Grade Eight Earth Science

Theme ***Order and Organization***

This theme focuses on helping students use scientific inquiry to discover patterns, trends, structures, and relationships that may be described by simple principles. These principles are related to the properties or interactions within and between systems.

Strand Connection

Systems can be described and understood by analysis of the interaction of their components. Energy, forces, and motion combine to change the physical features of the Earth. The changes of the physical Earth and the species that have lived on Earth are found in the rock record. For species to continue, reproduction must be successful.

Science Inquiry and Applications:

During the years of grades 5-8, all students must use the following scientific processes, with appropriate laboratory safety techniques, to construct their knowledge and understanding in all science content areas:

- Identify questions that can be answered through scientific investigations
- Design and conduct a scientific investigation
- Use appropriate mathematics, tools, and techniques to gather data and information
- Analyze and interpret data
- Develop descriptions, models, explanations, and predictions
- Think critically and logically to connect evidence and explanations
- Recognize and analyze alternative explanations and predications
- Communicate scientific procedures and explanations

Reading in Science

Key Ideas and Details:

1. Cite specific textual evidence to support analysis of science and technical texts.
2. Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.
3. Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Craft and Structure:

4. Determine the meaning of symbols, key terms, and other domain-specific words and phrases as they are used in a specific scientific or technical context relevant to grades 6-8 texts and topics.
5. Analyze the structure an author uses to organize a text, including how the major sections contribute to the whole and to an understanding of the topic.
6. Analyze the author's purpose in providing an explanation, describing a

Writing in Science

Text Types and Purposes:

1. Write arguments focused on discipline-specific content.
   a. Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and organize the reasons and evidence logically.
   b. Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources.
   c. Use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence.
   d. Establish and maintain a formal style.
   e. Provide a concluding statement or section that follows from and supports the argument presented.
2. Write informative/explanatory texts, including the narration of historical events, scientific procedures/experiments, or technical

procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas:

7. Integrate quantitative or technical information expressed in words in a text with a version of that information expressed visually (e.g., in a flowchart, diagram, model, graph, or table).
8. Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.
9. Compare and contrast the information gained from experiments, simulations, video or multimedia sources with that gained from reading a text on the same topic.

Range of Reading and Level of Text Complexity:

10. By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

processes.

a. Introduce a topic clearly, previewing what is to follow; organize ideas, concepts, and information into broader categories as appropriate to achieving purpose; include formatting (e.g., headings), graphics (e.g., charts, tables), and multimedia when useful to aiding comprehension.
b. Develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples.
c. Use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts.
d. Use precise language and domain-specific vocabulary to inform about or explain the topic.
e. Establish and maintain a formal style and objective tone.
f. Provide a concluding statement or section that follows from and supports the information or explanation presented.

3. Students' narrative skills continue to grow in these grades. The Standards require that students be able to incorporate narrative elements effectively into arguments and informative/explanatory texts. In science and technical subjects, students must be able to write precise enough descriptions of the step-by-step procedures they use in their investigations or technical work that others can replicate them and (possibly) reach the same results.

Production and Distribution of Writing:

4. Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and audience.
5. With some guidance and support from peers and adults, develop and strengthen writing as needed by planning, revising, editing, rewriting, or trying a new approach, focusing on how well purpose and audience have been addressed.
6. Use technology, including the Internet, to produce and publish writing and present the relationships between information and ideas clearly and efficiently.

Research to Build and Present Knowledge:

7. Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration.
8. Gather relevant information from multiple print and digital sources,

	using search terms effectively; assess the credibility and accuracy of each source; and quote or paraphrase the data and conclusions of others while avoiding plagiarism and following a standard format for citation. 9. Draw evidence from informational texts to support analysis, reflection, and research. ***Range of Writing:*** 10. Write routinely over extended time frames (time for reflection and revision) and shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, and audiences.

Grade Eight Earth Science

Topic ***Physical Earth*** This topic focuses on the physical features of Earth and how they formed. This includes the interior of Earth, the rock record, plate tectonics, and landforms.	**Pacing**
Content Statement ***1. The composition and properties of Earth's interior are identified by the behavior of seismic waves.*** The refraction and reflection of seismic waves as they move through one type of material to another is used to differentiate the layers of Earth's interior. Earth has an inner and outer core, an upper and lower mantle, and a crust. The formation of the planet generated heat from gravitational energy and the decay of radioactive elements, which are still present today. Heat released from Earth's core drives convection currents throughout the mantle and the crust. Note: The thicknesses of each layer of Earth can vary and be transitional rather than uniform and distinct as often depicted in textbooks. **Learning Targets:** • I can demonstrate how scientists determine the different layers of the interior of the earth (seismic waves). • I can evaluate how the interaction of gravity and density determine the position of the different layers of the Earth and other planets. • I can explain how convection currents in the mantle and crust result in the transfer of energy. • I can identify the physical and compositional layers of the Earth. • I can account for the heat generated within the earth. **Advanced Learning Targets:** • I can evaluate seismic wave data to determine epicenters and/or physical layers. • I can use the amplitude of the wave to determine the intensity of the earthquake wave.	**Content Elaborations** ***Prior Concepts Related to Earth's Interior*** PreK-2: Properties of materials can change due to heating or freezing. Forces change the motion of an object. Grades 3-5: Matter exists in different states. Heating and cooling can change the state of matter. Heat is a form of energy. Energy can cause motion. Earth's surface is changed in many ways. Light changes direction when it moves from one medium to another; it can be reflected, refracted, or absorbed. Grade 6-7: Matter is made up of atoms. Igneous, metamorphic, and sedimentary rocks form in different ways and in different environments. Magma from Earth's interior forms igneous rocks. Position and speed can be measured and graphed as a function of time. Matter and energy can be transferred through Earth's spheres. Energy can be transformed from one form to another. Thermal energy can be transferred through radiation, convection, and conduction. Electromagnetic waves transfer energy when they interact with matter. Seismic and oceanic waves are found in PS grade 7. ***Grade 8 Concepts*** It is important to provide the background knowledge regarding how scientists know about the structure and composition of the interior of Earth (without being able to see it). Seismic data, graphics, charts, digital displays, and cross sections must be used to study Earth's interior. Actual data from the refraction and reflection of seismic waves can be used to demonstrate how scientists have determined the different layers of Earth's interior. New discoveries and technological advances relating to understanding Earth's interior also play an important role in this content. Earth and other planets in the solar system formed as heavier elements coalesced in their centers. Planetary differentiation is a process in which more

	dense materials of a planet sink to the center, while less dense materials stay on the surface. A major period of planetary differentiation occurred approximately 4.6 billion years ago (College Board Standards for College Success, 2009). In addition to the composition of Earth's interior, the history of the formation of Earth, and the relationship of energy transfer, transformation and convection currents within the mantle and crust are essential in understanding sources of energy. ***Future Application of Concepts*** High School: Waves (all types), gravitational energy, energy transformation and transfer, and radioactivity are studied in greater detail. In addition, Earth's formation and the formation of the solar system are used as the formation of the universe is introduced.
Content Vocabulary • composition • convection currents • crust • differentiation • gravity • inner core • lower mantle • outer core • radioactive elements • reflection • refraction • seismic waves • structure • upper mantle	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect

	• evaluate • examine • exclude • explain • generalize • hypothesize • relationship • simulate • support • test • variation
Formative Assessments	**Summative Assessments**
Resources	**Enrichment Strategies** • Give students a fictitious planet with elements similar to the Earth and have them generate an idea of formation, layering, and heat generation.
Integrations • **ELA**: • **Math**: • **Social Studies**:	**Intervention Strategies** •

Grade Eight Earth Science

Topic ***Physical Earth*** This topic focuses on the physical features of Earth and how they formed. This includes the interior of Earth, the rock record, plate tectonics, and landforms.	**Pacing**
Content Statement ***2. Earth's crust consists of major and minor tectonic plates that move relative to each other.*** Historical data and observations such as fossil distribution, paleomagnetism, continental drift, and sea-floor spreading contributed to the theory of plate tectonics. The rigid tectonic plates move with the molten rock and magma beneath them in the upper mantle. Convection currents in the crust and upper mantle cause the movement of the plates. The energy that forms convection currents comes from deep within the Earth. There are three main types of plate boundaries: divergent, convergent, and transform. Each type of boundary results in specific motion and causes events (such as earthquakes or volcanic activity) or features (such as mountains or trenches) that are indicative of the type of boundary. **Learning Targets:** • I can argue for the current theory of plate movement and opposition to Wegner's theory of continental drift. • I can use current data to support the idea of seafloor spreading. • I can demonstrate Convection Theory. • I can use current events and data to support the idea of converging, transform, and diverging boundaries (Google Earth, StrataLogica, satellite imagery, ocean maps). • I can explain how plate movement causes the following physical characteristics: volcanic activity, earthquakes, tsunamis, geysers, hot springs, faults, oceanic vents, island arcs, hot spots, and rift valleys. • I can investigate tectonic activity of Ring of Fire, San Andreas Fault, Mid-Atlantic Ridge, Mariana Trench, Hawaiian Islands, New Madrid Fault System. **Advanced Learning Targets:**	**Content Elaborations** ***Prior Concepts Related to Forces, Movement, and Igneous Environments*** PreK-2: Properties of materials can change. Pushing and pulling can affect the motion of an object. Grades 3-5: Forces change the motion of an object. Rocks have specific characteristics. Heat is a form of energy. Energy can be conserved. Earth's surface has specific characteristics. Heat results when materials rub against each other. Gravitational force and magnetism also are studied. Grade 6-7: Rocks have characteristics that are related to the environment from which they form. Thermal energy is a measure of the motion of the atoms and molecules in a substance. Energy can be transformed, transferred, and conserved. Thermal energy can be transferred through radiation, convection, and conduction. ***Grade 8 Concepts*** The historical data related to the present plate tectonic theory must include continental "puzzle-like-fit" noticed as early as Magellan and by other mapmakers and explorers, paleontological data, paleoclimate data, paleomagnetic data, continental drift (Wegener), convection theory (Holmes), and sea floor spreading (Hess, Deitz). Contemporary data must be introduced, including seismic data, GPS/GIS data (documenting plate movement and rates of movement), robotic studies of the sea floor, and further exploration of Earth's interior. Physical world maps, cross sections, models (virtual or 3D), and data must be used to identify plate boundaries, movement at the boundary, and the resulting feature or event. The relationship between heat from Earth's core, convection in the magma, and plate movement should be explored. World distribution of tectonic activity of possible interest should be investigated (e.g., Ring of Fire, San Andreas Fault, Mid-Atlantic Ridge, Mariana Trench, Hawaiian Islands, New Madrid Fault System).

• I can assess early warning systems for catastrophic geological events. • I can predict the future arrangement of Earth's tectonic plates (i.e., Hawaii, Pacific Ocean, Atlantic Ocean, etc.).	Volcanic activity, earthquakes, tsunamis, geysers, hot springs, faults, oceanic vents, island arcs, hot spots, and rift valleys should all be included in the identification of plates and plate boundaries. Plate boundary identification (converging, diverging, transform) must be based on the resulting features or events. The focus must be on the cause of plate movement, the type and direction of plate movement, and the result of the plate movement, not on memorizing plate names. ***Future Application of Concepts*** High School: Thermal energy, gravitational energy, radioactive decay, and energy transfer are studied. In the grades 11/12 Physical Geology course, further studies of plate tectonics, seismology, and volcanism are found.
Content Vocabulary • compression • continental crust • continental drift • convergent • divergent • earthquakes • faults • geysers • Holm's Convection Theory • hot spots • hot springs • island arcs • Mid Ocean Ridge • oceanic crust • oceanic vents • paleoclimate • paleomagnetic • Pangea • plate boundary • plate tectonics • rift valleys • seafloor spreading • subduction	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate

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Grade Eight Earth Science

Topic ***Physical Earth***	**Pacing**
This topic focuses on the physical features of Earth and how they formed. This includes the interior of Earth, the rock record, plate tectonics, and landforms.	

Content Statement	**Content Elaborations**
3. A combination of constructive and destructive geologic processes formed Earth's surface. Earth's surface is formed from a variety of different geologic processes, including but not limited to plate tectonics. Note: The introduction of Earth's surface is found in ESS grade 4. **Learning Targets:** • I can demonstrate that surface features on Earth are a result of erosion, deposition, and tectonic motion. • I can use technology to access real-time photographs and graphics related to landforms and features to describe conditions for formation (remote sensing, satellite data, LANDSAT). **Advanced Learning Targets:** • I can manipulate Earth's surface to create a variety of surface features (i.e., kettle lakes, delta, moraines, sand dunes).	***Prior Concepts Related to Earth's Surface*** PreK-2: Water can be found in many forms and locations. Wind is moving air. Grades 3-5: Characteristics of rocks and soil, weathering, deposition, erosion, landforms, mass wasting, and weather events (e.g., flooding) are studied. Grade 6-7: Igneous, metamorphic, and sedimentary formation, interactions between Earth systems, and patterns of erosion and deposition are studied. ***Grade 8 Concepts*** The interactions between the hydrosphere and lithosphere are studied as they relate to erosional events (e.g., flooding, mass wasting). The characteristics of rocks and soil, the climate, location, topography, and geologic process are studied. Distinguishing between major geologic processes (e.g., tectonic activity, erosion, deposition) and the resulting feature on the surface of Earth is the focus of this content statement. It is important to build on what was included in the elementary grades (recognizing features), enabling students to describe conditions for formation. Topographic, physical, and aerial maps, cross-sections, field trips, and virtual settings are methods of demonstrating the structure and formation of each type of feature. The use of technology (remote sensing, satellite data, LANDSAT) can be used to access real-time photographs and graphics related to landforms and features. Factors that affect the patterns and features associated with streams and floodplains (e.g., discharge rates, gradients, velocity, erosion, deposition), glaciers (e.g., moraines, outwash, tills, erratic, kettles, eskers), tectonic activity (should include the features listed in the content statement above), coastlines, flooding, and deserts should be studied.

	Future Application of Concepts High School: Gravitational forces and movement of matter are explored. In the grades 11/12 Physical Geology course, glaciation, sedimentation, stream evolution, seismology, volcanics, bathymetry, and further information about weathering, erosion, and deposition are included.
Content Vocabulary • deposition • discharge rates • erosion • erratic • eskers • gradients • hydrosphere • kettles • lithosphere • moraines • outwash • rate • speed/velocity • superposition • tills • topography • weathering	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • exclude • explain • generalize • hypothesize • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate • support • test • variation
Formative Assessments	**Summative Assessments**

Resources	Enrichment Strategies
Integrations • **ELA**: • **Math**: • **Social Studies**:	**Intervention Strategies** •

Grade Eight Earth Science

Topic ***Physical Earth*** This topic focuses on the physical features of Earth and how they formed. This includes the interior of Earth, the rock record, plate tectonics, and landforms.	**Pacing**
Content Statement ***4. Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.*** Earth is approximately 4.6 billion years old. Earth history is based on observations of the geologic record and the understanding that processes observed at present day are similar to those that occurred in the past (uniformitarianism). There are different methods to determine relative and absolute age of some rock layers in the geologic record. Within a sequence of undisturbed sedimentary rocks, the oldest rocks are at the bottom (superposition). The geologic record can help identify past environmental and climate conditions. Note: Environmental and climate conditions also can be documented through the cryosphere as seen through ice cores. **Learning Targets:** • I can design a graphic representation of the evolutionary timeline. • I can predict the relative age of a fossil using index fossils. • I can explain how uniformitarianism is key to understanding earth's history. • I can analyze and interpret local geologic data to determine local earth history. • I can explain exceptions to the law of superposition (i.e., unconformities, faults, igneous intrusions, inclusions). **Advanced Learning Targets:** • I can predict age of a fossil based on radiometric dating. • I can predict historical environment/events based on types of rock both stratalogic and facies.	**Content Elaborations** ***Prior Concepts Related to Rocks and Fossils*** PreK-2: Some living things that once lived on Earth no longer exist because their needs were not met. Grades 3-5: Rocks have characteristics and form in different ways. Earth's surface changes. Most types of organisms that have lived on Earth no longer exist. Fossils provide a point of comparison between the types of organisms that lived long ago and those living today. Rocks can change size and shape due to weathering, water, and wind. Ice can physically remove and carry rock, soil, and sediment. Grade 6-7: Igneous, metamorphic, and sedimentary rocks form in different ways. Each type of rock can provide information about the environment in which it was formed. ***Grade 8 Concepts*** The representation of the age of the Earth must include a graphic demonstration of the immensity of geologic time, as this is a very difficult concept to grasp. The different methods used to determine the age of the Earth are an important factor in this concept. In elementary grades, fossils are used to compare what once lived to what lives now, but the concept of Earth's age and the age of the fossils were not included (the concept of billions or millions of years was not age-appropriate). In grade 8, the concept of index fossils is a way to build toward understanding relative dating. Superposition, crosscutting relationships, and index fossils play an important role in determining relative age. Radiometric dating plays an important role in absolute age. The inclusion of new advances and studies (mainly due to developing technological advances) is important in learning about the geologic record. Uniformitarianism can be an important key in understanding how scientists have interpreted the environmental conditions that existed throughout Earth's

	history. Fossil evidence also can indicate specific environments and climate conditions that help interpret the geologic record. Relating Earth's climate history to present-day climate issues should include evidence from ice core sampling as well as evidence from the geologic record. Using actual data to generate geologic maps of local or statewide formations can connect to the real world. Field studies or geologic research (can be virtual/digital) can help identify local formations and interpret the environment that existed at the time of the formation. Analyzing and interpreting the data to draw conclusions about geologic history is an important part of this content statement. Note: This content is closely connected to LS grade 8 content pertaining to diversity of species as documented in the fossil record, tracing changes evident in the fossil record, and relating this content to evolution. ***Future Application of Concepts*** High School: The age of Earth is further explored through learning about the evolution and extinction of species throughout Earth's history. In grades 11/12 Physical Geology, the interpretations of sections of the rock record and geologic time periods are explored.
Content Vocabulary • absolute dating • angular conformities • catastrophism • disconformities • environmental and climate conditions • extrusions • faults • fossil record • geologic record • index fossil • intrusions • radiometric dating • relative dating • stratigraphy • superposition	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order

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Grade Eight Life Science

Topic ***Species and Reproduction*** This topic focuses on continuation of the species	**Pacing**
Content Statement ***1. Reproduction is necessary for the continuation of every species.*** Every organism alive today comes from a long line of ancestors who reproduced successfully every generation. Reproduction is the transfer of genetic information from one generation to the next. It can occur with mixing of genes from two individuals (sexual reproduction). It can occur with the transfer of genes from one individual to the next generation (asexual reproduction). The ability to reproduce defines living things. **Learning Targets:** • I can compare and contrast the genetic and environmental advantages and disadvantages of sexual and asexual reproduction. • I can apply the concepts of mitosis and meiosis to sexual and asexual reproduction. • I can show the difference in the offspring of sexual and asexual reproduction (using investigations and experimentation). **Advanced Learning Targets:** • I can analyze, through a pedigree, various genetic disorders.	**Content Elaborations** ***Prior Concepts Related to Species and Reproduction*** Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next. Grade 6-7: Modern Cell Theory states cells come from pre-existing cells. ***Grade 8 Concepts*** An individual organism does not live forever. Reproduction is necessary for the continuation of every species. Most organisms reproduce either sexually or asexually. Some organisms are capable of both. In asexual reproduction, all genes come from a single parent, which usually means the offspring are genetically identical to their parent, allowing genetic continuity. Mitosis was investigated in grade 6. The end products of mitotic and meiotic cell divisions are compared as they relate to asexual and sexual reproduction. It is important that both mitosis and meiosis are addressed in preparation for future study of Mendelian genetics and embryology. In sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm). Typically, half of the genes come from each parent. The fertilized cell, carrying genetic information from each parent, multiples to form the complete organism. The same genetic information is copied in each cell of the new organism. In sexual reproduction, new combinations of traits are produced which may increase or decrease an organism's chances for survival. Investigations and experimentation (3-D or virtual) must be used to compare offspring to parents in sexual and asexual reproduction. ***Future Application of Concepts*** High School: The details and importance of gamete formation are studied.

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<td>Content Vocabulary
asexual reproduction
chromosome
clone
DNA
fertilized cell
gene
genetic variation
genotype
meiosis
mitosis
offspring
phenotype
sexual reproduction</td>
<td>Academic Vocabulary
account for
alter
analyze
anticipate
apply
claim
classify
compare
conclude
conduct
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contrast
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demonstrate
describe
design
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differentiate
discriminate
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Grade Eight Life Science

Topic ***Species and Reproduction*** This topic focuses on continuation of the species	**Pacing**
Content Statement **2.** ***Diversity of species occurs through gradual processes over many generations. Fossil records provide evidence that changes have occurred in number and types of species.*** Fossils provide important evidence of how life and environmental conditions have changed Changes in environmental conditions can affect how beneficial a trait will be for the survival and reproductive success of an organism or an entire species. Throughout Earth's history, extinction of a species has occurred when the environment changes and the individual organisms of that species do not have the traits necessary to survive and reproduce in the changed environment. Most species (approximately 99 percent) that have lived on Earth are now extinct. Note: Population genetics and the ability to use statistical mathematics to predict changes in a gene pool are reserved for grade 10. **Learning Targets:** • I can use the fossil record to explain the genetic variation of a species over time. • I can predict the survival and reproductive success of an organism when given an environmental condition. • I can explain how the rate of environmental change impacts an organism's response (evolution to extinction). **Advanced Learning Targets:** • I can evaluate a set of traits that would allow an organism to survive significant environmental changes.	**Content Elaborations** ***Prior Concepts Related to Species and Reproduction*** PreK-2: Living things have physical traits that enable them to live in different environments. Some kinds of individuals that once lived on Earth have completely disappeared, although they may be something like others that are alive today. Grades 3-5: Fossils provide a point of comparison between the types of organisms that lived long ago and those existing today. Grade 6-7: In any particular biome, the number, growth, and survival of organisms and populations depend on biotic and abiotic conditions. ***Grade 8 Concepts*** The fossil record documents the variation in a species that may have resulted from changes in the environment. The fossil record is contained within the geologic record (ESS grade 8). Combining data from the geologic record and the fossil record, Earth's living history can be interpreted. Data and evidence from the fossil record must be used to develop further the concepts of extinction, biodiversity, and the diversity of species. Diversity can result from sexual reproduction. The sorting and combination of genes results in different genetic combinations, which allow offspring to be similar to, yet different from, their parents and each other. (This statement must be connected to the grade 8 Life Science content statement on reproduction and Mendelian Genetics.) These variations may allow for survival of individuals when the environment changes. Diversity in a species increases the likelihood that some individuals will have characteristics suitable to survive under changed conditions. Evidence from geologic and fossil records can be used to infer what the environment was like at the time of deposition. The variations that exist in organisms can accumulate over many generations, so organisms can be very different in appearance and behavior from their distant ancestors.

	Note 1: Molecular clocks are not appropriate at this grade level. Note 2: The term “transitional form” should be used to describe parts of the fossil record that are incomplete.
Content Vocabulary • abiotic • biodiversity • biotic • diversity • environmental conditions • evolution • extinction • fossil record • reproductive success • trait • transitional form	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • exclude • explain • generalize • hypothesize • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate • support • test • variation
Formative Assessments	**Summative Assessments**

Resources	Enrichment Strategies
Integrations • **ELA**: • **Math**: • **Social Studies**:	**Intervention Strategies** •

Grade Eight Life Science

Topic ***Species and Reproduction*** This topic focuses on continuation of the species.	**Pacing**
Content Statement ***3. The characteristics of an organism are a result of inherited traits received from parent(s).*** Expression of all traits is determined by genes and environmental factors to varying degrees. Many genes influence more than one trait, and many traits are influenced by more than one gene. During reproduction, genetic information (DNA) is transmitted between parent and offspring. In asexual reproduction, the lone parent contributes DNA to the offspring. In sexual reproduction, both parents contribute DNA to the offspring. Note 1: The focus should be the link between DNA and traits without being explicit about the mechanisms involved. Note 2: The ways in which bacteria reproduce is beyond the scope of this content statement. Note 3: The molecular structure of DNA is not appropriate at this grade level. **Learning Targets:** • I can identify and explain how traits are passed on (dominance, codominance, recessive genes). • I can conduct a long-term investigation to analyze and compare characteristics passed on from parents to offspring through sexual and asexual reproduction (pedigree analysis). • I can apply Mendel's laws (Law of Segregation and Law of Independent Assortment) to a variety of organisms. • I can identify the relationship between traits, DNA, and genes. **Advanced Learning Targets:** • I can identify the genotypes of parents based on phenotypes of offspring. • I can analyze a given pedigree to determine whether traits are	**Content Elaborations** ***Prior Concepts Related to Species and Reproduction*** PreK-2: Offspring tend to look like their parents. Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next. Grade 6-7: Modern Cell Theory states cells come from preexisting cells. ***Grade 8 Concepts*** The traits of one or two parents are passed on to the next generation through reproduction. Traits are determined by instructions encoded in deoxyribonucleic acid (DNA), which forms genes. Genes have different forms called alleles. Introduce the principles of Mendelian genetics by reviewing Mendel's work. Mendel's two laws provide the theoretical base for future study of modern genetics. Mendel's first law, the Law of Segregation, and his second law, the Law of Independent Assortment, should be demonstrated and illustrated in a variety of organisms. The concepts of dominant and recessive genes are appropriate at this grade level. Codominant traits such as roan color in horses and cows may be useful to provide further validation of the theory and to help dispel some misconceptions. Pedigree analysis is appropriate for this grade level when limited to dominant, recessive, or codominance of one trait. The Law of Independent Assortment should only be explored in simple cases of dominance and recessive traits. Chi-square and dihybrid crosses are reserved for high school. Conduct a long-term investigation to analyze and compare characteristics passed on from parent to offspring through sexual and asexual reproduction. Ask questions about the phenotypes that appear in the resulting generations and what they infer about genotypes of the offspring. Note 1: Myxobacteria reproduce by spore formation and streptomyces bacteria reproduce by budding.

dominant, codominant, or recessive.	Note 2: Incomplete dominance is not suggested for this grade level to help avoid the misconception of "blending of traits." Codominance is encouraged because both traits are expressed in the resulting offspring. ***Future Application of Concepts*** High School: The details and importance of gamete formation, the structure of DNA, and modern genetics are studied.
Content Vocabulary • alleles • budding • codominance • dominate genes • environmental factors • fission • genotype • Law of Independent Assortment • Law of Segregation • Mendelian Genetics • pedigree analysis • phenotype • recessive genes • spore	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • exclude • explain • generalize • hypothesize • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate • support • test • variation

Formative Assessments	Summative Assessments
Resources	**Enrichment Strategies**
Integrations • **ELA**: • **Math**: • **Social Studies**:	**Intervention Strategies** •

Grade Eight Physical Science

Topic ***Forces and Motion***	**Pacing**
This topic focuses on forces and motion within, on, and around the Earth and within the universe.	

Content Statement

1. ***Forces between objects act when the objects are in direct contact or when they are not touching.***

   Magnetic, electrical, and gravitational forces can act at a distance.

   Note: Direct contact forces were addressed in the elementary grades.

   Learning Targets:
   - I can describe the field that exists around an object (electrical, gravitational, or magnetic).
   - I can demonstrate how an object can exert a force on another object without touching it.
   - I can show how the strength of the electric, gravitational, and magnetic forces are related to distance.
   - I can demonstrate how a field can cause changes in the motion of an object.
   - I can compare and contrast weight and mass.
   - I can construct an electromagnet and explain the relationship between electricity and magnetism.
   - I can design an electric generator/motor and explain the relationship between electricity and magnetism.

   Advanced Learning Targets:
   - I can construct a working generator/motor.
   - I can adjust the variables in an electromagnet that will be the most effective at lifting various weights.

Content Elaborations

Prior Concepts Related to Forces

PreK-2: Forces are pushes and pulls. Forces are required to change the motion of an object. Magnetic, gravitational, and electrical forces act without touching.

Grades 3-5: The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted. The speed of an object is defined and calculated.

Grade 6-7: An object's motion can be described by its speed and the direction in which it is moving. An object's position and speed can be measured and graphed as a function of time.

Grade 8 Concepts

A field model can be used to explain how two objects can exert forces on each other without touching. An object is thought to have a region of influence, called a field, surrounding it. When a second object with an appropriate property is placed in this region, the field exerts a force on and can cause changes in the motion of the object.

Electric fields exist around objects with charge. If a second object with charge is placed in the field, the two objects experience electric forces that can attract or repel them, depending on the charges involved. Electric force weakens rapidly with increasing distance.

Magnetic fields exist around magnetic objects. If a second magnetic object is placed in the field, the two objects experience magnetic forces that can attract or repel them, depending on the objects involved. Magnetic force weakens rapidly with increasing distance. Magnetic field lines can be seen when iron filings are sprinkled around a magnet.

Gravitational fields exist around objects with mass. If a second object with

	mass is placed in the field, the two objects experience attractive gravitational forces toward each other. Gravitational force weakens rapidly with increasing distance. Every object exerts a gravitational force on every other object with mass. These forces are hard to detect unless at least one of the objects is very massive (e.g., sum, planets). The gravitational force increases with the mass of the objects, decreases rapidly with increasing distance, and points toward the center of objects. Weight is gravitational force and is often confused with mass. Weight is proportional to mass but depends upon the gravitational field at a particular location. An object will have the same mass when it is on the moon as it does on Earth. However, the weight (force of gravity) will be different at these two locations. Electricity is related to magnetism. In some circumstances, magnetic fields can produce electrical currents in conductors. Electric currents produce magnetic fields. Electromagnets are temporary magnets that lose their magnetism when the electric current is turned off. Building an electromagnet to investigate magnetic properties and fields can demonstrate this concept. Generators convert mechanical energy into electrical energy and are used to produce electrical energy in power plants. Electric motors convert electrical energy into mechanical energy. Motors are in blenders and washing machines. Both motors and generators have magnets (or electromagnets) and a coil of wire that creates its own magnetic field when an electric current flows through it. Note 1: Magnetic poles are often confused with electric charges. It is important to emphasize the differences. Note 2: Mathematics is not used to describe fields at this level. Note 3: This content statement involves a basic introduction to the field model. Details about the field model are not required other than the idea that a field is a concept that is used to understand forces that act at a distance. ***Future Application of Concepts*** High School: The strength of the force between two charges is calculated using

	Coulomb's Law. Electromagnetic induction is applied to generators and motors. DC circuits are studied. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.
Content Vocabulary • conductor • current • electrical field • electrical force • electromagnet • field • force • generators • gravitational force • insulator • magnetic field • magnetic forces • mass • region of influence • volt • weight	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • exclude • explain • generalize • hypothesize • identify • illustrate • include • infer • influence • interpret • investigate • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate • support • test • variation

Formative Assessments	Summative Assessments
Resources	**Enrichment Strategies**
Integrations • **ELA**: • **Math**: • **Social Studies**:	**Intervention Strategies** •

Grade Eight Physical Science

Topic ***Forces and Motion***	**Pacing**
This topic focuses on forces and motion within, on, and around the Earth and within the universe.	

Content Statement	**Content Elaborations**
2. Forces have magnitude and direction. The motion of an object is always measured with respect to a reference point. Forces can be added. The net force on an object is the sum of all of the forces acting on the object. The net force acting on an object can change the object's direction and/or speed. When the net force is greater than zero, the object's speed and/or direction will change. When the net force is zero, the object remains at rest or continues to move at a constant speed in a straight line. **Learning Targets:** • I can explain the importance of the use of a reference point to show motion. • I can use a force diagram to show the strength and direction of forces on an object (free body diagram). • I can distinguish between balanced and unbalanced forces. • I can argue for the concept of inertia (prove inertia actually exists). • I can demonstrate the impact of kinetic friction on an object. **Advanced Learning Targets:** • I can calculate the angle of a vector on a free body diagram.	***Prior Concepts Related to Forces*** PreK-2: Forces are introduced as pushes and pulls that can change the motion of objects. Forces are required to change the motion of an object. Greater force on a given object results in greater change of motion. Grades 3-5: The amount of change in movement of an object is based on the mass* of the object and the amount of force exerted. Grade 6-7: An object's motion can be described by its speed and the direction in which it is moving. An object's position and speed can be measured and graphed as a function of time. ***Grade 8 Concepts*** Motion can be described in different ways by different observers (e.g., a pencil held in someone's hand may appear to be at rest, but to an observer in a car speeding by, the pencil may appear to be moving backward). A force is described by its strength (magnitude) and in what direction it is acting. Many forces can act on a single object simultaneously. The forces acting on an object can be represented by arrows drawn on an isolated picture of the object (a force diagram). The direction of each arrow shows the direction of push or pull. When many forces act on an object, their combined effect is what influences the motion of that object. The sum of all the forces acting on an object depends not only on how strong the forces are but also in what directions they act. Forces can cancel to a net force of zero if they are equal in strength and act in opposite directions. Such forces are said to be balanced. If all forces are balanced by equal forces in the opposite direction, the object will maintain its current motion (both speed and direction). This means if the object is stationary, it will remain stationary. If the object is moving, it will continue moving in the same direction and at the same speed. Such qualitative, intuitive understandings and descriptions of inertia must be developed through inquiry activities.

	Kinetic friction is a force that occurs when two objects in contact interact by sliding past one another. Drag is a force that opposes the motion of an object when an object moves through a fluid (e.g., gas, liquid). Kinetic friction and drag affect the motion of objects and may even cause moving objects to slow to a stop unless another force is exerted in the direction of motion. This phenomenon leads to the misconception that objects require a sustained force to continue moving. Experimentation with objects that have limited friction (e.g., a puck on an air hockey table, dry ice on a surface) can address the misconception that objects with a net force of zero naturally slow down. If the forces are not balanced, the object's motion will change, either by speeding up, slowing down, or changing direction. Qualitative, intuitive understandings of the influence of unbalanced forces on objects must be developed through inquiry investigations. Note 1: The concept of fields for objects that exert forces without touching is introduced at this grade level. Note 2: The content description states that there will be acceleration when "the net force is greater than zero." When positive and negative values are used to represent the direction of forces, this statement will need to be expanded. Any nonzero net force, including a negative net force, also may result in a change in speed or direction (acceleration). ***Future Application of Concepts*** High School: Newton's second law will be developed quantitatively and situations will be explored mathematically. *While mass is the scientifically correct term to use in this context, the NAEP 2009 Science Framework (page 27) recommends using the more familiar term "weight" in the elementary grades with the distinction between mass and weight being introduced at the middle school level. In Ohio, students will not be assessed on the differences between mass and weight until Grade 6.
Content Vocabulary • acceleration • balanced forces	**Academic Vocabulary** • account for • alter • identify • illustrate

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constant speed
drag
force diagram
friction
inertia
kinetic
magnitude
net force
Newton
reference point
speed
static
stationary
unbalanced forces

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Grade Eight Physical Science

Topic ***Forces and Motion*** This topic focuses on forces and motion within, on, and around the Earth and within the universe.	**Pacing**
Content Statement ***3. There are different types of potential energy.*** Gravitational potential energy changes in a system as the masses or relative positions of objects are changed. Objects can have elastic potential energy due to their compression or chemical potential energy due to the nature and arrangement of the atoms that make up the object. **Learning Targets:** • I can explain the different types of potential energy through experimentation and investigation and include the relationship of energy transfer and springs, magnets, or static electricity. • I can describe the potential energy of an object in a system (e.g., skate park, roller coaster, pendulum). **Advanced Learning Targets:** • I can calculate the energy dissipated out of the system (using energy bar charts).	**Content Elaborations** ***Prior Concepts Related to Energy*** PreK-2: The sun is the principal source of energy (ESS). Plants get energy from sunlight (LS). Grades 3-5: Energy is the ability to cause motion or create change. Heat, electrical energy, light, sound, and magnetic energy are forms of energy. Earth's renewable and nonrenewable resources can be used for energy (ESS). All processes that take place within organisms require energy (LS). Grade 6-7: All matter is composed of atoms. Each substance has its own unique, unchanging composition of type and number of atoms. There are two general categories of energy: kinetic and potential. Energy can be transformed or transferred but is never lost. The thermal energy of water changes during the water cycle (ESS). Thermal energy transfers in the ocean and the atmosphere contribute to the formation of currents that influence global climate patterns (ESS). Plants transform light energy contained in organic molecules, which can then be transformed into thermal and other forms of energy when the molecules are broken down (LS). ***Grade 8 Concepts*** Gravitational potential energy is associated with the mass of an object and its height above a reference point (e.g., above ground level, above floor level). A change in the height of an object is evidence that the gravitational potential energy has changed. Elastic potential energy is associated with how much an elastic object has been stretched or compressed and how difficult such a compression or stretch is. A change in the amount of compression or stretch of an elastic object is evidence that the elastic potential energy has changed. Chemical potential energy is associated with the position and arrangement of

	the atoms within substances. Rearranging atoms into new positions to form new substances (chemical reaction) is evidence that the chemical potential energy has most likely changed. The energy transferred when a chemical system undergoes a reaction is often thermal energy. Electrical potential energy is associated with the position of electrically charged objects relative to each other and the amount of charge they have. A change in the position of charged particles relative to each other is evidence of a change in electrical potential energy. Magnetic potential energy is associated with the position of magnetic objects relative to each other. The different types of potential energy must be explored through experimentation and investigation that include the relationship of energy transfer and springs, magnets, or static electricity. Note: Potential energy is often taught as "stored" energy. If the word "stored" means that it is kept by the object and not given away to another object, then kinetic energy also can be classified as "stored" energy. A rocket at constant speed through space has kinetic energy and is not transferring any of this energy to another object. ***Future Application of Concepts*** High School: Gravitational potential energy will be calculated for objects at varying heights and kinetic energy will be calculated for moving objects. Conservation of energy will be explored mathematically. Elastic potential energy will be calculated for different systems. Electric potential and electric potential energy will be introduced.
Content Vocabulary • chemical potential • elastic potential • gravitational potential • magnetic potential • potential energy	**Academic Vocabulary** • account for • alter • analyze • anticipate • apply • claim • classify • identify • illustrate • include • infer • influence • interpret • investigate

	• compare • conclude • conduct • construct • contrast • critique • demonstrate • describe • design • determine • differentiate • discriminate • distinguish • estimate • evaluate • examine • exclude • explain • generalize • hypothesize • judge • justify • locate • manipulate • model • modify • objective • order • pattern • predict • prove • purpose • rare • reflect • relationship • simulate • support • test • variation
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