8th Grade Science

Pacing Guide and Unpacked Standards

GROVEPORT MADISON SCHOOLS

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Groveport Madison Science Pacing Guide

8	Science Inquiry and Application	Physical Science	Earth and Space Science	Life Science	Standards for Literacy-Reading (Integrate Throughout Each Topic)
1st 9 wks	**Thinking Like a 21st Century Scientist/Engineer** Approx 3 weeks Intro to Science, Technology & Engineering: Lab Safety Procedures, Equipment, Team Building, Computer Technology, Engineering Design	➢**Forces (8.PS.2)** 3 weeks Motion, Magnitude & Direction Net Force, Diagrams, Inertia, Newton's 1st Law of Motion, Kinetic Friction	➢**Earth's Interior (8.ESS.1a)** 2 weeks Earth's Layers Planet Formation ➢**Earth's Interior (8.ESS.1b)** 1 week Use of Seismic, Waves Convection Currents		**RST.6-8.1** Cite specific textual evidence to support analysis. **RST.6-8.2(a,b)** Analyze central ideas & summarize. **RST.6-8.3** Follow precisely a multistep procedure. **RST.6-8.4** Determine the meaning of symbols & key terms. **RST.6-8.5** Analyze the structure of text. **RST.6-8.6** Analyze the author's purpose. **RST.6-8.7** Integrate quantitative or technical information visually. **RST.6-8.8** Distinguish among facts & speculations in a text. **RST.6-8.9** Compare and contrast gained information on the same topic. **RST.6-8.10** Read, comprehend & respond to science/technical texts.
2nd 9 wks	**Thinking Like a 21st Century Scientist/Engineer** (continue to integrate)		➢**Theory of Plate Tectonics (8.ESS.2)** 4 weeks Historical & Contemporary Data, Convection Currents Plate Boundaries, Boundary Motion & Resulting Events ➢**Formation of Earth's Surface (8.ESS.3)** 2 weeks Constructive & Destructive Forces, Features of Earth's Surface ➢**Geologic History (8.ESS.4)** 2 weeks Geologic Time, Relative Age Absolute Age, Interpreting Environmental Conditions		**Standards for Literacy-Writing** (Integrate Throughout Each Topic) **WHST.6-8.1(a,b,c,d,e,f)** Write arguments to support claims & thesis. **WHST.6-8.2(a,b,c,d,e,f,g)** Write informative/ explanatory texts. **WHST.6-8.4** Develop, organize & produce clear and coherent writing. **WHST.6-8.5** Develop & strengthen writing through revision processes. **WHST.6-8.6** Use technology to produce & publish writing. **WHST.6-8.7** Conduct short research projects. **WHST.6-8.8** Gather relevant information from credible digital & print sources. **WHST.6-8.9** Support analysis & draw evidence from informational text. **WHST.6-8.10** Write routinely over extended time frames.
3rd 9 wks	**Thinking Like a 21st Century Scientist/Engineer** (continue to integrate)			➢**Diversity (8.LS.1)** 3 weeks Effects of Changes in Environment on Species, Fossil Record Diversity ➢**Reproduction (8.LS.2)** 3 weeks Sexual Reproduction Asexual Reproduction ➢**Heredity (8.LS.3)** 3 weeks Traits, Genes, Alleles Mendelian Genetics, Laws of Inheritance, Monohybrid Crosses	
4th 9 wks	**Thinking Like a 21st Century Scientist/Engineer** (continue to integrate)	➢**Energy and Forces (8.PS.1)** 5 weeks Electric & Magnetic Fields, Forces, Electric Current			

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.EES.1

PHYSICAL EARTH

The composition and properties of Earth's interior are identified by the behavior of seismic waves.

Vocabulary

Crust	Density
Displacement	Volume
Inner Core	Lithosphere
Mantle	Mass
Outer Core	P wave
Planetary Differentiation	
Reflection	Refraction
S wave	Seismic Waves
Seismograph	Seismologist

Essential Understandings

- 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 a core, a mantle, and a crust.
- Impacts during planetary formation generated heat.
- These impacts converted gravitational potential energy to heat. Earth's core is also able to generate its own thermal energy because of decaying atoms. This continuously releases thermal energy. Thermal energy generated from Earth's core drives convection currents in the asthenosphere.

Note: Radioactive decay is not the focus; this will be discussed in Physical Science and Chemistry.

Note: At this grade level, analyzing seismograms (e.g., amplitude and lag time) and reading a travel time curve are not the focus. At this grade the properties of seismic waves should be addressed.

Essential Skills

The students can construct a model of how a planet's interior became organized into layers from cosmic debris.

The students can explain the effect of gravity on newly forming planets.

The students can design a method to determine the relative density of a material.

The students can orally present to the class, using a model to explain that as planets form, the materials which are most dense move to the core, and materials become part of the planet in decreasing degrees of density. (planetary differentiation)

The students can compare and contrast the speed and movement of different seismic waves.

The students can evaluate seismic data and relate it to how scientists have determined the layers of Earth's interior.

The students can model and explain how S and P waves move through the earth.

Misconceptions

- Students substitute weight for density. They assume that heavier objects are denser without considering weight per size.

- Students find it hard to attend to two variables at once and focus on the relationship between them as understanding density requires. They attend to only one variable at a time (weight, size, shape, etc.) Often they attach more importance to one variable than the others.

- When learning about density, students often think that density cannotchange.

- Students think that because weight is additive, so is density, so if you have twice as much material, you have twice as much weight and twice as much density.

- Students think that because volume is additive, so is density, so if you have twice as much material, you have twice as much volume and twice as much density.

- Earth's interior is hollow.

- Earth's interior is one solid mass.

- All seismic waves travel through all materials.

- All seismic waves travel in straight lines.

- Scientists have been able to study the layers of the Earth, by digging deep into the Earth and taking samples of materials.

-A common student misconception is that only California or Alaska experiences earthquakes. Researching and examining actual seismic events that occur in Ohio or surrounding areas can dispel this misconception. The USGS provides seismic data for all 50 states, including real-time data, at http://earthquake.usgs.gov/ earthquakes/states/?old=top_states.html.

- NASA lists common misconceptions for all ages about the sun and the Earth at http://www-istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html.

- NASA provides a list of overarching Earth Science questions that address many of the common misconceptions at this grade level. There are resources and information that help address questions that center on Earth Systems Science at http://science.nasa.gov/big-questions/.

Instructional Strategies and Resources

-Building a working seismograph can be a way of combining design and engineering with understanding earthquakes and waves within science. Relating earthquakes to actual movements of the Earth can be difficult if the student has not actually experienced it. Using a seismograph and interpreting seismic data from working seismographs can help demonstrate the movement. Teach Engineering resources include information on building a seismograph. There also are specific resources to the engineering and design process and how to use them with eighth-grade students. Other examples of building a seismograph are available online. It is important to allow the student to test and experiment with the instrument to develop an understanding of how it measures Earth movement.

- The USGS provides helpful background data that connects the structure of Earth to plate tectonics. There also are links provided to show real-time seismic data (including data for the state of Ohio) and interactive seismic maps that can be manipulated.

- Another way to engage and interest students in the study of the structure of Earth and seismic activity is through specific case studies and research (e.g., the Denali Fault Earthquake of 2002). Showing the actual seismic waves as they travel can help students see the actual results of a real earthquake. This is helpful for all students, but may be especially helpful for students that are more visual or have difficulty developing concepts from text.

Career Connections

Geologist/Seismologists, Geochemist, the study of Mineralogy and Petrology, Earth/space teacher

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recognize that seismic data can be used to determine the composition of Earth's interior;
- **Basic:** Recognize that seismic data can be used to determine the composition of Earth's interior;
- **Proficient:** Use seismic data, graphs, and charts to interpret the structure of Earth's interior;
- **Accelerated:** Analyze or complete a diagram that shows how constructive or destructive processes affect the lithosphere;
- **Advanced:** Analyze or complete a diagram that shows how constructive or destructive processes affect the lithosphere.

Prior Knowledge

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.

Grades 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.

Future Knowledge

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.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.ESS.2

PHYSICAL EARTH

Earth's lithosphere consists of major and minor tectonic plates that move relative to each other.

Essential Understandings

- 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 uppermantle.
- Convection currents in the asthenosphere cause the movement of the lithospheric 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.

Vocabulary

Continental Drift
Convection Currents
Core Density
Divergent
Earthquakes
Fault
Magma
Mantle
Mariana Trench
Mid-Atlantic Ridge
New Madrid Fault
Paleoclimate
Paleontological
Pangaea
Plate Boundaries Plate
Tectonic Theory Ridge
Ring of Fire
San Andreas Fault
Sea-Floor Spreading
Tsunami
Volcanism

Essential Skills

The students can describe various historical theories and data evidence that have led to the present-day Plate Tectonic Theory.

The students can describe Wegener's Theory of Continental Drift.

The students can model and explain the process of sea-floor spreading.

The students can model and explain how convection currents in the mantle cause the movement of tectonic plates.

The students can describe the movement and interaction of the 3 primary types of plate boundaries (convergent, divergent, transform).

The students can use a boundary map to explain various plate interactions around the world.

The students can explain the resulting geologic effects of plate boundary movement and interaction.

The students can identify specific geologic events and features around the world and explain how plate movement or interaction is responsible for such events.

Misconceptions

- Only the continents move.

- The plates move at a fast rate.

- The plates used to move but currently have stopped moving.

- Weather patterns cause the plates to move.

- Plates only consist of continental crust.

- All geologic events are caused by plate movement.

- Divergent ocean ridges are due to vertical uplift or convergence, rather than divergence.

- Misconceptions regarding Earth Science, including those dealing with plate tectonics and Earth history, can be determined through a professional "gallery walk." Discussing the conclusions and findings can be a very useful way to determine possible misconceptions that exist for the class and address them. Carleton College offers a gallery walk website at http://serc.carleton.edu/introgeo/gallerywalk/misconceptions.html.

- The Journal of Geoscience Education contains an article (Visual Abilities and Misconceptions about Plate Tectonics), Sept. 2005, outlining the use of student drawings to identify misconceptions http://d32ogoqmya1dw8.cloudfront.net/files/nagt/jge/abstracts/Sibley_v53p471.pdf.

- NASA provides a list of overarching Earth Science questions that address many of the common misconceptions at this grade level. There are resources and information that help address questions that center on Earth Systems Science at http://science.nasa.gov/big-questions/.

Instructional Strategies and Resources

-To grasp plate movement fully, students must investigate Earth's history using real data and maps. Maps constructed using scientific evidence, such as Earth's magnetism and sea floor spreading, can be helpful. Interpreting paleomagnetic data for different geologic periods demonstrates how scientists determine plate movement over time.

- Another way to show plate movement and emphasize the evidence from the geologic record is to use technology and virtual field trips. Seeing the impact and movement of the plates firsthand can help with understanding the dynamic and changing features of Earth.

- Showing each geologic time period and the location of the major plates through time can help illustrate the ever-changing surface of Earth. Comparing tectonic maps from the earliest time period to present day and then predicting where the plates will be in the future can deepen the understanding of these processes.

- NSTA provides learning modules called SciPacks that are designed to increase teacher content knowledge through inquiry-based modules. This module addresses Plate Tectonics.

- Constructing geologic maps from actual data allows students to document evidence in a unique way. Maps can be compared and be used to discuss the changes that occur in specific locations. The National Association of Geoscience Teachers provides inquiry-based activities and resources for constructing geologic maps to demonstrate plate tectonics.

- The USGS provides helpful background data to understand the relationship between the structure of Earth and plate tectonics.

Career Connections

Petroleum geologist, job in oceanography, Seismologist, Tectonophysicists

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recall that tectonic plates move; Identify tectonic plate boundaries;
- **Basic:** Recall that movement of tectonic plates is caused by convection currents; Identify types and characteristics of tectonic plate boundaries and the resulting features or events;
- **Proficient:** Explain and justify conclusions based on data, maps, and diagrams about the formation and boundaries of geologic features due to tectonic plate movement;
- **Accelerated:** Use evidence from a geologic column to make conclusions about Earth's geologic history and make comparisons between the past and present; Analyze or complete a diagram that shows how constructive or destructive processes affect the lithosphere;
- **Advanced:** Use evidence from a geologic column to make conclusions about Earth's geologic history and make comparisons between the past and present; Analyze or complete a diagram that shows how constructive or destructive processes affect the lithosphere.

Prior Knowledge

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.

Grades 6-7: Rocks have characteristics that are related to the environment in 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.

Future Knowledge

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.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.EES.3

PHYSICAL EARTH

A combination of constructive and destructive geologic processes formed Earth's surface.

Vocabulary

Coastlines
Constructive Processes
Contour Lines
Deposition
Destructive Processes
Elevation
Erosion
Floodplains
Geological Processes
Glaciers
Gradients
Hydrosphere
Landforms
Plate Tectonics
Lithosphere
Streams
Topographic, Physical, Arial Maps
Topography

Essential Understandings

- Earth's surface is formed from a variety of different geologic processes, including but not limited to plate tectonics.

Essential Skills

The students can identify various landforms on a map (i.e. mountains, valleys, ridges, plateaus, depressions).

The students can use maps to determine what caused constructive and destructive features.

The students can compare maps of various locations to identify differences in landforms.

The students can construct a model of a beach that is experiencing erosion and deposition.

The students can design an experiment to test the best method to reduce erosion.

The students can describe the conditions and constructive/destructive processes that form various landforms.

The students can explain how plate tectonics acts as constructive and destructive processes that can cause changes in earth's surface.

Misconceptions

- NASA provides a list of overarching Earth Science questions that address many of the common misconceptions at this grade level. There are resources and information that help address questions that center on Earth Systems Science at http://science.nasa.gov/big-questions/.

- NSTA provides recommendations for specific publications that are designed to address strategy in the K-8 classroom to support teaching science to all students in the classroom. Helpful in starting to work with inquiry to reach and engage all students, the recommendations can be found at http://www.nsta.org/recommends/ViewProduct.aspx?ProductID=18466

Instructional Strategies and Resources

-Constructing geologic maps from actual data allows students to document evidence in a unique way. Maps can be compared and used to discuss the changes that occur in specific locations. The National Association of Geoscience Teachers provides inquiry-based activities and resources for constructing geologic maps to demonstrate plate tectonics.

- The USGS provides helpful background data to understand constructive and destructive Earth processes as related to plate tectonics.

- Students should be able to look at topographic maps, geologic maps and aerial photographs to identify constructive and destructive features found in Ohio, the United States and other areas of the world. Comparing and contrasting the features and the processes that created the features increase the depth of student understanding. ODNR demonstrates the dynamic surface of Earth through interactive and geologic maps specific to Ohio. There are many other resources that help support the teaching of geology using surficial maps to view the changing, dynamic surface of the Earth.

- The relationship between plate movement and the interior of Earth should be demonstrated through a variety of different resources (e.g., maps, photographs, virtual experiences, film clips of constructive and destructive processes, study of Earth systems). The Digital Library for Earth Systems Education offers resources from a number of sources (e.g., National Geographic, government agencies, and scientific agencies).
An inquiry example can show how to integrate the study of plate tectonics, seismic waves and earthquakes with constructive and destructive processes.

Career Connections

Meteorologist, Environmental Earth scientist, Earth science teacher, Job involving geohazard assessments

Criteria for Success (Performance Level Descriptors)

- **Limited:** Define tectonic activity, erosion, and deposition;
- **Basic:** Describe major geologic processes that form specific features on the surface of Earth (e.g., tectonic activity, erosion, deposition); Identify the processes that cause the formation of various types of surface features (e.g., rivers, streams, deserts, coastlines); Identify and recall factors (e.g., topography, climate, soil, rock characteristics) that affect the surface patterns associated with streams, floodplains, glaciers, coastlines, flooding, and deserts;
- **Proficient:** Explain the connection between the presence of specific rock types, rock features, or fossils and environmental conditions at the time of formation (e.g., rocks with ripple marks and moving water, basalt and volcanic activity); Explain the characteristics of rocks and soil, climate, location, and topography as they relate to constructive and destructive processes occurring between the hydrosphere and lithosphere;
- **Accelerated:** Analyze or complete a diagram that shows how constructive or destructive processes affect the lithosphere;
- **Advanced:** Use evidence from aerial photographs and/or topographical maps to generate and justify a conclusion about how specific land features were formed.

Prior Knowledge	Future Knowledge
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. **Grades 6-7:** Igneous, metamorphic and sedimentary formation, interactions between Earth systems, and patterns of erosion and deposition are studied.	**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.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.ESS.4

PHYSICAL EARTH

Evidence of the dynamic changes of Earth's surface through time is found in the geologic record.

Vocabulary

Absolute Age
Crosscutting
Fossil Evidence
Geologic Record
Geologic Time
Ice Core Sampling
Index Fossils
Law of Superposition
Radiometric Dating
Relative Age

Essential Understandings

- 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.

Essential Skills

The students can investigate virtual dig sites using various methods in order to determine relative and absolute ages of rock layers.

The students can interpret index fossils and radiometric dating results to explain the law of superposition.

The students can interpret and understand past environments by developing and using ice core models.

Misconceptions

- All rock layers on the bottom are the oldest, and all rock layers on the top are the youngest.

- All rock types can be used for radiometric dating.

- Understanding the age of the Earth (4.6 billion years) can be difficult to grasp. This activity helps demonstrate the time scale in a visual and active way using a football field as the "scale." The activity can be modified to include important events and fossils for North America or Ohio to generate student interest.

- NASA lists common misconceptions for all ages about the sun and the Earth at http://www-istp.gsfc.nasa.gov/istp/outreach/sunearthmiscons.html.

- Students may have misinformation and misconceptions that pertain to climate change. To address this, it is important to provide evidence of climate change throughout Earth's history and current data to document temperature changes (surface and oceanic). Data and other resources to help with teaching climate change can be found on EPA's website at http://www.epa.gov/climatechange/index.html.

- NASA provides a list of overarching Earth Science questions that address many of the common misconceptions at this grade level. There are resources and information that help address questions that center on Earth Systems Science at http://science.nasa.gov/big-questions/.

Instructional Strategies and Resources

- The USGS provides helpful background data to understand the relationship between the structure of Earth, the history of Earth and plate tectonics. Students often struggle with the immense scale of Earth's history, so using relative and absolute time data to construct timelines can be helpful. It is important to use actual geologic time data and ensure that absolute time is fully explained. Timeline activities (e.g., using a football field for the timeline with an inch equaling one million years) may enhance class discussions.

- Relating the geologic record to Ohio is another strategy that can increase student engagement. Allow students to interpret Ohio's geologic history by combining field observations, bedrock geology maps and scientific research and data. ODNR offers a number of references and resources to help interpret Ohio geologic history.

- In addition to the geologic record, ice cores can be used to determine environmental conditions that existed at the time of formation. Actual ice-core data should be used. Interpretations of the data can support student ideas and discussions. Virtual field experiences and film clips can add to student interest.

Career Connections

Geochronologists, Paleontologist, Sedimentologists, job in stratigraphy

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recall that geologic and fossil records serve as evidence for past environmental conditions; Define relative and absolute age of geologic features;
- **Basic:** Describe how to determine relative age of geologic features;
- **Proficient:** Apply the concept of uniformitarianism to determine the relative age of geologic features using the law of superposition, index fossils or crosscutting relationships); Use diagrams or data from geologic columns and glacial cores to interpret and compare relative and absolute age and environmental conditions;
- **Accelerated:** Analyze data to justify conclusions that the fossil record serves as evidence for biodiversity and/or diversity within a species and the fact that most species that have lived on Earth are now extinct;
- **Advanced:** Evaluate rock and fossil data to generate and justify conclusions about past environmental conditions; Trace climate change as documented by the geologic record and ice cores.

Prior Knowledge

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.

Grades 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.

Future Knowledge

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.

Ohio's Learning Standards- Clear Learning Targets

Science, Grade 8

8.LS.1

SPECIES AND REPRODUCTION

Diversity of species is a result of variation of traits, a result of variation of traits, occurs through the process of evolution and extinction over many generations. The fossil records provide evidence that changes have occurred in number and types of species.

Vocabulary

Diversity
Extinction
Fossil Record
Genes
Geologic and Fossil Records
Sexual Reproduction
Traits
Variations

Essential Understandings

- 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 statistic mathematics to predict changes in a gene pool are reserved for high school Biology.

Essential Skills

The students can explain how diversity can result from sexual reproduction.

The students can describe how variations may allow for survival when the environment changes.

The students can use data and evidence from geologic and fossil records to infer what the environment was like at the time of deposition.

Misconceptions

- Environmental conditions are responsible for changes in traits.

- Organisms develop new traits because they need them to survive.

- Species adapt to environmental changes quickly.

- AAAS' Benchmarks 2061 Online, Chapter 15, 5f, Evolution of Life, states many students believe that environmental conditions are responsible for changes in traits or that organisms develop new traits because they need them to survive.

Instructional Strategies and Resources

- The Annenberg Media series Essential Science for Teachers: Life Science: Session 5 provides information on how children can learn about the variations of living things and offers classroom footage to illustrate implementation. Conduct an investigation to study adaptations of organisms and how they affect survival in a particular environment. Bottle biology offers a methodology for this investigation.

- The Missouri Botanical Garden helps students explore the world's biomes and their organisms. When students choose a biome or ecosystem, they discover a wide variety of information on plants, animals and their habitats.

- The Annenberg Media series Essential Science for Teachers: Life Science: Session 6 provides information about how children can learn about the variations of living things that lead to evolution. It focuses on the development of a species.

- Project Wild was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the ODNR Website. In Bottleneck Genes, students simulate the gene-pool analysis of an animal population and all the factors that affect it, including genetic diversity, environmental change, and limiting factors. In Here Today, Gone Tomorrow, students explore endangered species and the reasons whythey are endangered.

- Guide to Using Animals in the Classroom by the Ohio Department of Natural Resources provides guidance, explains legally which organisms may be collected and limited advice on use of animals in theclassroom.

- ODNR-Division of Wildlife's A to Z Species Guide has photos, information, tracks and sounds of Ohio's wild animals.

Career Connections

Paleontologist, Zoologist, Geneticist, Science writer

Criteria for Success (Performance Level Descriptors)

- **Limited:** Recall that geologic and fossil records serve as evidence for past environmental conditions;
- **Basic:** Explain the advantages and disadvantages of sexual and asexual reproduction;
- **Proficient:** Predict how genetic variation (e.g., beak structure, coloration) affects the survival or extinction of a species when environmental conditions change gradually or suddenly;
- **Accelerated:** Interpret data from real-world scenarios or experiments showing outcomes (e.g., survival and reproduction rates) of sexual and asexual reproduction under varying environmental conditions;
- **Advanced:** Evaluate graphs showing population data related to environmental changes; Evaluate rock and fossil data to generate and justify conclusions about past environmental conditions; Trace climate change as documented by the geologic record and ice cores; Interpret and explain data from real-world scenarios or experiments showing outcomes (e.g., survival and reproduction rates) of sexual and asexual reproduction under varying environmental conditions.

Prior Knowledge	**Future Knowledge**
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. **Grades 6-7:** In any particular biome, the number, growth and survival of organisms and populations depend on biotic and abiotic conditions.	N/A

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.LS.2

SPECIES AND REPRODUCTION

Every organism alive today comes from a long line of ancestors who reproduced successfully every generation.

Vocabulary
Asexual Reproduction
Bacteria
Chromosome
Clone
Fertilization
Gamete
Genetic Modification (GM)
Identical
Media Bias
Meiosis
Mitosis
Sexual Reproduction
Unique
Zygote

Essential Understandings

- 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.

Essential Skills

The students can explain that every organism alive today comes from a long line of ancestors who reproduced successfully every generation.

The students can describe reproduction as the transfer of genetic information from one generation to the next.

The students can predict the probability of traits that can occur with mixing of genes from two individuals (sexual reproduction).

The students can use a model to represent the transfer of genes from one individual to the next generation (asexual reproduction).

The students can compare the characteristics of asexual and sexual reproduction. (identical v. unique offspring; low energy expenditure v. high energy expenditure; short amount of time v. longer gestation, etc.)

The students can compare meiosis and mitosis, their phases and purposes.

Misconceptions

- One set of alleles is responsible for determining each trait, and there are only 2 different alleles (dominant and recessive) for each gene.

- Your genes determine all of your characteristics, and cloned organisms are exact copies of the original.

- All mutations are harmful.

- A dominant trait is the most likely to be found in the population.

- Genetics terms are often confused.

- Weber State University provides a list for misconceptions in biology. Scroll down to Standard IV to address misconceptions about reproduction.

Instructional Strategies and Resources

- Teachers' Domain: Reproduction is an online activity in which students explore the various ways that organisms reproduce.

- Teachers' Domain: Reproduction and Genetics is a two-session course that explores the cellular processes that organisms use to develop, reproduce and pass traits from one generation to the next.

- Project Wild was developed through a joint effort of the Western Association of Fish and Wildlife Agencies and the Council for Environmental Education. This program helps students learn basic concepts about wild animals, their needs and importance and their relationships to people and the environment. The activity guides are available to educators free of charge when they attend a workshop. Information about upcoming workshops are available on the ODNR Website. In Bottleneck Genes, students simulate the gene-pool analysis of an animal population and all the factors that affect it, including genetic diversity, environmental change, and limiting factors.

Career Connections

Bioscientist, Mammalogist, Job involving genetics, High school science teacher, Animal breeder

Criteria for Success (Performance Level Descriptors)

- **Limited:** Describe sexual and asexual reproduction; Recall that mitosis and meiosis are processes by which genetic material is copied and divided;
- **Basic:** Use diagrams to show the genetic differences between the daughter cells produced by mitosis and meiosis; explain the advantages and disadvantages of sexual and asexual reproduction;
- **Proficient:** Compare end products of sexual and asexual reproduction with an emphasis on their advantages and disadvantages in relation to the continuation of the species;
- **Accelerated:** Interpret data from real-world scenarios or experiments showing outcomes (e.g., survival and reproduction rates) of sexual and asexual reproduction under varying environmental conditions;
- **Advanced:** Interpret and explain data from real-world scenarios or experiments showing outcomes (e.g., survival and reproduction rates) of sexual and asexual reproduction under varying environmental conditions.

Prior Knowledge	**Future Knowledge**
Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next. **Grades 6-7:** Modern Cell Theory states cells come from pre-existing cells.	**High School:** The details and importance of gamete formation are studied.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.LS.3

SPECIES AND REPRODUCTION

The characteristics of an organism are a result of inherited traits received from parent(s).

Essential Understandings

- 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: The focus should be the link between DNA and traits without being explicit about the mechanisms involved.

Note: The ways in which bacteria reproduce is beyond the scope of this content statement.

Note: The molecular structure of DNA is not appropriate at this grade level.

Vocabulary

Tier 3:

Alleles
Co-dominance
Dominant Allele
Fertilization
Genes
Genotype
Heredity
Heterozygous (hybrid)
Homozygous (purebred)
Hybrid
Offspring
Phenotype
Probability
Punnett Square
Recessive Allele
Trait

Essential Skills	**The students can explain how traits are passed from one generation to the next.** **The students can identify the difference between dominant and recessive traits.** **The students can demonstrate the Mendelian Law of Segregation.** **The students can demonstrate the Mendelian Law of Independent Assortment.** **The students can analyze Family Histories to Identify Inherited Genetic Disorders.**

Misconceptions

- One set of alleles is responsible for determining each trait, and there are only 2 different alleles (dominant and recessive) for each gene.

- Your genes determine all of your characteristics, and cloned organisms are exact copies of the original.

- All mutations are harmful.

- A dominant trait is the most likely to be found in the population.

- AAAS' Benchmarks 2061 Online, Chapter 15, 5b, Heredity, highlights that students think sexual reproduction results in traits being inherited from only one parent (e.g., the mother or same-sex parent). They may believe that there is a "blending of characteristics" in offspring.

Instructional Strategies and Resources

- DNA from the Beginning explores aspects of Mendel's genetic experiments with animations. The Law of Segregation, the Law of Independent Assortment and the Law of Dominance are explained.
- The University of Utah's Genetic Learning Center offers Tour of the Basics, a tutorial that contains animations to explain heredity and its components. For this content area, focus on What is Heredity? and What is a Trait? Some areas of this site go beyond the scope of this grade-level content.

Career Connections

Geneticists, Veterinarian and Vet Techs, Biologists, Medical and Animal Scientists

Criteria for Success (Performance Level Descriptors)

- **Limited:** Complete a monohybrid cross Punnett square;
- **Basic:** Analyze the inheritance patterns shown in pedigrees based on relationships between phenotypes and genotypes;
- **Proficient:** Use pedigrees to explain the principles of Mendelian genetics, law of segregation, and law of independent assortment;
- **Accelerated:** Design an experiment to determine possible genotypes and their probabilities of occurring in offspring from a cross;
- **Advanced:** Interpret a pedigree to determine the genotype of an individual within that pedigree.

Prior Knowledge

Grades 3-5: Individual organisms inherit many traits from their parents indicating a reliable way to transfer information from one generation to the next. Grades 6-7: Modern Cell Theory states cells come from pre- existing cells.

Future Knowledge

High School: The details and importance of gamete formation, the structure of DNA and modern genetics are studied.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.PS.1

FORCES AND MOTION

Objects can experience a force due to an external field such as magnetic, electrostatic, or gravitational fields.

Essential Understandings

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

Vocabulary
Attraction
Conductor
Earth's magnetic field
Electrical current
Electromagnetic (energy, field, wave, induction)
Field model
Galvanometer
Insulator
Ions
Magnetic field (lines)
Magnetic poles
Multimeter
Negative charge
Negative pole
Positive charge
Positive pole
Repulsion
Theory

Essential Skills	**The students can identify forces that act at a distance, such as gravity, magnetism, and electrical.** **The students can describe some of the properties of magnets and some of the basic behaviors of magnetic forces.** **The students can use a field model to explain the effects of forces that act at a distance.** **The students can generate an electric current by passing a conductive wire through a magnetic field and quantify electric current, using a galvanometer or multimeter.** **The students can demonstrate that the Earth has a magnetic field.** **The students can explain that objects and particles have stored energy due to their position from a reference point and this energy has the potential to cause motion.** **The students can explain that a field originates at a source and radiates away from that source decreasing in strength.** **The students can demonstrate how electrons transfer electrical and magnetic (electromagnetic) energy through waves.** **The students can plan, design, construct and implement an electromagnetic system to solve a real-world problem.**

Misconceptions

- Only animate objects can exert a force.

- Force is a property of an object.

- An object has force and when it runs out of force, it stops moving.

- Large objects exert a greater force than small objects.

- There is no gravity in space.

Instructional Strategies and Resources

- Coulomb's Law, an interactive simulation from the State University of New York's Department of Chemistry, allows students to change the amount and distance between two charges and see the resulting change in electric force.

- Hand-cranked radios or cell-phone chargers are examples of items that include generators.

Career Connections

Game programmer, Architect, Career in the air force, Geoscientist

Criteria for Success (Performance Level Descriptors)

- **Limited:** Identify gravitational, electric, and magnetic fields;

- **Basic:** Identify behavior of objects with mass, charge and/or magnetic properties in gravitational, electric or magnetic fields; Interpret the magnetic field from drawings/pictures of a magnet and iron filings;

- **Proficient:** Explain the relationship between electric currents and magnetic fields; Explain that generators and motors transform electrical and mechanical energy using electric currents and magnetic fields; Compare the properties of gravitational, electric, and magnetic fields;

- **Accelerated:** Use diagrams of motors, generators, or electromagnets to demonstrate the relationships between current and magnetic field;

- **Advanced:** Design an experiment to assess how objects would behave in electric, magnetic, or gravitational fields.

Prior Knowledge	Future Knowledge
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. **Grades 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. **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.*	**High School:** The strength of the force between two charges is calculated using Coulomb's Law. Electromagnetic induction is applied to generator and motors. DC circuits are studied.

Ohio's Learning Standards- Clear Learning Targets
Science, Grade 8

8.PS.2

FORCES AND MOTION

Forces can act to change the motion of objects.

Essential Understandings

- 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.
- If there is a nonzero net force acting on an object, its speed and/or direction will change.
- Kinetic friction and drag are forces that act in a direction opposite the relative motion of objects.

Vocabulary

Air Resistance (Drag)
Balanced Forces
Force Diagram
Friction
Gravity
Inertia
Magnitude(strength)
Mass
Motion
Net Force
Position
Reference Point
Speed
Stationary
Unbalanced Force
Weight

Essential Skills

The students can describe motion in relation to reference points.

The students can demonstrate how forces can oppose the motion of an object.

The students can describe a force by its magnitude and direction.

The students can construct a force diagram.

The students can describe how net force affects an object's direction and/or speed.

The students can demonstrate how forces are related to Newton's 1st Law of Motion (inertia).

The students can apply knowledge about forces to solve a problem by designing a solution.

Misconceptions

- Reference points change as the position of an object changes.

- Motion can only be described from one reference point.

- Only non-moving objects can be reference points.

- Gravity pulls in the direction of motion on a ramp.

- The only natural motion is for an object to be at rest.

- If an object is at rest, no forces are acting on the object.

- Only animate objects can exert a force. Thus, if an object is at rest on a table, no forces are acting on it.

- Force is a property of an object. An object has force and when it runs out of force, it stops moving.

- A force is needed to keep an object moving with a constant speed. Students do not realize that gravity and friction are forces.

Instructional Strategies and Resources

- Use balloon cars, hover pucks and air hockey tables with students to explore motion that is not affected by a great deal of friction.

- Friction, an interactive simulation from BBC Schools, allows students to apply different forces to start a cart moving and explore how far the cart travels on different surfaces.

- Forces in Action, an interactive simulation from BBC Schools, allows students to observe how different-sized parachutes with different amounts of drag affect the motion of a truck.

- Gravity Force Lab, an interactive simulation from PhET, allows students to visualize the gravitational force that two objects exert on each other. Students may change the mass of and distance between the objects and observe the changes in the gravitational force.

- Forces in 1-Dimension is an interactive simulation from PhET that allows students to use different forces to push an object, see the resulting friction force, net force, and any change in motion that occurs.

Career Connections

Career involving sports, Mechanical engineer, Theme park engineer

Criteria for Success (Performance Level Descriptors)

- **Limited:** Identify that motion is relative and dependent on the position of the observer;
- **Basic:** Interpret force/free-body diagrams;
- **Proficient:** Complete and analyze simple force/free-body diagrams; Explain the changes in motion in a scenario involving balanced or unbalanced forces;
- **Accelerated:** Predict changes in motion given a scenario involving balanced or unbalanced forces;
- **Advanced:** Design an experiment to test the effect of multiple forces on the motion of an object.

Prior Knowledge

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.

Grades 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.

Future Knowledge

High School: Newton's second law will be developed quantitatively and situations will be explored mathematically.

Common Core Standards for Literacy in Science – Reading Standards 6-8

Key Ideas and Details:
CCSS.ELA-LITERACY.RST.6-8.1
Cite specific textual evidence to support analysis of science and technical texts.

CCSS.ELA-LITERACY.RST.6-8.2
Determine the central ideas or conclusions of a text; provide an accurate summary of the text distinct from prior knowledge or opinions.

CCSS.ELA-LITERACY.RST.6-8.3
Follow precisely a multistep procedure when carrying out experiments, taking measurements, or performing technical tasks.

Craft and Structure:
CCSS.ELA-LITERACY.RST.6-8.4
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*.

CCSS.ELA-LITERACY.RST.6-8.5
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.

CCSS.ELA-LITERACY.RST.6-8.6
Analyze the author's purpose in providing an explanation, describing a procedure, or discussing an experiment in a text.

Integration of Knowledge and Ideas:
CCSS.ELA-LITERACY.RST.6-8.7
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).

CCSS.ELA-LITERACY.RST.6-8.8
Distinguish among facts, reasoned judgment based on research findings, and speculation in a text.

CCSS.ELA-LITERACY.RST.6-8.9
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:
CCSS.ELA-LITERACY.RST.6-8.10
By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

Common Core Standards for Literacy in Science – Writing Standards 6-8

CCSS.ELA-LITERACY.WHST.6-8.1
Write arguments focused on *discipline-specific content*.

CCSS.ELA-LITERACY.WHST.6-8.1.A, B, C, D, E
Introduce claim(s) about a topic or issue, acknowledge and distinguish the claim(s) from alternate or opposing claims, and or ganize the reasons and evidence logically; support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources; use words, phrases, and clauses to create cohesion and clarify the relationships among claim(s), counterclaims, reasons, and evidence; establish and maintain a formal style; provide a concluding statement or section that follows from and supports the argument presented.

CCSS.ELA-LITERACY.WHST.6-8.2
Write informative/explanatory texts, including the narration of historical events, scientific procedures/ experiments, or technical processes.

CCSS.ELA-LITERACY.WHST.6-8.2.A, B, C, D, E, F
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; develop the topic with relevant, well-chosen facts, definitions, concrete details, quotations, or other information and examples; use appropriate and varied transitions to create cohesion and clarify the relationships among ideas and concepts; use precise language and domain-specific vocabulary to inform about or explain the topic,; establish and maintain a formal style and objective tone; provide a concluding statement or section that follows from and supports the information or explanation presented.

Production and Distribution of Writing:
CCSS.ELA-LITERACY.WHST.6-8.4
Produce clear and coherent writing in which the development, organization, and style are appropriate to task, purpose, and au dience.

CCSS.ELA-LITERACY.WHST.6-8.5
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.

CCSS.ELA-LITERACY.WHST.6-8.6
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:
CCSS.ELA-LITERACY.WHST.6-8.7
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.

CCSS.ELA-LITERACY.WHST.6-8.8
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.

CCSS.ELA-LITERACY.WHST.6-8.9
Draw evidence from informational texts to support analysis, reflection, and research.

Range of Writing:
CCSS.ELA-LITERACY.WHST.6-8.10
Write routinely over extended time frames (time for reflection and revision) & shorter time frames (a single sitting or a day or two) for a range of discipline-specific tasks, purposes, & audiences.