

Physical Science: Embedded Inquiry

Conceptual Strand

Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21st century.

Guiding Question

What tools, skills, knowledge, and dispositions are needed to conduct scientific inquiry?

Course Level Expectations

CLE 3202.Inq.1 Recognize that science is a progressive endeavor that reevaluates and extends what is already accepted.

CLE 3202.Inq.2 Design and conduct scientific investigations to explore new phenomena, verify previous results, test how well a theory predicts, and compare opposing theories.

CLE 3202.Inq.3 Use appropriate tools and technology to collect precise and accurate data.

CLE 3202.Inq.4 Apply qualitative and quantitative measures to analyze data and draw conclusions that are free of bias.

CLE 3202.Inq.5 Compare experimental evidence and conclusions with those drawn by others about the same testable question.

CLE 3202.Inq.6 Communicate and defend scientific findings.

Checks for Understanding

✓**3202.Inq.1** Trace the historical development of a scientific principle or theory.

✓**3202.Inq.2** Conduct scientific investigations that include testable questions, verifiable hypotheses, and appropriate variables to explore new phenomena or verify the experimental results of others.

✓**3202.Inq.3** Select appropriate tools and technology to collect precise and accurate quantitative and qualitative data.

✓**3202.Inq.4** Determine if data supports or contradicts a hypothesis or conclusion.

✓**3202.Inq.5** Compare or combine experimental evidence from two or more investigations.

✓**3202.Inq.6** Recognize, analyze, and evaluate alternative explanations for the same set of observations.

✓**3202.Inq.7** Analyze experimental results and identify possible

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	<p>sources of experimental error.</p> <p>✓3202.Inq.8 Formulate and revise scientific explanations and models using logic and evidence.</p> <p>✓3202.Inq.9 Evaluate the accuracy and precision of data.</p> <p>✓3202.Inq.10 Explore how bias can affect conclusions and identify conclusions that are affected by bias.</p>
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Physical Science : Embedded Technology & Engineering

Conceptual Strand

Society benefits when engineers apply scientific discoveries to design materials and processes that develop into enabling technologies.

Guiding Question

How do science concepts, engineering skills, and applications of technology improve the quality of life?

Course Level Expectations	Checks for Understanding
<p>CLE 3202.T/E.1 Explore the impact of technology on social, political, and economic systems.</p> <p>CLE 3202.T/E.2 Differentiate among elements of the engineering design cycle: design constraints, model building, testing, evaluating, modifying, and retesting.</p> <p>CLE 3202.T/E.3 Explain the relationship between the properties of a material and the use of the material in the application of a technology.</p>	<p>✓3202.T/E.1 Select appropriate tools to conduct a scientific inquiry.</p> <p>✓3202.T/E.2 Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.</p> <p>✓3202.T/E.3 Explore how the unintended consequences of new technologies can impact human and non-human communities.</p> <p>✓3202.T/E.4 Present research on current engineering technologies that</p>

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<p>CLE 3202.T/E.4 Describe the dynamic interplay among science, technology, and engineering within living, earth-space, and physical systems.</p>	<p>contribute to improvements in our daily lives.</p> <p>✓3202.T/E.5 Design a series of multi-view drawings that can be used by other students to construct an adaptive design and test its effectiveness.</p> <p>✓3202.T/E.6 Evaluate the overall benefit to cost ratio of a new technology.</p>
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Physical Science : Embedded Mathematics

Conceptual Strand

Physical science applies mathematics to investigate questions, solve problems, and communicate findings.

Guiding Question

What mathematical skills and understandings are needed to successfully investigate physical science?

Course Level Expectations	Checks for Understanding
<p>CLE 3202.Math.1 Understand the mathematical principles behind the science of physics.</p> <p>CLE 3202.Math.2 Utilize appropriate mathematical equations and processes to solve basic physics problems.</p>	<p>✓3202.Math.1 Use a variety of notations appropriately (e.g. exponential, functional, square root).</p> <p>✓3202.Math.2 Select and apply an appropriate method (e.g., mental mathematics, paper and pencil, or technology) for computing with real numbers, and evaluate the reasonableness of results.</p> <p>✓3202.Math.3 Apply and interpret rates of change from graphical and numerical data.</p> <p>✓3202.Math.4 Analyze graphs to describe the behavior of functions.</p>

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	<p>✓3202.Math.5 Interpret results of algebraic procedures.</p> <p>✓3202.Math.6 Model real-world phenomena using functions and graphs.</p> <p>✓3202.Math.7 Articulate and apply algebraic properties in symbolic manipulation.</p> <p>✓3202.Math.8 Apply geometric properties, formulas, and relationships to solve real-world problems.</p> <p>✓3202.Math.9 Make decisions about units, scales, and measurement tools that are appropriate for problem situations involving measurement.</p> <p>✓3202.Math.10 Collect, represent, and describe linear and nonlinear data sets developed from the real world.</p> <p>✓3202.Math.11 Make predictions from a linear data set using a line of best fit.</p> <p>✓3202.Math.12 Interpret a data set using appropriate measures of central tendency.</p> <p>✓3202.Math.13 Choose, construct, and analyze appropriate graphical representations for a data set.</p> <p>✓3202.Math.14 Use concepts of length, area, and volume to estimate and solve real-world problems.</p>
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Physical Science : Standard 1 - Matter

Conceptual Strand 1

The composition and structure of matter is known, and it behaves according to principles that are generally understood.

Guiding Question 1

How does the structure of matter influence its physical and chemical behavior?

Course Level Expectations	Checks for Understanding
CLE 3202.1.1 Explore matter in terms of its physical and chemical properties.	✓ 3202.1.1 Distinguish among solids, liquids, gases, and plasmas.
CLE 3202.1.2 Describe the structure and arrangement of atomic particles.	✓ 3202.1.2 Describe and illustrate the physical differences among solids, liquids, and gases in terms of their mass, volume, density, shape, and particle arrangement.
CLE 3202.1.3 Characterize and classify elements based on their atomic structure.	✓ 3202.1.3 Use appropriate units to measure or calculate the mass and volume of substances.
CLE 3202.1.4 Investigate chemical and physical changes.	✓ 3202.1.4 Calculate the density of substances or objects.
CLE 3202.1.5 Evaluate pure substances and mixtures.	✓ 3202.1.5 Construct and interpret a density column.
CLE 3202.1.6 Distinguish between common ionic and covalent compounds.	✓ 3202.1.6 Identify substances as homogeneous or heterogeneous mixtures.
CLE 3202.1.7 Construct chemical formulas for common compounds.	✓ 3202.1.7 Construct an experiment to separate the components of a mixture.
CLE 3202.1.8 Investigate relationships among the pressure, temperature, and volume of gases and liquids.	✓ 3202.1.8 List the three major subatomic particles and distinguish among their location, charges, and relative masses.
CLE 3202.1.9 Apply the Laws of Conservation of Mass/Energy to	

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<p>balance chemical equations.</p> <p>CLE 3202.1.10 Distinguish among acids, bases, and neutral substances.</p>	<p>✓3202.1.9 Distinguish between atomic number and atomic mass.</p> <p>✓3202.1.10 Define an isotope and describe the use of common isotopes.</p> <p>✓3202.1.11 Identify the number of protons, neutrons, and electrons in an atom of an isotope based on its atomic number and atomic mass.</p> <p>✓3202.1.12 Know the chemical symbols for the common elements.</p> <p>✓3202.1.13 Use the periodic table to determine the number of protons, neutrons, and electrons in an isotope of an element.</p> <p>✓3202.1.14 Use the periodic table to identify the characteristics and properties of metals, non-metals, and metalloids.</p> <p>✓3202.1.15 Label a periodic table with oxidation numbers of main group elements, identify elements likely to form ions and use information to construct formulas for compounds.</p> <p>✓3202.1.16 Classify a substance as an element or compound based on its chemical formula or symbol.</p> <p>✓3202.1.17 Explain ionic and covalent bonding based on the oxidation numbers of the elements in a compound.</p> <p>✓3202.1.18 Investigate physical and chemical changes in a laboratory setting.</p> <p>✓3202.1.19 Balance simple chemical equations, identifying the reactants, products, and proper coefficients.</p> <p>✓3202.1.20 Predict the products of common chemical reactions.</p>
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	<p>✓3202.1.21 Use models to represent chemical reactions as synthesis, decomposition, single-replacement, and double-replacement.</p> <p>✓3202.1.22 Describe synthesis, decomposition, single-replacement, and double-replacement reactions using equations.</p> <p>✓3202.1.23 Describe how chemical symbols and balanced chemical equations illustrate the Law of Conservation of Mass/Energy.</p> <p>✓3202.1.24 Observe and measure temperature changes to distinguish between endothermic and exothermic reactions.</p> <p>✓3202.1.25 Conduct, analyze, and communicate the results of an experiment that demonstrates the relationship between pressure and volume of a gas.</p> <p>✓3202.1.26 Conduct, analyze, and communicate the results of an experiment that demonstrates the relationship between temperature and volume of a gas.</p> <p>✓3202.1.27 Apply indicators and instruments to classify a material as acidic, basic, or neutral.</p> <p>✓3202.1.28 Conduct research on issues associated with acid rain.</p> <p>✓3202.1.29 Construct the chemical formula of a compound using the periodic table.</p>
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Physical Science : Standard 2 - Energy

Conceptual Strand 2

Various forms of energy are constantly being transformed into other types without any net loss of energy from the system.

Guiding Question 2

What basic energy related ideas are essential for understanding the dependency of the natural and man-made worlds on energy?

Course Level Expectations	Checks for Understanding
<p>CLE 3202.2.1 Investigate the properties and behaviors of mechanical and electromagnetic waves.</p> <p>CLE 3202.2.2 Explore and explain the nature of sound and light energy.</p> <p>CLE 3202.2.3 Examine the applications and effects of heat energy.</p> <p>CLE 3202.2.4 Probe the fundamental principles and applications of electricity.</p> <p>CLE 3202.2.5 Distinguish between nuclear fission and nuclear fusion.</p> <p>CLE 3202.2.6 Investigate the Law of Conservation of Energy.</p>	<p>✓3202.2.1 Investigate energy transfer through waves and particles.</p> <p>✓3202.2.2 Demonstrate how waves are produced and transmitted.</p> <p>✓3202.2.3 Investigate the characteristics of light energy and sound energy.</p> <p>✓3202.2.4 Compare and contrast the four types of wave interactions: reflection, refraction, diffraction and interference.</p> <p>✓3202.2.5 Explore heat as a form of energy that may be transferred between materials.</p> <p>✓3202.2.6 Identify the boiling and freezing points of water in the Celsius, Fahrenheit, and Kelvin temperature scales.</p> <p>✓3202.2.7 Design and conduct an activity to demonstrate the conservation of heat energy during temperature changes.</p>

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- ✓**3202.2.8** Investigate the relationships among kinetic, potential, and total energy within a closed system (the Law of Conservation of Energy).
- ✓**3202.2.9** Solve problems related to voltage, resistance, and current in a series circuit.
- ✓**3202.2.10** Investigate Ohm's law to design and build a simple circuit.
- ✓**3202.2.11** Research the importance of energy conservation.
- ✓**3202.2.12** Explore nuclear energy and its impact on science and society.
- ✓**3202.2.13** Classify waves as transverse or longitudinal.
- ✓**3202.2.14** Distinguish between wavelength, frequency and amplitude.
- ✓**3202.2.15** Classify heat transfer as conduction, convection or radiation.
- ✓**3202.2.16** Distinguish between nuclear fission and nuclear fusion.
- ✓**3202.2.17** Solve problems regarding heat, mass, specific heat capacity and temperature change ($Q = mC_p\Delta T$).

Physical Science : Standard 3 - Motion

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Objects move in ways that can be observed, described, predicted, and measured.

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Guiding Question 3

What causes objects to move differently under different circumstances?

Course Level Expectations	Checks for Understanding
<p>CLE 3202.3.1 Investigate the relationships among speed, position, time, velocity, and acceleration.</p> <p>CLE 3202.3.2 Investigate and apply Newton’s three laws of motion.</p> <p>CLE 3202.3.3 Examine the Law of Conservation of Momentum in real world situations.</p> <p>CLE 3202.3.4 Demonstrate the relationships among work, power, and machines.</p> <p>CLE 3202.3.5 Explore and explain the nature of sound and light energy.</p> <p>CLE 3202.3.6 Investigate the properties and behaviors of mechanical and electromagnetic waves.</p>	<p>✓3202.3.1 Demonstrate the relationship between speed and velocity.</p> <p>✓3202.3.2 Create models that represent Newton’s three laws of motion.</p> <p>✓3202.3.3 Evaluate scenarios that illustrate Newton’s three laws of motion.</p> <p>✓3202.3.4 Investigate the Law of Conservation of Momentum.</p> <p>✓3202.3.5 Research the historical development of the laws of motion.</p> <p>✓3202.3.6 Collect data to construct, analyze, and interpret graphs for experiments that involve distance, speed, velocity, and time.</p> <p>✓3202.3.7 Solve problems related to velocity, acceleration, force, work, and power.</p>

Physical Science : Standard 4 – Forces In Nature

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Everything in the universe exerts a gravitational force on everything else; there is interplay between magnetic fields and electrical currents.

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Guiding Question 4

What are the scientific principles that explain gravity and electromagnetism?

Course Level Expectations	Checks for Understanding
<p>CLE 3202.4.1 Explore the difference between mass and weight.</p> <p>CLE 3202.4.2 Relate gravitational force to mass.</p> <p>CLE 3202.4.3 Demonstrate the relationship among work, power, and machines.</p>	<p>✓3202.4.1 Demonstrate the effect of gravity on objects.</p> <p>✓3202.4.2 Explore the difference between mass and weight.</p> <p>✓3202.4.3 Identify, design, demonstrate, and explain simple and compound machines.</p> <p>✓3202.4.4 Gather and analyze data and solve problems related to mechanical advantage and efficiency of simple machines.</p> <p>✓3202.4.5 Recognize the combinations of various simple machines found in a compound machine.</p>

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