force required to bring an object into equilibrium.
Describe an object’s acceleration in terms of its mass and the net force acting on it.
Predict the direction and magnitude of the acceleration caused by a known net force.
Identify action-reaction pairs.
Understand the basic properties of electric charge.
Differentiate between conductors and insulators.
Distinguish between charging by contact, charging by induction, and charging by polarization.
Calculate electric field strength.
Draw and interpret electric field lines.
Identify the four properties associated with a conductor in electrostatic equilibrium.
Distinguish between electrical potential energy, electric potential, and potential difference.
Solve problems involving electrical energy and potential difference.
Describe the basic properties of electric current, and solve problems relating current, charge, and time.
Distinguish between the drift speed of a charge carrier and the average speed of the charge carrier between collisions.
Calculate resistance, current, and potential difference by using the definition of resistance.
Distinguish between ohmic and non-ohmic materials.
Interpret and construct circuit diagrams.
Identify circuits as open or closed.
Deduce the potential difference across the circuit load, given the potential difference across the battery’s terminals.
Calculate the equivalent resistance for a circuit of resistors in series, and find the current in and potential difference across each resistor in the circuit.
Calculate the equivalent resistance for a circuit of resistors in parallel, and find the current in and potential difference across each resistor in the circuit

**STANDARDS/BENCHMARKS:**

**Structure and Properties of Matter**
HS-PS1-1 Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-3 Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
HS-PS1-8 Develop models to illustrate the changes in the composition of the nucleus of the atom and the
energy released during the processes of fission, fusion, and radioactive decay.

HS-PS2-6 Communicate scientific and technical information about why the molecular level structure is important in the functioning of designed materials. *

**Chemical Reactions**

HS-PS1-2 Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.

HS-PS1-4 Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

HS-PS1-5 Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.

HS-PS1-6 Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.*

HS-PS1-7 Use mathematical representations to support the claim that atoms, and therefore mass, are conserved during a chemical reaction.

**Forces and Interactions**

HS-PS2-1 Analyze data to support the claim that Newton’s second law of motion describes the mathematical relationship among the net force on a macroscopic object, its mass, and its acceleration.

HS-PS2-2 Use mathematical representations to support the claim that the total momentum of a system of objects is conserved when there is no net force on the system.

HS-PS2-3 Apply scientific and engineering ideas to design, evaluate, and refine a device that minimizes the force on a macroscopic object during a collision.*

HS-PS2-4 Use mathematical representations of Newton’s Law of Gravitation and Coulomb’s Law to describe and predict the gravitational and electrostatic forces between objects.

HS-PS2-5 Plan and conduct an investigation to provide evidence that an electric current can produce a magnetic field and that a changing magnetic field can produce an electric current.

**Energy**

HS-PS3-1 Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

HS-PS3-2 Develop and use models to illustrate that energy at the macroscopic scale can be accounted for as a combination of energy associated with the motions of particles (objects) and energy associated with the relative position of particles (objects).

HS-PS3-3 Design, build, and refine a device that works within given constraints to convert one form of energy into another form of energy.*

HS-PS3-4 Plan and conduct an investigation to provide evidence that the transfer of thermal energy when two components of different temperature are combined within a closed system results in a more uniform energy distribution among the components in the system (second law of thermodynamics).

HS-PS3-5 Develop and use a model of two objects interacting through electric or magnetic fields to illustrate the forces between objects and the changes in energy of the objects due to the
interaction.

**Engineering Design**

HS-ETS1-1 Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.

HS-ETS1-2 Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.

HS-ETS1-3 Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics, as well as possible social, cultural, and environmental impacts.

HS-ETS1-4 Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

**RESOURCES:**

Fusion Earth Science book and online resources
One Stop Planner, Linked Lesson presentations, Extended Visual Labs
You Tube movies
E-games and links
Teacher’s Extended Handouts
Lab Handouts

**COURSE OUTLINE:**

*Chapter 1 Matter and Change*

Section 2: *Matter and its properties*

Section 3: *Elements*

*Chapter 3 Atoms: The building blocks of Matter*

Section 2: *The structure of the atom*

Section 3: *Counting atoms*
Chapter 4
Section 2: The quantum model of the atom
Section 3: Electron configurations

Chapter 5: The periodic Law
Section 2: Electron configuration and the periodic table

Chapter 6: Chemical Bonding
Section 1: Introduction to chemical bonding
Section 2: Covalent Bonding and Molecular Compounds
Section 3: Ionic bonding and ionic compounds.

Chapter 7: Chemical Formulas and Chemical Compounds
Section 1: Chemical Names and Formulas.

Chapter 8: Chemical Equations and reactions
Section 1: Describing chemical reactions
Section 2: Types of chemical reactions

Chapter 14: Acids and Bases
Section 1: Properties of acids and bases

Chapter 16: Reaction Energy
Section 1: Thermochemistry

Chapter 17: Reaction Kinetics
Section 1: The reaction Process
Chapter 1: The Science of Physics
Section 2: Measurements in Experiments

Chapter 2: Motion in One Dimension
Section 1: Displacement and velocity
Section 2: Acceleration
Section 3: Falling objects

Chapter 4: Forces and The Laws of Motion
Section 1: Changes in Motion
Section 2: Newton’s First Law
Section 3: Newton’s Second and Third Law

Chapter 16: Electric Forces and fields
Section 1: Electric Charge
Section 3: The Electric Field

Chapter 17: Electrical Energy and Current
Section 1: Electrical Potential
Section 3: Current and Resistance

Chapter 18: Circuits and Circuit Elements
Section 1: Schematic Diagrams and Circuits
Section 2: Resistors in Series or in parallel
1. **Quizzes/tests** are given every other week as assigned by school. **Our tests and assessments** consist of multiple-choice, short answer, direct application problems, critical thinking situations, refer to figures, texts, graphs and/or open response items. They are aligned with Michigan benchmarks. A student failing any of his quizzes would have to sit for a **support class and retest** to achieve his 60% which is our passing mark. A progress report is sent to the parent eventually after sitting for the **make up exam.** 40 % is given to students that do not have a medical excuse for missing such an assessment. The department considers the highest 2 grades out of 3 exams.

2. **Skill Based Assignments** are done in class where a student has his resources all opened in front of him to answer a set of questions under verbal, nonverbal, quantitative, and spatial domains.

3. **Research Sessions** are done under where students can debate as groups and check the internet for resources and answers to support their ideas. This kind of Assessment is lined under **Research Lab Sessions or the copybook Journals.** They are evaluated to info, creativity, presentation, discussion and relation to the subject.

4. **Daily assessments and drop quizzes** take place to check the understanding of students.

5. **Laboratory work** is checked for research, completeness, accuracy, understanding the experiment, group work, and reports submitted completed. The general lab course has a separate grade than the subject labs. The policy of the general lab is attached within the manual itself.

7. **Projects** are integrated across and assigned for every term. They are evaluated to accuracy, creativity, info and relation to the subject.

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**Grade Distribution:**

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<th>SCIENCE DEPARTMENT GRADE DISTRIBUTION</th>
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<td><strong>HIGH SCHOOL</strong></td>
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Cross-Curricular Project(s):
- Integrated project Once per semester across the disciplines.