Investigative Science Course Descriptions:

Investigative Science Investigative Science is a physical laboratory science course that focuses on the topics of the Scientific Process, Physics, Chemistry and Earth Science through the use of inquiry and mathematics. Students will obtain, evaluate, and communicate scientific information reading scientific texts, using mathematical practices, conducting numerous hands-on laboratory investigations, collecting, analyzing and interpreting data and communicating their scientific knowledge through writing and speaking. This course will lay a solid foundation for students to pursue multiple avenues of science in high school and beyond.

Grade Level: 9-10

Entrance Requirements: N/A

Standards: Meets graduation, AZCCRS. Pending University and NCAA requirements

Outline of Course Units:

Unit 1: Introduction to Science Practices & Skills

Will cover:

- science skills associated with the scientific method
- measurement and the metric system
- calculations using dimensional analysis between units in the metric system
- safety protocols

Students will complete:

- scientific investigation of density (using mass and volume data) – focus is on how to collect and organize data, using safety protocols, using equipment and tools appropriately and safely, data analysis
- practice calculations with metric to metric conversions using dimensional analysis

Unit 2: The Components of Matter: Matter (Elements, Compounds, Mixtures, Solutions)

Will cover:

- the definitions of, and the differences between, elements, compounds, and mixtures
- the definition of matter
- the components of a solution, and how to calculate the concentration of a solution
- modeling elements, compounds, mixtures
- definitions and examples of physical properties and physical changes of matter
- definitions and examples of the chemical properties and chemical changes of matter (just define and give examples, do not actually investigate these changes)

Students will do the following:

- separation of a mixture
- modeling of elements, compounds, and mixtures activity
- evaluation of the differences (at the molecular level) of solids, liquids, and gases

Unit 3: The Components of Matter: Gas Laws

Will cover:

- variables investigated with gases (pressure, amount, temperature, volume)
- define and give an example of a proportional relationship
- statement of and explanation of Boyle's Law (P vs V)
- statement of and explanation of Charles' Law (V vs T)
- statement of and explanation of Avogadro's Law (amount vs V)
- statement of and explanation of Gay-Lussac's Law (T vs P)
- statement of and explanation how the pressure is affected by an increase of mass in a fixed volume

Students will do the following:

- investigations of Boyle's Law, Charles' Law, Avogadro's Law, Gay-Lussac's Law, and pressure vs amount

Unit 4: The Components of Matter: The Periodic Table

Will cover:

- families of the PT
- periodicity
- isotopes

Students will do the following:

- identifying the families of the periodic table
- identifying the commonalities of the elements within a given family
- defining and explaining electronegativity, atomic radius, ionization energy
- relating location of an element on the PT to its electronegativity, atomic radius, and ionization energy
- defining atomic number and atomic mass

Unit 5: The Components of Matter: Atomic Structure (atomic particles, electron configuration, atomic forces)

Will cover:

- defining and locating protons, neutrons and electrons
- electron configuration
- atomic forces (Coulombic attraction)
- formation and definition of ions
- Bohr modeling
- Defining valence electrons and creating Lewis dot diagrams
- Relating periodicity to ion charge
- Explaining how elements become ions, and what kind of ion each type of element will make
- Radioactive decay and nuclear energy

Students will do the following:

- Bohr models of elements from H to Ca
- Lewis dot diagramming elements on the PT, all elements outside of the transition metals, lanthanides, and actinides
- Modeling ion formation using Bohr models and Lewis dot diagrams

- Calculating ion charge from a Lewis dot diagram
- Flame test
- Modeling radioactive decay and identifying the products of alpha, beta+, beta-, electron capture, and gamma decay
- Modeling electron configuration and orbital diagrams for elements up to Ba.

Unit 6: Chemical Reactions: Bonding

Will cover:

- Modeling ionic bonding using Lewis dot diagrams
- Nomenclature for ionic and covalent compounds
- Using polyatomic ions in ionic bonding
- Explaining why elements bond --- which is to lower their energy/make them more stable
- Predicting the chemical formula for ionic and covalent compounds

Students will do the following:

- Investigations in types of bonds – differentiating ionic, covalent, metallic, and hydrogen bonds
- Naming compounds and identifying what type of bond to determine which nomenclature is appropriate for each compound formula
- Predicting the chemical formulas for each type of compound (except metallic and hydrogen bonding)
- Modeling ionic bonding and covalent bonding using Lewis dot diagrams
- Predicting the charge of the ions in an ionic compound
- Predicting the number of valence electrons from the charge on an ion
- Modeling the use of polyatomic ions in ionic compounds
- Explaining how ionic and covalent compounds get their name
- Using nomenclature correctly with polyatomic ions in ionic compounds
- Relating/Using periodicity to form ions and ionic compounds

Unit 7: The Components of Matter: Chemical Properties

Will cover:

- The different types of chemical reactions
- Defining and evidence of chemical change
- Predicting products of double replacement reactions using bonding concepts
- Predicting products of combustion reactions
- Identifying the differences between synthesis and decomposition reactions
- Identifying the parts of a chemical equation (reactants and products)
- Writing a chemical equation

Students will do the following:

- Identifying and explaining how a chemical change and physical change are different
- Investigating evidence of chemical change in a lab activity
- Investigating the different types of chemical reactions through a lab activity
- Predicting products using reactants as clues

- Modeling chemical change using chemical equations
- Identifying and labeling the parts of a chemical equation (reactants, products)
- Classifying a reaction using the reactants
- Investigating the cause and effect relationships between reaction rate factors

Unit 8: Chemical Reactions: Stoichiometry

Will cover:

- Balancing chemical reactions
- Explaining the application of the Law of Conservation of Mass/Matter
- Predicting products of a chemical reaction (using the reactants as clues)

Students will do the following:

- Classifying, predicting products for, and balancing chemical equations

Unit 9: Chemical Reactions: Energy

Will cover:

- The law of conservation of energy as its applied in chemical reactions(Hess' Law)
- Enthalpy
- Calculations of energy in phase changes
- Identification of system and surrounding

Students will complete:

- Calculations in chemical reactions using Hess' Law
- Calculations in phase changes, identifying whether a change in endothermic or exothermic

Unit 10: Chemical Reactions: Equilibrium

Will cover:

- Collision theory and activation energy to describe how chemical reactions take place
- Investigating the 4 factors that can affect reaction rates and explaining the result of such investigation, explaining why each changes
- Rates of reactions and their purpose in chemistry
- Determining the relative rate of reaction and direction given time and concentration
- Qualitative relationships between concentrations of reactants and products in a system which exists in a state of equilibrium
- Definition of K_{eq} and writing expressions for K_{eq}
- Relating the magnitude of K_{eq} to relative amounts of product and reactant
- Predicting the direction of a reaction using K_{eq}
- Le Chatelier's principle and its application in predicting the shift in a reaction when conditions are changed

Student will do the following:

- modeling collision theory and using it to describe how chemical reactions take place

- Investigating reaction rate factors and explaining the effect of changing each factor (concentration, temperature, catalyst, pressure)
- Investigating the rate of a reaction in a lab activity
- Investigating equilibrium in a lab activity

Unit 11: Physics: Newton's Laws

Will cover:

- Identifying differences and similarities between vectors and scalars
- Investigate reference frames when making calculations
- Determine average acceleration when given changes in velocity
- Determine the characteristics of a 2D projectile
- Use kinematic equations to determine values for a horizontally launched projectile
- Definitions of Newton's 1st, 2nd, and 3rd law
- Describe examples for each of Newton's laws
- Discuss and identify different forces (normal force, friction, gravity, centripetal force and air resistance)
- Identify changes in energy through energy transformation examples
- Discuss conservation of energy and conservation of momentum

Students will do the following:

- Determine changes in acceleration, velocity, distance, and displacement through a map activity
- Investigate 2D projectiles and use kinematic equations to make calculations in a water balloon launch lab
- Identify Newton's laws in real world examples
- Use Newton's laws to construct a balloon cart
- Identify forces involved with centripetal force
- Research real-world examples of energy transformations and their positive and negative effects on the environment and society

Unit 12: Physics: Electricity and Magnetism

Will cover:

- Describing events leading to the triboelectric effect
- Defining and using coulomb's law
- Characteristics of conductors and insulators
- Characterizing properties of electric fields
- Identifying relationships between electric fields and electric forces
- Calculating electric potential energy in a uniform electric field
- Constructing circuits with resistors in series
- Constructing circuits with resistors in parallel
- Defining Ohm's Law

Students will do the following:

- Investigate voltage through virtual lab

- Buildings circuits through virtual lab
- Writing observations for electric field and forces in virtual lab
- Writing observations about the triboelectric effect in a virtual lab

Unit 13: Physics: Waves

Will cover:

- Identify characteristics of periodic waves
- Calculate wavelength, period, and frequency
- Assess changes in amplitude and frequency as they pertain to light
- Investigate the electromagnetic spectrum and classify types of radiation based on frequency and wavelength
- Determine real-world uses for radiation and determine good and bad effects on humans
- Explain the doppler effect as it relates to sound and light
- identify characteristics of standing waves
- Identify diffraction, reflection, and refraction as they relate to the behavior of light and water

Students will do the following:

- Calculate wavelength, frequency, and period when provided necessary variables
- Construct an informational poster on the electromagnetic spectrum
- Research real-world examples of the waves found on the electromagnetic spectrum

Unit 14: Earth Science: Structure and Processes

Will cover:

- radiometric dating
- cycling of matter – focusing on the origination of energy from the interior of Earth
- structure of the Earth

Students will do the following:

- model Earth's structure
- relating geological time scale to major Earth events
- model cycling of matter
- modeling radioactive decay
- modeling and calculating half-life

Unit 15: Space Science: Planetary Motions and The Universe

Will cover:

- nuclear decay
- fusion and fission
- star life cycle
- scope of the universe and the hierarchy of the objects/units in the universe (planet, solar system, galaxy, etc.)

Students will do the following:

- model nuclear decay
- model fusion and fission
- model the life cycle of a star showing the various possible outcomes
- construct a hierarchy of the universe to show the size and scope

Unit 16: Space Science: Nuclear Reactions

Will cover:

- Kepler's Laws
- Newton's Law of universal gravitation
- Coulomb's Law
- Planetary motion

Students will do the following:

- Calculate the gravitational pull on an object
- Model planetary motion
- Construct a model to demonstrate the application of Coulomb's Law
- Calculations of momentum

Science Sequence:

Science Sequence	
Grade	**Accelerated**
7th	Exploring Science
8th	Science Inquiry
9th	**Investigative Science**
10th	Biology
11th	Biology II
12th	Science Credit Complete for Graduation OR Optional Science Elective

Examples of Three Major Assessments:

Midterm (End of Q1/Q3)

Final Exam (End of Q2/Q4)