# CMAS Science 2023 Performance Level Descriptors
# Grade 8 Science
### Based on the 2020 Colorado Academic Standards for Middle School Science

**Partially Met Expectations**
Students who demonstrate a limited command of the concepts, skills, and practices embodied by the Colorado Academic Standards assessed at their grade level. They will need additional academic support to engage successfully in further studies in this content area.

**Approached Expectations**
Students who demonstrate a moderate command of the concepts, skills, and practices embodied by the Colorado Academic Standards assessed at their grade level. They will likely need additional academic support to engage successfully in further studies in this content area.

**Met Expectations**
Students who demonstrate a strong command of the concepts, skills, and practices embodied by the Colorado Academic Standards assessed at their grade level. They are academically prepared to engage successfully in further studies in this content area.

**Exceeded Expectations**
Students who demonstrate a distinguished command of the concepts, skills, and practices embodied by the Colorado Academic Standards assessed at their grade level. They are academically well prepared to engage successfully in further studies in this content area.

**Color Legend for Three-Dimensional Alignment**

Colorado Essential Skills and Science and Engineering Practice

Grade Level Expectation

Cross Cutting Concept

<table>
<tr><th colspan="5">Physical Science</th></tr>
<tr><th></th><th>Partially Met Expectations</th><th>Approached Expectations</th><th>Met Expectations</th><th>Exceeded Expectations</th></tr>
<tr><td>PG 1</td><td colspan="4">Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding structure, properties, and interactions of matter.</td></tr>
<tr><td rowspan="3">GLE 1.1, 1.2</td><td>Incompletely label the parts of familiar models of molecular compounds or phase changes.<br>OR<br>Describe the scale of molecular compounds or causes of phase changes.<br>[1.1.a, 1.1.d]</td><td>Identify parts of familiar models that describe the atomic composition or scale of simple molecules, or that show changes in particle arrangement and motion that cause phase changes.<br>[1.1.a, 1.1.d]</td><td rowspan="2">For phenomena referenced in the EO, develop models that describe the structure, properties, and interactions of matter, including processes that cause phase changes and chemical reactions, with a clear understanding of the law of conservation of matter and the various scales used in the models.<br>[1.1.a, 1.1.d, 1.2.b]</td><td rowspan="2">For phenomena not referenced in the EO, model, at various scales, examples of the structure, properties and interactions of matter, including phase changes, chemical reactions, and the law of conservation of matter, to distinguish causes and effects.<br>[1.1.a, 1.1.d, 1.2.b]</td></tr>
<tr><td>Use simple models that show chemical reactions as rearrangements of particles.<br>OR<br>Identify, with explicit instruction, simple chemical reactions as rearrangements of extremely small particles of matter.<br>[1.2.b]</td><td>Use simple models to describe chemical reactions as rearrangements of atoms and/or molecules on a scale too small to be directly observed, in which matter and the number of atoms are conserved.<br>[1.2.b]</td></tr>
<tr><td>Communicate straightforward aspects of scientific information that is provided about synthetic materials and how those materials may be used.<br>[1.1.c]</td><td>Summarize scientific information that is provided about synthetic materials derived from natural resources and how those materials may be shaped and used.<br>[1.1.c]</td><td>For phenomena referenced in the EO, use routine scientific reasoning to make sense of information about synthetic materials derived from natural resources and describe how their use may impact society.<br>[1.1.c]</td><td>Evaluate complex or inconclusive scientific information about impacts on society from the use of natural resources to create synthetic materials, especially those in which there is no clear single solution to the impact from how those materials are shaped and used, including phenomena not referenced in the EO<br>[1.1.c]</td></tr>
</table>

| Physical Science | | | | |
|---|---|---|---|---|
| | **Partially Met Expectations** | **Approached Expectations** | **Met Expectations** | **Exceeded Expectations** |
| | Create simple or below-grade-level graphs of data on the properties of substances during familiar, routine interactions that absorb or release energy.<br>**OR**<br>Relate the properties of substances experiencing the transfer of energy during familiar, routine interactions that absorb or release energy.<br>[1.1.b, 1.2.a, 1.2.c] | Interpret data on the properties of substances before and after they interact and on the transfer of energy during straightforward interactions that absorb or release energy.<br>[1.1.b, 1.2.a, 1.2.c] | Analyze and interpret data on the properties of substances before and after they interact for patterns that distinguish chemical processes from physical ones.<br>[1.1.b, 1.2.a]<br><br>Undertake a design project, as referenced in the EO, to develop a device that releases or absorbs energy through chemical processes; test and modify the device by tracking energy flows into and out of it.<br>[1.2.c] | Analyze and interpret large or complex data sets on the properties of substances before and after they interact for patterns that distinguish chemical processes from physical ones.<br>[1.1.b, 1.2.a]<br><br>Undertake a design project not referenced in the EO, to develop a device that releases or absorbs energy through chemical processes; test and modify the device by predicting, tracking, and evaluating energy flows into and out of it.<br>[1.2.c] |
| **PG 2** | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding interactions between objects and within systems of objects.** | | | |
| **GLE 1.3** | Conduct simple measurements while investigating an object's motion.<br>**OR**<br>Describe changes in an object's motion.<br>[1.3.b] | Conduct simple measurements within an investigation to demonstrate the impact of mass on the difficulty of changing an object's motion.<br>[1.3.b] | Apply familiar scientific ideas, such as Newton's Third Law and the concepts of stability and change, to plan and conduct conventional investigations or construct straightforward design solutions and explanations related to the masses of and forces experienced by systems of interacting objects, including collisions of two objects.<br>[1.3.a, 1.3.b] | Select from and apply scientific ideas, such as Newton's Third Law and the concepts of stability and change, to plan and conduct novel investigations or construct sophisticated design solution and explanations related to the masses of and forces experienced by systems of interacting objects, including collisions of two or more objects.<br>[1.3.a, 1.3.b] |
| | Identify familiar examples of Newton's Third Law in the context of situations involving two colliding objects.<br>**OR**<br>Describe two colliding objects as a system.<br>[1.3.a] | Summarize Newton's Third Law in the context of a design problem involving the motion of two colliding objects in a system.<br>[1.3.a] | | |

<table>
<tr><th colspan="5">Physical Science</th></tr>
<tr><th></th><th>Partially Met Expectations</th><th>Approached Expectations</th><th>Met Expectations</th><th>Exceeded Expectations</th></tr>
<tr><td rowspan="2">GLE 1.4</td><td rowspan="2">Given familiar scenarios, make observations or identify evidence of electric, magnetic, or gravitational forces related to motions of objects acting on one another at a distance.<br>OR<br>Identify electric, magnetic, or gravitational forces as the cause of motions of objects acting within a simple system.<br>[1.4.a, 1.4.b, 1.4.c]</td><td>Conduct guided investigations about and ask routine questions about causes and effects related to the strength of forces between objects that act on one another at a distance through electric or magnetic forces.<br>[1.4.a, 1.4.c]</td><td>Conduct basic investigations and ask routine questions about conventional data to determine causes and effects related to the strength of electric or magnetic forces in phenomena referenced in the EO.<br>[1.4.a, 1.4.c]</td><td>Conduct novel investigations and ask sophisticated and original questions about ambiguous data to determine causes and effects related to the strength of electric or magnetic forces in phenomena not referenced in the EO.<br>[1.4.a, 1.4.c]</td></tr>
<tr><td>Identify evidence in support of claims about gravitational forces within a simple system.<br>[1.4.b]</td><td>Use evidence as referenced in the EO to construct and present arguments about the attractive nature of gravitational force and its dependence on the masses of a system of interacting objects.<br>[1.4.b]</td><td>Use evidence not referenced in the EO to construct and present arguments about the attractive nature of gravitational force and its dependence on the masses and proximities of a unique system of interacting objects.<br>[1.4.b]</td></tr>
<tr><td>PG 3</td><td colspan="4">Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how energy is transferred and conserved.</td></tr>
<tr><td>GLE 1.5, 1.6, 1.7</td><td>Identify familiar examples of kinetic energy, and describe it as being related to the speed or mass of the object.<br>OR<br>Describe kinetic energy as being proportional to either speed or mass of an object.<br>[1.5.a]</td><td>Interpret familiar sets of data to describe how the kinetic energy of an object is affected by quantitative changes in the mass or speed of the object.<br>[1.5.a]</td><td>Construct and interpret conventional graphical displays of data to relate the separate proportional and quantitative relationships between the kinetic energy of an object and its mass, and between the kinetic energy of an object and its speed.<br>[1.5.a]</td><td>Construct and interpret graphical displays of complex, puzzling, or anomalous data concerning proportional and quantitative relationships between the mass, speed, and kinetic energy of an object.<br>[1.5.a]</td></tr>
</table>

| | | | | |
|---|---|---|---|---|
| | Use models to identify changes in the potential energy of an object when its distance from an interacting object is changed.<br>**OR**<br>Describe the potential energy of a system of objects as being related to their distances from one another.<br>[1.5.b, 1.7.a] | Use previously studied models to describe that a change to the arrangement of objects interacting at a distance results in a change to the potential energy stored in the system.<br>[1.5.b, 1.7.a] | Develop and/or use a model for phenomena referenced in the EO to describe how different arrangements of objects interacting at a distance result in different amounts of potential energy being stored in the system.<br>[1.5.b, 1.7.a] | Develop and/or use a model for phenomena not referenced in the EO to describe how different arrangements of objects interacting at a distance result in exponentially different amounts of potential energy being stored in the system.<br>[1.5.b, 1.7.a] |
| | Make and record observations of a familiar device that minimizes or maximizes transfer of thermal energy.<br>[1.5.c, 1.6.a] | Identify whether given characteristics of a familiar device either minimize or maximize transfer of thermal energy.<br>[1.5.c, 1.6.a] | For phenomena referenced in the EO, apply scientific principles to design, construct, and test devices that either minimize or maximize the transfer of thermal energy.<br>[1.5.c, 1.6.a] | For phenomena not referenced in the EO, use sophisticated scientific reasoning to design, construct, test, and evaluate nontypical devices that either minimize or maximize the transfer of thermal energy.<br>[1.5.c, 1.6.a] |
| | Follow, with guidance, investigational procedures to observe the type of matter or measure the mass or temperature of a sample in well-practiced situations of energy transfers.<br>[1.5.d, 1.6.b] | Conduct a guided investigation to determine the relationship between energy transferred and one or more of these factors: the type of matter, the mass involved, and the change in the temperature of a sample.<br>[1.5.d, 1.6.b] | For phenomena referenced in the EO, plan and conduct investigations, and construct evidence-based arguments, involving the relationships between these factors: energy transfers to and away from objects, the type and mass of the matter involved, and the change in the matter's kinetic energy (including, for thermal energy transfers, the average kinetic energy of particles as measured by the temperature of a sample).<br>[1.5.d, 1.5.e, 1.6.b, 1.6.c] | For phenomena not referenced in the EO, construct novel, evidence-based arguments about, and plan and conduct original investigations of, the relationships between these factors: energy transfers to and away from objects, the type and mass of the matter involved, and the change in the matter's kinetic energy (including, for thermal energy transfers, the average kinetic energy of particles as measured by the temperature of a sample).<br>[1.5.d, 1.5.e, 1.6.b, 1.6.c] |
| | Make observations that show the kinetic energy of an object has changed.<br>[1.5.e, 1.6.c] | Summarize a typical argument that as the kinetic energy of an object changes, energy is transferred.<br>[1.5.e, 1.6.c] | | |

| PG 4 | Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how waves are used to transfer energy and information. | | | |
|---|---|---|---|---|
| **GLE 1.8, 1.9** | Use simple, possibly below-grade-level graphs and charts to identify the amplitude of a wave and describe it as related to the energy in the wave.<br>**OR**<br>Describe the amplitude of a wave as a pattern.<br>[1.8.a] | Use grade-appropriate graphs and charts to describe simple patterns in the relationship between the amplitude and energy of a wave.<br>[1.8.a] | Use mathematical representations, simple models, and graphs and charts to engage in routine sense-making about patterns in the relationship between the amplitude and energy contained in a wave.<br>[1.8.a] | Develop and use mathematical and computational representations to support and revise unfamiliar explanations about complex or subtle patterns in the relationship between the amplitude and the energy contained in a wave.<br>[1.8.a] |
| | Label a basic model, incompletely or with inconsistency, that illustrates waves being reflected, absorbed, or transmitted through some material.<br>**OR**<br>Describe the structure of a material as being important to how the material reflects, absorbs, or transmits waves.<br>[1.8.b, 1.9.a] | Use a basic model to describe that waves are reflected, absorbed, or transmitted through various materials with differing structures.<br>[1.8.b, 1.9.a] | Develop and use a basic model and apply well-practiced concepts to explain how waves are reflected, absorbed, or transmitted, depending on the structure of the material through which the waves travel.<br>[1.8.b, 1.9.a] | Create, use, and evaluate sophisticated models and explanations that communicate scientific ideas about how waves are reflected, absorbed, or transmitted by materials, and compare those wave behaviors across multiple materials based on their structures.<br>[1.8.b, 1.9.a] |
| **GLE 1.10** | Relate simple information about digitized signals as a reliable way to transmit information.<br>**OR**<br>Describe digitized signals as having a different structure from analog signals.<br>[1.10.a] | Use basic information to label a diagram that shows how digitized signals transmit information and describe their reliability as greater than that of analog signals because of their structure.<br>[1.10.a] | Integrate information about phenomena referenced in the EO to support the claim that digitized signals encode and transmit information using a structure that provides more reliable functionality than analog signals.<br>[1.10.a] | Obtain, evaluate, and synthesize information about phenomena not referenced in the EO to construct an explanation of why digitized signals are a reliable way to encode and transmit information and provide a greater functionality than analog signals.<br>[1.10.a] |

| Life Science | | | | |
|---|---|---|---|---|
| | **Partially Met Expectations** | **Approached Expectations** | **Met Expectations** | **Exceeded Expectations** |
| **PG 5** | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how individual organisms are configured and how these structures function to support life, growth behavior, and reproduction.** | | | |
| **GLE 2.1** | Follow explicit directions to make observations during investigations of single-celled organisms or cell samples of multicellular ones.<br>**OR**<br>Describe cells as parts of living things at the microscopic scale.<br>[2.1.a] | Conduct explicitly guided investigations at the microscopic scale in single-celled or multicellular organisms and describe all living things as being made of cells.<br>[2.1.a] | Conduct typical investigations at the microscopic scale to compare nonliving objects to single-celled or multicellular organisms to provide evidence that all living things are made of cells.<br>[2.1.a] | Plan and conduct novel investigations at the microscopic scale to compare nonliving objects to single-celled and multicellular organisms to provide evidence that all living things are made of cells.<br>[2.1.a] |
| | Label familiar models to illustrate a limited number of cell parts.<br>**OR**<br>Describe one or more cellular functions.<br>[2.1.b] | Use routine models to illustrate cellular functions or the contribution of cell parts to those functions.<br>[2.1.b] | Develop and use routine models to describe cellular functions and the contribution of basic cell parts to those functions as referenced in the EO.<br>[2.1.b] | Compare models that present unfamiliar science ideas about cell parts and cellular functions to more basic models to infer and speculate about functions and parts of cells not referenced in the EO.<br>[2.1.b] |
| | Describe evidence that organs are made up of tissues or that tissues are made up of cells.<br>**OR**<br>Describe the body as having many systems.<br>[2.1.c] | Describe evidence that the systems of the body operate at different scales, including cells, tissues, and organs.<br>[2.1.c] | Use arguments, based on familiar evidence, regarding the systems and subsystems of the body and how they operate through organs made up of tissues, which are in turn made up of the cells.<br>[2.1.c] | Create arguments, connecting several scientific ideas, regarding familiar and unfamiliar systems and subsystems of the body and how they operate through organs made up of tissues, which are in turn made up of the cells.<br>[2.1.c] |

| | | | | |
|---|---|---|---|---|
| **GLE 2.2** | Describe simple evidence that organisms have characteristic behaviors and structures related to reproduction.<br>**OR**<br>Describe characteristics of organisms that affect their success in reproduction.<br>[2.2.a] | Summarize arguments supporting the idea that the organisms have characteristic behaviors and structures that affect their success in reproduction.<br>[2.2.a] | Use evidence-based arguments about phenomena referenced in the EO regarding effects that organisms' characteristic behaviors and structures have on their success in reproduction.<br>[2.2.a] | Develop original, evidence-based arguments about phenomena not referenced in the EO regarding effects that organisms' characteristic behaviors and structures have on their success in reproduction.<br>[2.2.a] |
| | Identify familiar effects of genetic or environmental factors on the growth of organisms.<br>[2.2.b] | Describe genetic and environmental factors as two different sources of effects on the growth of organisms.<br>[2.2.b] | Use evidence about phenomena referenced in the EO to explain effects of genetic and environmental factors on the growth of organisms.<br>[2.2.b] | Obtain, evaluate, and use unfamiliar evidence about phenomena not referenced in the EO that explains effects of genetic and environmental factors on the growth of organisms.<br>[2.2.b] |
| **GLE 2.3** | Explain that photosynthesis provides food for organisms or use basic models of chemical reactions that rearrange food molecules into other molecules for growth of organisms.<br>**OR**<br>Identify photosynthesis as the source of food from which organisms obtain matter and energy for growth.<br>[2.3.a, 2.3.b] | Use familiar models to describe ways that matter and energy are used by organisms—for example, chemical reactions such as photosynthesis, and the reactions needed to use food for growth.<br>[2.3.a, 2.3.b] | Construct explanations and develop and use conventional models to represent the concept that matter and energy cycle into, out of, and through organisms, by way of chemical reactions such as photosynthesis and the reactions that rearrange food into materials needed for growth.<br>[2.3.a, 2.3.b] | Construct novel explanations and develop and use unconventional models to represent the concept that matter and energy cycle into, out of, and through organisms, by way of chemical reactions such as photosynthesis and the reactions that rearrange food into new molecules needed for growth.<br>[2.3.a, 2.3.b] |

| | | | | |
|---|---|---|---|---|
| **GLE 2.4** | Identify one or more examples of a sensory organ and describe such organs as being connected to the brain.<br>**OR**<br>Describe the stimulation of sensory receptors as causing signals to flow to the brain.<br>[2.4.a] | Summarize the cause and effect flow of information from the occurrence of stimuli to corresponding sensory receptors and then to the brain.<br>[2.4.a] | Gather and synthesize information to describe signals from sensory receptors as causing the brain to direct immediate behavior or store memories based on stimuli.<br>[2.4.a] | Gather and synthesize information on novel examples of signals from sensory receptors causing the brain to direct immediate behavior or store memories based on stimuli (e.g., antennae of insects, Pavlovian response experiments demonstrating memory).<br>[2.4.a] |

| PG 6 | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how living systems interact with the biotic and abiotic environment.** | | | |
|---|---|---|---|---|
| **GLE 2.5** | Use simple representations of data on population levels in an ecosystem or on availability of a resource such as food within the ecosystem.<br>**OR**<br>Identify a familiar example, such as food, of a resource whose availability has effects on organisms in an ecosystem.<br>[2.5.a] | Describe simple data as showing familiar effects of resource availability on organisms in an ecosystem.<br>[2.5.a] | Analyze and interpret routine data to provide evidence for familiar effects of resource availability on organisms and populations of organisms in an ecosystem.<br>[2.5.a] | Analyze complex data sets to compare the effects of resource availability on multiple organisms or populations of organisms within an ecosystem or between ecosystems.<br>[2.5.a] |
| | Relate a familiar explanation of interactions among organisms in an ecosystem.<br>**OR**<br>When provided with examples, identify patterns of interactions among organisms in an ecosystem.<br>[2.5.b] | Summarize a routine explanation that predicts patterns of interactions among organisms across one or more ecosystems.<br>[2.5.b] | Using examples as referenced in the EO, construct a routine explanation that predicts patterns of interactions among organisms across multiple ecosystems.<br>[2.5.b] | Using examples not referenced in the EO, construct and revise sophisticated explanations to compare and predict patterns in interactions among organisms across multiple, markedly different ecosystems.<br>[2.5.b] |
| **GLE 2.6** | Partially label a familiar model that shows the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.<br>[2.6.a] | Use a familiar model to describe, in expected ways, the cycling of matter and flow of energy among a limited number of living and nonliving parts of an ecosystem.<br>[2.6.a] | Develop a routine model to engage in sense-making about phenomena related to the cycling of matter and flow of energy among living and nonliving parts of an ecosystem.<br>[2.6.a] | Develop novel and/or complex models to engage in detailed sense-making about phenomena regarding the cycling of matter and flow of energy among living and nonliving parts of an ecosystem, and how this cycling supports the ecosystem.<br>[2.6.a] |

| PG 7 | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how genetic and environmental factors influence variation of organisms across generations.** | | | |
|---|---|---|---|---|
| **GLE 2.7 and 2.12** | Describe evidence for one or more familiar changes to physical or biological components of an ecosystem that can affect populations.<br>[2.7.a] | Based on familiar empirical evidence, identify changes to a physical or biological component of an ecosystem that can affect populations.<br>[2.7.a] | Construct typical arguments supported by empirical evidence to explain that changes to physical or biological components of an ecosystem can affect populations.<br>[2.7.a] | Construct complex arguments that use empirical evidence to explain mechanisms by which changes to physical or biological components of an ecosystem can affect populations.<br>[2.7.a] |
| | Identify a common design solution for maintaining biodiversity.<br>[2.7.b, 2.12.a] | Explain a familiar design solution for maintaining or stabilizing biodiversity and ecosystem services.<br>[2.7.b, 2.12.a] | For examples referenced in the EO, evaluate competing design solutions for maintaining and stabilizing biodiversity and ecosystem services.<br>[2.7.b, 2.12.a] | For examples not referenced in the EO, evaluate competing design solutions for maintaining and stabilizing biodiversity and ecosystem services, or to mitigate harmful changes to ecosystems.<br>[2.7.b, 2.12.a] |
| **GLE 2.8** | Label or describe a familiar model of structural changes to genetic material.<br>**OR**<br>Restate the basic concept that structural changes to genetic material may affect the structure and function of the organism.<br>[2.8.a] | Use a model to describe how structural changes (mutations) to genes or chromosomes may result in harmful, beneficial, or neutral effects to the structure and function of the organism.<br>[2.8.a] | Develop and use a conventional model to describe how mutations, structural changes to genes located on chromosomes, may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.<br>[2.8.a] | Develop and use novel models to illustrate how mutations, structural changes to genes located on chromosomes, may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.<br>[2.8.a] |

| | | | | |
|---|---|---|---|---|
| | Distinguish between familiar models of asexual reproduction and sexual reproduction and provide one or more examples of each.<br>OR<br>Describe both asexual reproduction and sexual reproduction as causing offspring to inherit genetic information from the parent. [2.8.b] | Use a familiar model to describe characteristics of asexual reproduction and sexual reproduction, and identify which one causes offspring to inherit genetic information identical to the parent and which causes offspring to exhibit genetic variation.<br>[2.8.b] | Develop and use a model referenced in the EO to describe why asexual reproduction causes offspring to inherit genetic information identical to the parent, and sexual reproduction causes offspring to exhibit genetic variation.<br>[2.8.b] | Develop and use a model not referenced in the EO to describe why asexual reproduction causes offspring to inherit genetic information identical to, or nearly identical to, the parent, and sexual reproduction causes offspring to exhibit genetic variation.<br>[2.8.b] |
| **PG 8.** | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how natural selection drives biological evolution accounting for the unity and diversity of organisms.** | | | |
| **GLE 2.9** | Identify fossils in visual data from rock layers and describe them as the preserved remnants of life forms from previous eras in the history of life on Earth.<br>OR<br>Describe patterns in the fossil record as a main source of knowledge about previous eras in the history of life on Earth.<br>[2.9.a] | Connect simple patterns in data from the fossil record to changes in life-forms from previous eras in the history of life on Earth.<br>[2.9.a] | Analyze and interpret typical data for patterns in the fossil record, as referenced in the EO, that document changes of life-forms throughout the history of life on Earth, acknowledging the assumption that natural laws operate today as in the past.<br>[2.9.a] | Analyze and interpret atypical data to identify complex patterns in the fossil record, not referenced in the EO, that document changes of life-forms throughout the history of life on Earth, and to support the assumption that natural laws operate today as in the past.<br>[2.9.a] |
| | Use provided anatomical drawings or diagrams to identify a familiar pattern of similarity or difference among modern organisms or between modern and fossil organisms.<br>[2.9.b] | Restate a familiar explanation for the patterns of anatomical similarities and differences among modern organisms and between modern and fossil organisms.<br>[2.9.b] | Apply familiar scientific ideas to construct a straightforward explanation for patterns in the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships.<br>[2.9.b] | Engage with unfamiliar scientific information to explain subtle or complex patterns in the anatomical similarities and differences among modern organisms and between modern and fossil organisms to infer evolutionary relationships, possibly including more advanced topics such as convergent evolution.<br>[2.9.b] |

| | | | | |
|---|---|---|---|---|
| | Given familiar displays of pictorial data, identify one or more prominent features common to embryological development in two or more species.<br>**OR**<br>Describe the use of patterns in embryological features as an important means of identifying relationships between species.<br>[2.9.c] | Given familiar displays of pictorial data, identify prominent patterns of similarities in the embryological development between two or more species that show known relationships between the species.<br>[2.9.c] | Analyze familiar or conventional displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.<br>[2.9.c] | Analyze displays of atypical, novel, or ambiguous pictorial data to compare patterns of similarities in the embryological development across multiple familiar and unfamiliar species to identify relationships not evident in the fully formed anatomy.<br>[2.9.c] |
| **GLE 2.10** | Describe traits as varying within a population and influencing the survival or reproduction of individuals.<br>[2.10.a] | Restate familiar explanations about how variation of traits in a population can increase some individuals' probability of surviving and reproducing.<br>[2.10.a] | Construct routine, evidence-based explanations about how genetic variation of traits in a population can increase some individuals' probability of surviving and reproducing in a specific environment.<br>[2.10.a] | Construct novel, evidence-based explanations about unusual instances of genetic variation in populations, and predict how variation may increase some individuals' probability of surviving and reproducing in the specific environment.<br>[2.10.a] |
| **GLE 2.11** | With well-scaffolded directions, perform mathematical comparisons of the prevalence of specific traits in populations.<br>**OR**<br>Describe natural selection as a cause of changes in specific traits in populations.<br>[2.10.c, 2.11.a] | Use simple data sets to mathematically estimate the proportions of specific traits in populations over time, and identify natural selection as the likely cause of changes.<br>[2.10.c, 2.11.a] | Use mathematical representations to support routine explanations about how natural selection may cause populations to exhibit various effects over time, such as increases and decreases of the frequency of specific traits.<br>[2.10.c, 2.11.a] | Develop and use original mathematical models of unusual effects of natural selection, such as increases and decreases of specific traits in populations over time, and extrapolate future trends that natural selection may cause in those populations.<br>[2.10.c, 2.11.a] |

| Earth and Space Science | | | | |
|---|---|---|---|---|
| | **Partially Met Expectations** | **Approached Expectations** | **Met Expectations** | **Exceeded Expectations** |
| **PG 9** | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding the universe and Earth's place in it.** | | | |
| **GLE 3.1, 3.2** | Label, with varying degrees of success, familiar models of the Earth-Sun-Moon system that describe lunar phenomena and seasons.<br>**OR**<br>Describe the patterns of lunar phenomena and seasons as being cyclic.<br>[3.1.a, 3.2.c] | Use familiar models of the Earth-Sun-Moon system to identify the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons.<br>[3.1.a, 3.2.c] | Develop and use models of the Earth-Sun-Moon system to perform routine sense-making of the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons.<br>[3.1.a, 3.2.c] | Develop and relate models of the Earth-Sun-Moon system to perform sophisticated sense-making of the cyclic patterns of lunar phases, eclipses of the Sun and Moon, and seasons, as well as related phenomena such as tides.<br>[3.1.a, 3.2.c] |
| | Given familiar models of our solar system or galaxy, identify the importance of gravity in their motions.<br>[3.1.b, 3.2.a] | Use familiar models to describe the role of gravity in the motions within galaxies and the solar system.<br>[3.1.b, 3.2.a] | Develop and use models referenced in the EO to describe the role of gravity in the motions within galaxies and the solar system.<br>[3.1.b, 3.2.a] | Develop and use models not referenced in the EO to illustrate evidence-based explanations that describe the role of gravity in the motions within galaxies and solar systems, including less familiar star systems such as those with exoplanets or multiple co-orbiting stars.<br>[3.1.b, 3.2.a] |
| | Compare scientific data to a provided model of our solar system to identify differences of scale.<br>[3.2.b] | Use scientific data to describe scale properties of objects in our solar system.<br>[3.2.b] | Analyze and interpret data on phenomena referenced in the EO to determine scale properties of objects in the solar system.<br>[3.2.b] | Analyze and interpret data on phenomena not referenced in the EO to determine scale properties of objects in the solar system.<br>[3.2.b] |

| PG 10 | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how and why Earth is constantly changing.** | | | |
|---|---|---|---|---|
| **GLE 3.3** | Explain that rock strata are a source of evidence about Earth's past.<br>**OR**<br>Describe rock strata as a source of evidence about Earth's history.<br>[3.3.a] | Relate an explanation of how geologists use evidence from rock strata to organize geologic events in Earth's history.<br>[3.3.a] | Construct an explanation based on evidence from rock strata for how the geologic time scale is used to organize Earth's 4.6-billion-year history.<br>[3.3.a] | Connect multiple scientific ideas to construct an explanation of how evidence from rock strata is used to organize and refine Earth's 4.6-billion-year-history in a geologic time scale.<br>[3.3.a] |
| **GLE 3.4** | Identify components of familiar models that show how Earth's materials cycle.<br>**OR**<br>Describe how the flow of energy leads to changes as Earth's materials cycle.<br>[3.4.a] | Use a model to illustrate the cycling of Earth's materials and the flow of energy that drives the changes.<br>[3.4.a] | Develop a conventional model to describe the cycling of Earth's materials and the flow of energy that drives this process of change.<br>[3.4.a] | Create, use, and evaluate sophisticated models to communicate the cycling of Earth's materials and the flow of energy that drives this process of change, including complex examples such as the formation of unusual materials (e.g., diamonds, geodes).<br>[3.4.a] |
| | Identify, from provided examples, one or more geoscience processes that have produced changes to Earth's surface over time.<br>**OR**<br>Describe different time scales over which geoscience processes produce changes to Earth's surface.<br>[3.4.b, 3.6.a] | Relate a basic explanation of one or more geoscience processes that have produced changes to Earth's surface over time and identify the time scale of such processes as rapid or gradual.<br>[3.4.b, 3.6.a] | For phenomena referenced in the EO, use scientific ideas to construct an explanation based on evidence for how geoscience processes have produced changes to Earth's surface at varying time and spatial scales.<br>[3.4.b, 3.6.a] | For phenomena not referenced in the EO, construct a novel explanation that describes how geoscience processes have produced changes to Earth's surface at varying time and spatial scales.<br>[3.4.b, 3.6.a] |

| | | | | |
|---|---|---|---|---|
| **GLE 3.5** | Identify, from simple representations of data, evidence of past plate motions, such as distribution of fossils or the shapes of continents.<br>**OR**<br>Describe patterns in the distribution of fossils or the shapes of continents as a source evidence of past plate motions. [3.5.a] | Describe how provided data show a pattern that provides evidence of past plate motions based on one or more factors, such as the distribution of fossils and rocks, continental shapes, and seafloor structures.<br>[3.5.a] | Using routine sense-making, analyze and interpret data types referenced in the EO that demonstrates patterns in the distribution of fossils and rocks, continental shapes, and seafloor structures to provide evidence of past plate motions.<br>[3.5.a] | Analyze and interpret data types not referenced in the EO for patterns that provide evidence of past plate motions from the distribution of fossils and rocks, continental shapes, and seafloor structures.<br>[3.5.a] |
| **GLE 3.6 3.7** | Identify components of a model that illustrates how water is cycled through Earth's systems.<br>[3.6.b] | Use a model to describe the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.<br>[3.6.b] | Develop and use models to describe phenomenon-based scenarios regarding the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.<br>[3.6.b] | Analyze and use models that illustrate unfamiliar scientific concepts (e.g., Titan's methane-based hydrology) to examine the cycling of water through Earth's systems driven by energy from the Sun and the force of gravity.<br>[3.6.b] |
| | Describe data about the motions of air masses as useful in predicting weather conditions.<br>**OR**<br>Describe motions of air masses as causing changes in weather conditions.<br>[3.6.c, 3.7.a] | Summarize information from provided data to describe the motions and interactions of air masses as causing changes in weather conditions.<br>[3.6.c, 3.7.a] | For phenomena referenced in the EO, collect and/or use data to provide evidence for how the motions and interactions of air masses cause changes in weather conditions.<br>[3.6.c, 3.7.a] | For phenomena not referenced in the EO, collect data to provide evidence for how the motions and complex interactions of air masses on a global scale cause changes in weather conditions.<br>[3.6.c, 3.7.a] |

| | | | | |
|---|---|---|---|---|
| | Identify familiar components of a model showing unequal heating and rotation of Earth, patterns of atmospheric and oceanic currents, or variations between regional climates.<br>**OR**<br>Describe unequal heating and rotation of Earth, patterns of atmospheric and oceanic currents, or variations between regional climates as related parts of Earth's complex systems.<br>[3.6.d, 3.7.b] | Use familiar models to illustrate unequal heating and rotation of Earth, patterns of atmospheric and oceanic systems, or variations between regional climates.<br>[3.6.d, 3.7.b] | For phenomena referenced in the EO, develop and use a model to describe how unequal heating and rotation of Earth causes patterns in the circulation of atmospheric and oceanic systems, which work together to determine regional climates.<br>[3.6.d, 3.7.b] | For phenomena not referenced in the EO, connect familiar and novel scientific ideas to construct original models showing how unequal heating and rotation of Earth causes patterns in the circulation of atmospheric and oceanic systems, and how change in these systems over time can greatly alter regional climates.<br>[3.6.d, 3.7.b] |
| **PG 11.** | **Students can use the full range of science and engineering practices to make sense of natural phenomena and solve problems that require understanding how human activities and the Earth's surface processes interact.** | | | |
| **GLE 3.8** | Communicate a basic explanation of geoscience processes related to the distribution of Earth's resources.<br>**OR**<br>Describe geoscience processes as causes of the distribution of Earth's resources. [3.8.a] | Communicate a familiar explanation of how Earth's mineral, energy, and groundwater resources are unevenly distributed, with past and current geoscience processes as causes of this phenomenon.<br>[3.8.a] | For phenomena referenced in the EO, construct an evidence-based explanation for how past and current geoscience processes have caused the uneven distribution of Earth's mineral, energy, and groundwater resources.<br>[3.8.a] | For phenomena not referenced in the EO, construct complex evidence-based explanations for how past and current geoscience processes have caused the uneven distribution of Earth's mineral, energy, and groundwater resources.<br>[3.8.a] |

| | | | | |
|---|---|---|---|---|
| **GLE 3.9** | Describe data about natural hazards as useful for planning for future catastrophic events.<br>OR<br>Describe natural hazards as occurring in patterns that can be used to plan for future catastrophic events.<br>[3.9.a] | Describe observable patterns in provided data from natural hazards, and explain that scientists use these patterns to forecast future catastrophic events and inform the development of technologies to mitigate their effects.<br>[3.9.a] | For phenomena referenced in the EO, analyze and interpret straightforward data for observable patterns in natural hazards to forecast future catastrophic events and inform the development of technologies to mitigate their effects.<br>[3.9.a] | For phenomena not referenced in the EO, analyze and interpret complex current and historical data for observable patterns in natural hazards to forecast future catastrophic events, inform the development of technologies to mitigate their effects, and explain the impact of past events on local, regional, and global human history.<br>[3.9.a] |
| **GLE 3.10** | Identify a simple or partial example of a method used to monitor or minimize effects of humans in the environment.<br>[3.10.a] | Identify scientific principles used in a familiar method for monitoring and minimizing a human effect on the environment.<br>[3.10.a] | For phenomena referenced in the EO, apply familiar scientific principles to design a method for monitoring and minimizing effects caused by human impacts on the environment.<br>[3.10.a] | For phenomena not referenced in the EO, establish a set of design criteria and constraints, and use them to design a novel method for monitoring and minimizing an effect caused by human impacts on the environment.<br>[3.10.a] |
| | Identify provided evidence as showing increases in human population and increased consumption of natural resources.<br>**OR**<br>Describe increases in human population or increased consumption of natural resources as causing changes to Earth's systems.<br>[3.10.b] | Describe basic evidence of increases in human population leading to increased consumption of natural resources, which causes changes to Earth's systems.<br>[3.10.b] | For phenomena referenced in the EO, construct a routine argument supported by evidence for how increases in human population and per-capita consumption of natural resources cause changes to Earth's systems.<br>[3.10.b] | For phenomena not referenced in the EO, construct a novel or sophisticated argument supported by evidence for how increases in human population and per-capita consumption of one or more specific natural resources cause changes to Earth's systems.<br>[3.10.b] |