

# Physical Science: Embedded Inquiry

## Conceptual Strand

*Understandings about scientific inquiry and the ability to conduct inquiry are essential for living in the 21<sup>st</sup> 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>✓<b>3202.Inq.8</b> Formulate and revise scientific explanations and models using logic and evidence.</p> <p>✓<b>3202.Inq.9</b> Evaluate the accuracy and precision of data.</p> <p>✓<b>3202.Inq.10</b> 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><b>CLE 3202.T/E.1</b> Explore the impact of technology on social, political, and economic systems.</p> <p><b>CLE 3202.T/E.2</b> Differentiate among elements of the engineering design cycle: design constraints, model building, testing, evaluating, modifying, and retesting.</p> <p><b>CLE 3202.T/E.3</b> Explain the relationship between the properties of a material and the use of the material in the application of a technology.</p> | <p>✓<b>3202.T/E.1</b> Select appropriate tools to conduct a scientific inquiry.</p> <p>✓<b>3202.T/E.2</b> Apply the engineering design process to construct a prototype that meets developmentally appropriate specifications.</p> <p>✓<b>3202.T/E.3</b> Explore how the unintended consequences of new technologies can impact human and non-human communities.</p> <p>✓<b>3202.T/E.4</b> Present research on current engineering technologies that</p> |

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| <p><b>CLE 3202.T/E.4</b> 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>✓<b>3202.T/E.5</b> 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>✓<b>3202.T/E.6</b> 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?*

| <b>Course Level Expectations</b>  | <b>Checks for Understanding</b>  |
|---|--|
| <p><b>CLE 3202.Math.1</b> Understand the mathematical principles behind the science of physics.</p> <p><b>CLE 3202.Math.2</b> Utilize appropriate mathematical equations and processes to solve basic physics problems.</p> | <p>✓<b>3202.Math.1</b> Use a variety of notations appropriately (e.g. exponential, functional, square root).</p> <p>✓<b>3202.Math.2</b> 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>✓<b>3202.Math.3</b> Apply and interpret rates of change from graphical and numerical data.</p> <p>✓<b>3202.Math.4</b> Analyze graphs to describe the behavior of functions.</p> |

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

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

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| <p>balance chemical equations.</p> <p><b>CLE 3202.1.10</b> Distinguish among acids, bases, and neutral substances.</p> | <p>✓<b>3202.1.9</b> Distinguish between atomic number and atomic mass.</p> <p>✓<b>3202.1.10</b> Define an isotope and describe the use of common isotopes.</p> <p>✓<b>3202.1.11</b> Identify the number of protons, neutrons, and electrons in an atom of an isotope based on its atomic number and atomic mass.</p> <p>✓<b>3202.1.12</b> Know the chemical symbols for the common elements.</p> <p>✓<b>3202.1.13</b> Use the periodic table to determine the number of protons, neutrons, and electrons in an isotope of an element.</p> <p>✓<b>3202.1.14</b> Use the periodic table to identify the characteristics and properties of metals, non-metals, and metalloids.</p> <p>✓<b>3202.1.15</b> 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>✓<b>3202.1.16</b> Classify a substance as an element or compound based on its chemical formula or symbol.</p> <p>✓<b>3202.1.17</b> Explain ionic and covalent bonding based on the oxidation numbers of the elements in a compound.</p> <p>✓<b>3202.1.18</b> Investigate physical and chemical changes in a laboratory setting.</p> <p>✓<b>3202.1.19</b> Balance simple chemical equations, identifying the reactants, products, and proper coefficients.</p> <p>✓<b>3202.1.20</b> Predict the products of common chemical reactions.</p> |
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|  | <p>✓<b>3202.1.21</b> Use models to represent chemical reactions as synthesis, decomposition, single-replacement, and double-replacement.</p> <p>✓<b>3202.1.22</b> Describe synthesis, decomposition, single-replacement, and double-replacement reactions using equations.</p> <p>✓<b>3202.1.23</b> Describe how chemical symbols and balanced chemical equations illustrate the Law of Conservation of Mass/Energy.</p> <p>✓<b>3202.1.24</b> Observe and measure temperature changes to distinguish between endothermic and exothermic reactions.</p> <p>✓<b>3202.1.25</b> Conduct, analyze, and communicate the results of an experiment that demonstrates the relationship between pressure and volume of a gas.</p> <p>✓<b>3202.1.26</b> Conduct, analyze, and communicate the results of an experiment that demonstrates the relationship between temperature and volume of a gas.</p> <p>✓<b>3202.1.27</b> Apply indicators and instruments to classify a material as acidic, basic, or neutral.</p> <p>✓<b>3202.1.28</b> Conduct research on issues associated with acid rain.</p> <p>✓<b>3202.1.29</b> 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><b>CLE 3202.2.1</b> Investigate the properties and behaviors of mechanical and electromagnetic waves.</p> <p><b>CLE 3202.2.2</b> Explore and explain the nature of sound and light energy.</p> <p><b>CLE 3202.2.3</b> Examine the applications and effects of heat energy.</p> <p><b>CLE 3202.2.4</b> Probe the fundamental principles and applications of electricity.</p> <p><b>CLE 3202.2.5</b> Distinguish between nuclear fission and nuclear fusion.</p> <p><b>CLE 3202.2.6</b> Investigate the Law of Conservation of Energy.</p> | <p>✓<b>3202.2.1</b> Investigate energy transfer through waves and particles.</p> <p>✓<b>3202.2.2</b> Demonstrate how waves are produced and transmitted.</p> <p>✓<b>3202.2.3</b> Investigate the characteristics of light energy and sound energy.</p> <p>✓<b>3202.2.4</b> Compare and contrast the four types of wave interactions: reflection, refraction, diffraction and interference.</p> <p>✓<b>3202.2.5</b> Explore heat as a form of energy that may be transferred between materials.</p> <p>✓<b>3202.2.6</b> Identify the boiling and freezing points of water in the Celsius, Fahrenheit, and Kelvin temperature scales.</p> <p>✓<b>3202.2.7</b> 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**

### **Conceptual Strand 3**

*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?*

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

## **Physical Science : Standard 4 – Forces In Nature**

### **Conceptual Strand 4**

*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?*

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

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