Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.ESS.1	**ROCKS, MINERALS AND SOIL** **This topic focuses on the study of rocks, minerals and soil, which make up the lithosphere. Classifying and identifying different types of rocks, minerals and soil can decode the past environment in which they formed.**
Essential Understandings: • Minerals are naturally occurring, inorganic solids that have a defined chemical composition. Minerals have properties that can be observed and measured. Minerals form in specific environments.	**Academic Vocabulary/Language** **Tier 3:** Cleavage Density Fracture Hardness Inorganic Luster Mineral Streak
I Can Statements	**The students can identify minerals by testing their properties.** **The students can use mineral properties to identify minerals.**

Misconceptions

- Rocks are the same, and it's hard to tell how they originated.

- Rocks and minerals are the same thing; distinguishing them is not important.

- Humans can fabricate rocks and minerals; artifacts are the same as rocks and minerals.

- Rocks are hard.

- Allowing student investigation in the testing of different mineral properties is a key part of really understanding minerals. The properties of the mineral define its value and uses. The USGS provides mineral resources and information that can support the teaching of minerals. Specific mineral data is available using the website's search engine.

- Understanding how to test minerals accurately is essential in identifying minerals correctly. Identification should not be based upon visuals, but rather testing and analyzing the results. Many minerals can look or feel the same, so it is important to encourage students to run tests before identifying an unknown mineral. The Mineralogical Society of America offers training, workshops, data and resources to support learning about minerals and geology.

- Connecting mineral uses with mineral identification is an important part of teaching about minerals with connections to the real world. Geology.com provides information on each major mineral type or group with details on mineral properties and uses.

-Carleton College provides geology-specific assessment techniques that can identify misconceptions, lists of common Earth science misconceptions and resources to correct misconceptions at http://serc.carleton.edu/NAGTWorkshops/teaching_methods/conceptests/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

-CCS curriculum guide lessons: Minerals (6.ES.1)

-Websites: Rocks for Kids: http://www.rocksforkids.com/RFK/howrocks.html,
Properties of Common Minerals: http://newyorkscienceteacher.com/sci/site/files/esrt/ESRT-2010.pdf,
ODNR ROCK KITS: http://www.dnr.state.oh.us/tabid/22338/Default.aspx

- Use this lab to become familiar with minerals and their properties. http://www.uaf.edu/files/olli/Lab1_Final_MineralID.pdf

- Rocks and minerals web quest, websites provided in the activity. Use this to become familiar with rock and mineral characteristics.

http://www.nwcsd.k12.ny.us/cms/lib/NY19000569/Centricity/Domain/316/Rocks%20and%20Minerals%20Webquest.pdf

- Introduction to minerals video- https://youtu.be/8a7p1NFn64s

- Mystery mineral lab- students test mineral properties to identify a mystery mineral. http://www.skidmore.edu/~jthomas/fairlysimpleexercises/pdf/minid.pdf

Gizmo- Observe and measure the properties of a mineral sample, and then use a key to identify the mineral. Students can observe the color, luster, shape, density, hardness, streak, and reaction to acid for each mineral. There are 26 mineral samples to identify.

https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=640

Career Connections

Geologist, Machine Operator, Site Manager, Environmentalists, Engineer

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Objects have physical properties, properties of objects can change, and Earth's nonliving resources have specific properties.

Grades 3-5: Rocks and soil have characteristics, soil contains pieces of rocks, and objects are composed of matter and may exhibit electrical conductivity and magnetism.

Future Knowledge

Grades 7-8: Biogeochemical cycles, igneous environments and the history of Earth (including the changing environments) from the interpretation of the rock record are studied.

High School: The formation of elements, chemical bonding and crystal structure are found in the Physical Sciences. In grades 11-12 Physical Geology, mineralogy is explored at depth.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.ESS.2	**ROCKS, MINERALS AND SOIL** **Igneous, metamorphic and sedimentary rocks have unique characteristics that can be used for identification and/or classification.**	**Academic Vocabulary/Language** **Tier 3:** Chemical Sedimentary Rock Clastic Sedimentary Rock Contact metamorphism Extrusive Igneous rock Foliated High Silica Igneous Intrusive Igneous rock Lava Low Silica Magma Metamorphic Rock Nonfoliated Organic Sedimentary Rock Regional metamorphism Sedimentary Rocks Strata Stratification Texture
Essential Understandings: • Most rocks are composed of one or more minerals, but there are a few types of sedimentary rocks that contain organic material, such as coal. The composition of the rock, types of mineral present, mineral arrangement, and/or mineral shape and size can be used to identify the rock and to interpret its history of formation, breakdown (weathering) and transport (erosion).		
I Can Statements	**The students can identify the unique characteristics to classify rocks.** **The students can describe the formation of igneous rocks.** **The students can use the unique characteristic of sedimentary rocks to identify and classify sedimentary rocks.** **The students can identify the characteristics/classify metamorphic rocks.** **The students can describe how metamorphic rocks form.**	

Misconceptions

- Rocks are the same, and it's hard to tell how they originated.

- Rocks and minerals are the same thing; distinguishing them is not important.

- Humans can fabricate rocks and minerals; artifacts are the same as rocks and minerals.

- Rocks are hard.

- Carleton College provides geology-specific assessment techniques that can identify misconceptions, lists of common Earth science misconceptions and resources to correct misconceptions at http://serc.carleton.edu/NAGTWorkshops/teaching_methods/conceptests/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

-CCS curriculum guide lessons: Igneous Rock (6.ES.2a), Sedimentary Rocks (6.ES.2b), It's the Heat and Pressure (6.ES.2c)

-Involving students in rock collecting and building a classroom set of representative rocks can be a way to connect the classroom to what students see locally. The USGS provides a list of resources and links to help in the teaching of rock identification and rock formation at the middle school level. It is important that students identify and classify rocks using specific characteristics, such as what minerals are present and texture/grain size. Appearance alone should not be relied upon for identification. https://education.usgs.gov/primary.html#rocks

-It is important to teach how specific types of rocks form and connect this teaching to understanding Earth's history. The National Earth Science Teachers Association provides background information about the formation of each type of rock (sedimentary, metamorphic and igneous). In addition, information is provided about minerals found in the rocks. http://www.mestarocks.org/cms/content/welcome

-Introducing students to topographic and geologic maps can be used to connect the local geology to what is being taught in the classroom. ODNR's Division of Geological Survey provides a number of resources that link to Ohio specific geology, including a variety of geologic maps and information about the history of Ohio's geologic history. http://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/Misc_State_Maps&Pubs/OH_SurfaceRocks_Sediments.pdf

-NSTA provides learning modules called SciPacks that are designed to increase teacher content knowledge through inquiry-based modules. This module addresses rock forming environments. https://learningcenter.nsta.org/resource/?id=10.2505/7/SCB-RK.2.1

-The College Board provides Earth Science recommendations for grades 6-12 (beginning on page 21). Essential questions and scientific

applications are included in this document to encourage investigation and scientific inquiry. In addition, connections to other topics and subjects are suggested to add relevancy and interest for students. https://secure-media.collegeboard.org/apc/cbscs-science-standards-2009.pdf

- Gizmo: Try to classify a dozen different rock samples based on their appearance. Common characteristics of each major rock type are described. Rocks also can be classified by where they formed.
https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=437

- Classify rocks based on their characteristics using this interactive website. https://www.learner.org/interactives/rockcycle/types.html

-Video: Explains the types of rocks and how they form: https://youtu.be/17l2LrjZi9o

- Create stations for students to investigate types of rocks. Students task will be to sort each rock into igneous, metamorphic, or sedimentary based on their physical characteristics. Lab sheets and steps included. https://middleschoolscience.com/2015/07/08/rocks-rock-identification-stations/amp/

-Bill Nye video, explains rocks, minerals, and soil! https://www.youtube.com/watch?v=XIebFtd-t8Y

Career Connections

Geologist: people who study rocks, minerals, and composition, Machine Operator: the person who operates equipment, Site Manager: oversees each role and responsibility on the job site, Environmentalists: concerned with the environmental impact of projects, Engineer: understand and design the process, which includes the types of materials used

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Objects have physical properties, properties of objects can change and Earth's nonliving resources have specific properties.

Grades 3-5: Rocks and soil have characteristics, soil contains pieces of rocks, rocks form in different ways, and objects are composed of matter and may exhibit electrical conductivity and magnetism.

Future Knowledge

Grades 7-8: Sedimentary, metamorphic and igneous environments, and the history of Earth (including the changing environments) from the interpretation of the rock record are studied.

High School: The formation of elements, chemical bonding and crystal structure are found in the Physical Sciences. In grades 11/12 Physical Geology, depositional environments, volcanics, characteristics of rocks and mineralogy are explored in depth.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.ESS.3	**ROCKS, MINERALS AND SOIL** **Igneous, metamorphic and sedimentary rocks form in different ways.**	**Academic Vocabulary/Language**
Essential Understandings: • Magma or lava cools and crystallizes to form igneous rocks. Heat and pressure applied to existing rock forms metamorphic rocks. Sedimentary rock forms as existing rock weathers chemically and/or physically and the weathered material is compressed and then lithifies. Each rock type can provide information about the environment in which it was formed.		**Tier 3:** Igneous Metamorphic Rock Rock Cycle Sedimentary

I Can Statements	**The students can use the rock cycle to describe the formation of igneous, sedimentary and metamorphic rocks.**

Misconceptions

- All rocks are the same, and it's hard to tell how they originated.

- Rocks and minerals are the same thing; distinguishing them is not important.

- Humans can fabricate rocks and minerals; artifacts are the same as rocks and minerals.

- All rocks are hard.

- Carleton College provides geology-specific assessment techniques that can identify misconceptions, lists of common Earth science misconceptions and resources to correct misconceptions at http://serc.carleton.edu/NAGTWorkshops/teaching_methods/conceptests/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

-CCS curriculum guide lessons: Rocking The Cycle (6.ES.3)

- Help students understand the rock cycle by having them become a 'rock' themselves. Several stations represent stages of the rock cycle, using a die (one you create your own dice, the other you use a regular die.) to direct them to the next station students create their own journey through the rock cycle. Two websites are included, similar lesson plan but you can use them to help create an Activity that works best for your class.

https://www.nasa.gov/sites/default/files/rockingtherockcycle.pdf or https://www.slcschools.org/departments/curriculum/science/Grade-7-to-8/Grade-8/documents/s3-o2-lesson-rock-cycle-dice-lab.pdf

- Gizmo: Play the role of a piece of rock moving through the rock cycle. Select a starting location and follow many possible paths throughout the cycle. Learn how rocks are formed, weathered, eroded, and reformed as they move from Earth's surface to locations deep within the crust. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=436

- Video: Students see how the rock cycle works by seeing a demonstration of jelly beans! https://youtu.be/pm6cCg_Do6k

Career Connections

Geologist: people who study rocks, minerals, and composition, Machine Operator: the person who operates equipment, Site Manager: oversees each role and responsibility on the job site, Environmentalists: concerned with the environmental impact of projects, Engineer: understand and design the process, which includes the types of materials used

Sample Test Question

Not applicable at the grade level	
Prior Knowledge **PreK-2:** Objects have physical properties, properties of objects can change and Earth's nonliving resources have specific properties. **Grades 3-5:** Rocks and soil have characteristics, soil contains pieces of rocks, rocks form in different ways, and objects are composed of matter and may exhibit electrical conductivity and magnetism.	**Future Knowledge** **Grades 7-8:** Sedimentary, metamorphic and igneous environments, and the history of Earth (including the changing environments) from the interpretation of the rock record are studied. **High School:** The formation of elements, chemical bonding and crystal structure are found in the Physical Sciences. In grades 11/12 Physical Geology, depositional environments, volcanics, characteristics of rocks and mineralogy are explored in depth.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.ESS.4	**ROCKS, MINERALS AND SOIL** **Soil is unconsolidated material that contains nutrient matter and weathered rock.**
Essential Understandings: • Soil formation occurs at different rates and is based on environmental conditions, types of existing bedrock and rates of weathering. Soil forms in layers known as horizons. Soil horizons can be distinguished from one another based on properties that can be measured.	**Academic Vocabulary/Language** **Tier 3:** Minerals Soil Horizon Soil Profile Soil Properties Soil Region
I Can Statements	**The students can investigate how soil forms at different rates and has different measurable properties through soil sampling and testing.** **The students can explain how soil is formed into layers called horizons based on measurable properties.** **The students can identify and describe Ohio's soil as it relates to formation and soil properties.**

Misconceptions

-All soil has the same composition.
-Soil is solid.
-All soil is brown.
-Soil is only found in certain areas.
-Soil is only a few years old.
- Soil comes from plants.
- Carleton College provides geology-specific assessment techniques that can identify misconceptions, lists of common Earth science misconceptions and resources to correct misconceptions at http://serc.carleton.edu/NAGTWorkshops/teaching_methods/conceptests/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

- CCS curriculum guide lessons: Thinking Like A Soil Scientist (6.ES.4)

- Investigating local and statewide soil types and comparing them to actual tests of local soil samples can be a good starting point in understanding soil. Lists of soil types by state can be used to begin this process. https://www.nrcs.usda.gov/wps/portal/nrcs/soilsurvey/soils/survey/state/

- Examining student-based (classroom data) soil-sample results can be a good way to compare soil types by regions. The GLOBE program allows connections to other classrooms and can be used to analyze data beyond the local area to draw conclusions about specific criteria for soil formation.

- Specific resources related to Ohio soil, including Web-based survey tools, interactive maps and mapping programs, can be used in the identification of local and state soil. https://www.globe.gov/do-globe/globe-teachers-guide/soil-pedosphere

- NSTA offers reference books and materials that help students understand the properties and uses of soil at the middle school level. http://learningcenter.nsta.org/share.aspx?id=jmK94p7aMc

- The USGS has a resource page that provides data, information, books and maps that relate to Earth's surface, soils, soil formation, weathering and erosion. https://mrdata.usgs.gov/soilgeochemistry/#/summary

- Allowing students to test the properties of soil leads to a deeper understanding of soil formation, local soils and the importance of soil. Soil types, testing and use, and understanding the methods required for analysis of soils can further demonstrate the importance of soil conservation. http://www.thescienceofsoil.com/teacher-resources

- Local Soil and Water Conservation Districts can offer multiple environmental educational resources that pertain directly to soil uses,

conservation of soil, soil testing and interpretation of soil data. http://water.ohiodnr.gov/swcds/find-a-local-swcd

- Introducing problem-solving skills through the application of science can deepen the content knowledge for soils. Testing soils to determine which types of soil would work best in a specific situation is a good way to connect soils and soil uses to the real world. One example (provided in the Vision into Practice section) involves determining which soil is best to use to deter floodwaters. The sandbag example provides inquiry and engineering design for students of all ability levels.

- This resource gives lesson ideas for soil formation, properties, and the importance in conserving our soil. http://utah.agclassroom.org/files/uploads/estore/unit_dirt.pdf

- Investigate soil formation, types, and properties by using this webquest- https://communities.naae.org/servlet/JiveServlet/download/6947-4088/Smithsonian%20Soil%20web%20quest.doc

-Video explains soil types and soil formation: https://www.youtube.com/watch?v=ob2AMqZMLiw&t=23s

-Video Eexplains soil layers: https://www.youtube.com/watch?v=ysIm7ImsK6c

Career Connections

Geologist: people who study rocks, minerals, and composition, Machine Operator: the person who operates equipment, Site Manager: oversees each role and responsibility on the job site, Environmentalists: concerned with the environmental impact of projects, Engineer: understand and design the process, which includes the types of materials used

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Objects have physical properties, properties of objects can change and Earth's nonliving resources have specific properties.

Grades 3-5: Rocks and soil have characteristics. Soil contains pieces of rocks. Soil investigations measure color, texture, ability for water to pass through soil, moisture content and soil composition. Objects are composed of matter.

Future Knowledge

Grades 7-8: Biogeochemical cycles and the role of soil within them, soil erosion and runoff issues, hydrologic cycle including percolation and infiltration rates, and sedimentary environments are studied.

High School: The formation of elements, the importance of soil in an ecosystem, and issues with soil degradation and soil loss are explored. In grades 11/12 Physical Geology, depositional environments, soil mechanics, issues with mass wasting including soil/sediment contamination issues and the classification of soil is found.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.ESS.5	**ROCKS, MINERALS AND SOIL** **Rocks, minerals and soils have common and practical uses.**	**Academic Vocabulary/Language** **Tier 3:** Nonrenewable Open-Pit Ore Quarries Reclamation Strip Mining Subsurface Mining Surface Mining
Essential Understandings: • Nearly all manufactured material requires some kind of geologic resource. Most geologic resources are considered nonrenewable. Rocks, minerals and soil are examples of geologic resources that are nonrenewable.		
I Can Statements	**The students can identify examples of different ways the soil, rock and minerals can be used.** **The students can recognize the characteristics of soil, rock and minerals to determine how they can be used.**	

Misconceptions

- Soil is sterile. (Remind students that life exists in soil. If it were sterile, there would be no life inside of it.)

- All soil is brown. (Most have bits of red, yellow and orange, and then you get black from organic matter. The more unusual colors—blue, green, purple—you'll find in wetlands or from some unusual minerals. They also have a lot of texture. Run your hand over soils, and you'll find some are smooth, some are bumpy, and some have huge rocks in them.)

- Soil is only found in certain areas. (Soil is found everywhere.)

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

- Carleton College provides geology-specific assessment techniques that can identify misconceptions, lists of common Earth science misconceptions and resources to correct misconceptions at http://serc.carleton.edu/NAGTWorkshops/teaching_methods/conceptests/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

-CCS curriculum guide lessons: What Is In That (6.ES.5)

- It is important to relate the properties of minerals and the characteristics of rocks and soil to their value and use as resources. The USGS provides mineral resources and information that can support the teaching of minerals at the middle school level. Specific mineral data is available using the search engine on this USGS mineral resource Web page.

- ODNR's Mineral Resource Division provides Ohio-specific mineral resources, mineral uses and data regarding these resources. Students should be encouraged to investigate the different uses for geologic resources in Ohio. Ask: What properties allow this rock, mineral or soil to be used for this purpose? There must be a connection between the physical and chemical properties and the use.

- Connecting mineral, soil or rock resource use with the historical information about geologic resource use in Ohio can engage students and deepen the knowledge of resources in Ohio. A brief history of Ohio's geologic resources allows students to research changes that have occurred in resource use. Mining techniques can be a good connection to the real world and the environment.

- NSTA provides learning modules called SciPacks that are designed to increase teacher content knowledge through inquiry-based modules. This module addresses the Earth's Resources, including the uses of resources.

- Introducing problem-solving skills through the application of science can deepen the content knowledge for soils. Testing soils to determine which types of soil would work best in a specific situation is a good way to connect soils and soil uses to the real world. One

example (provided in the Vision into Practice section) involves determining which soil (from four or five unknown samples) is best to use to deter floodwaters. The sandbag example provides inquiry and engineering design for students of all ability levels.

-Article about how rocks, minerals, and soil are used specifically in Ohio https://geosurvey.ohiodnr.gov/portals/geosurvey/PDFs/GeoFacts/geof11.pdf

-See how rocks and minerals are used in everyday life http://natural-history.uoregon.edu/collections/web-galleries/everyday-uses-rocks-and-minerals

Career Connections

Geologist, Sculptor, Environmentalist, Engineer

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Objects have physical properties, properties of objects can change and Earth's nonliving resources have specific properties.

Grades 3-5: Rocks and soil have characteristics, Earth's resources can be used for energy, renewable and nonrenewable resources, some of Earth's resources are limited.

Future Knowledge

Grades 7-8: Biogeochemical cycles (including the hydrologic cycle) are related to erosion and weathering of rock, minerals and soil. The history of Earth (including the formation of nonrenewable resources) from the interpretation of the rock record are studied.

High School: The formation of elements, chemical bonding and nuclear energy are found in the Physical Sciences. In grades 11/12 Physical Geology, Earth's resources and specific laws pertaining to the resources are explored at a greater depth.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6. LS.1

CELLULAR TO MULTICELLULAR
Cells are the fundamental unit of life.

Essential Understandings

- All living things are composed of cells. Different body tissues and organs are made of different kinds of cells. The ways cells function are similar in all living organisms.

Academic Vocabulary/Language

Tier 3:

Cell membrane	Cell wall
Cells	Chloroplast
Eubacteria	Fungi
Lysosome	Microbes
Mitochondria	
Multicellular	
Nucleus	Organisms
Organs	Plantae cells
Plasma membrane	Protists
Ribosome	Single-celled
Tissue	Vacuole

I Can Statements

The students can identify single-celled organisms.

The students can identify multicellular organisms.

The students can distinguish between the different tissues and organs in plants and animals.

The students can use microscopes to observe cells, tissues, and organs from different organisms.

The students can use micrographs to observe cells, tissues, and organs from different organisms.

The students can use models and illustrations to observe cells, tissues, and organs from different organisms.

Misconceptions

-San Diego State University provides a list of naïve ideas that children hold about cells along with the scientific idea that needs to be established to correct misconceptions.

Instructional Strategies and Resources

- The University of Utah's Genetic Learning Center has an interactive (move the scroll bar from left to right) site to explore cell size and scale. This helps make the connection between cell size and how many cells are required to make tissues, organs and organ systems of entire organisms. http://learn.genetics.utah.edu/content/basics/

- Prepare slides with a variety of cell samples for viewing under the microscope to examine a variety of cells. The cells should be from different parts of the organism and from different organisms. Make comparisons between the cells based on their location and origin. Explain why they have the structure and function that they do. Oklahoma City Community College's website has detailed information on how to use a microscope. Click on the Biology button, and then click Introduction to the Microscope. Using information from observations and cell research, build a model of a cell. This organizational tool can be used to document findings. http://occc.edu/cbs/video.html

- Cells Alive and the University of Utah offer an interactive animated view of the interior of a cell. The organelles and their functions are the focus. http://www.cellsalive.com/cells/cell_model.htm

- Vision Learning provides teacher background information about the cell and its discovery. http://www.visionlearning.com/en/library/Biology/2/The-Discovery-and-Structure-of-Cells/208

- Activity learning about organelles in the cytoplasm- https://www.pbslearningmedia.org/resource/tdc02.sci.life.cell.organelles/organelles-in-the-cytoplasm/

-Video: Prokaryotes vs eukaryotes explained: https://youtu.be/RQ-SMCmWB1s

-Video: Cell theory explained in this short video- https://youtu.be/4OpBylwH9DU

-Help students understand functions of cell organelles by creating an Analogy using jobs in a city. This is a great group activity, that also allows students to be creative http://www2.umf.maine.edu/mclp/wp-content/uploads/sites/91/2014/06/Lesson-2c-Cell-City-Analogy-Article.pdf

-Video: Cell city song-https://youtu.be/u4ki28XLzOA

-Bill Nye explains Cells: https://www.youtube.com/watch?v=7bDpYZsC8mQ

-Video: Using a microscope-https://youtu.be/-b3Eejf4rDQ

-Become familiar with a microscope using this activity, and the end students will view onion and skin cells. http://www.beachwoodschools.org/Downloads/Microscope%20Lab%20-%20SKIN%20AND%20ONION%20CELLS.pdf

- Cell theory web quest and timeline creation- use information gathered from the web quest to set up a time line of how cells were discovered.http://ss.cms.rockwallisd.org/UserFiles/Servers/Server_125926/File/7th%20grade%20Science/cell.pdf

-Let students get creative with this comparison of Plant and Animal cell project. Rubric included: http://www.shellyssciencespot.com/Worksheets/Cell/CellProject.pdf

-Gizmo: Cells, Select sample cells from a plant or animal and place the cells on a microscope to look inside the cells. Information about their common structures is provided. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=450

Career Connections

Pathologist, Cytology screener, Work in a histocompatibility and immunogenetics laboratory

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Living things have specific traits and are made up of a variety of structures.

Grades 3-5: Organisms are made of parts.

Future Knowledge

High School: Details of cellular processes such as photosynthesis, chemosynthesis, cellular respiration, cell division and differentiation are studied. Cellular organelles studied are cytoskeleton, Golgi complex and endoplasmic reticulum.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6. LS.2	**CELLULAR TO MULTICELLULAR** **All cells come from pre-existing cells.**
Essential Understandings • Cells repeatedly divide resulting in more cells and growth and repair in multicellular organisms.	**Academic Vocabulary/Language** **Tier 3**: Binary Fission Cells Chromosomes Genetic material Mitosis Multicellular Organisms Reproduction Species

I Can Statements	**The students can explain how cells reproduce for the continuation of every species.** **The students can identify the binary fission process for producing a new single cell organism.** **The students can explain how cells multiply for growth and repair in multicellular organisms.** **The students can describe how chromosomes are the structures in cells that contain the genetic material.** **Students can observe cells dividing by using microscopes, micrographs, models and illustrations.**

Misconceptions

-San Diego State University provides a list of naïve ideas that children hold about cells along with the scientific idea that needs to be established to correct misconceptions.

- The Annenberg Media series Essential Science for Teachers: Life Science: Session 1: Children's Ideas provides greater insight to misconceptions children hold about the origin of living things. The students are elementary in this session but the content is relevant for middle school students. Classroom video and lessons are provided to help students avoid these misconceptions.

- The article Slow Death of Spontaneous Generation provides a historical overview of the timeline and scientific experiments performed to dispel the misconception of spontaneous generation.

Instructional Strategies and Resources

-Video: How cells reproduce with Mitosis: https://www.youtube.com/watch?v=VGV3fv-uZYI

-Video: Mitosis in real time: https://www.youtube.com/watch?v=m73i1Zk8EA0

-Video: Asexual reproduction: https://www.youtube.com/watch?v=DY9DNWcqxI4

-How do cells grow and repair? http://www.bbc.co.uk/schools/gcsebitesize/science/add_edexcel/cells/mitosisrev1.shtml

- The students will learn that binary fission and mitosis are both methods of cell division used by various organisms. The students will compare and contrast the difference between both methods of cell division, while building background knowledge through cooperative, direct, and fun-filled scientific discovery. This lesson requires students to use multiple reading and learning strategies to increase their comprehension skills.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=0ahUKEwi0rZnhnePUAhWK14MKHfWJA8YQFggoMAA&url=http%3A%2F%2Fwww.cpalms.org%2FExportTemplates%2FExport.aspx%3Furl%3D%2FPublic%2FPreviewResource%2FPrintResource%2F%3Fid%3D128906%26IsAuthenticated%3DFalse%26display%3Dblock%26Private%3Dtrue%26type%3DResource%26providerUserKey%3D00000000-0000-0000-0000-000000000000&usg=AFQjCNEKBrqmG3sXCv3ghvizzb_7CCqGzw

- Reading handout explaining genetic material in Eukaryotic cells:
http://jackson.stark.k12.oh.us/webpages/bwiggins/files/6b%20dna%20in%20eukaryotes%20reading.pdf

Use these questions to go along with reading:
http://jackson.stark.k12.oh.us/webpages/bwiggins/files/6b%20dna%20in%20eukaryotes%20reading%20ws.pdf

Video: What is a chromosome?: https://www.youtube.com/watch?v=xUrlreMaUrs

Career Connections

Histopathologist, Microbiologist, Doctor specializing in genetics

Sample Test Question

Not applicable at the grade level

Prior Knowledge	Future Knowledge
PreK-2: Living things are made up of a variety of structures. **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 8:** More details about asexual and sexual reproduction will be studied.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6. LS.3

CELLULAR TO MULTICELLULAR

Cells carry on specific functions that sustain life.

Essential Understandings

- Many basic functions of organisms occur in cells. Cells take in nutrients and energy to perform work, like making various molecules required by that cell or an organism.
- Every cell is covered by a membrane that controls what can enter and leave the cell.
- Within the cell are specialized parts for the transport of materials, energy capture and release, protein building, waste disposal, information feedback and movement.

Academic Vocabulary/Language

Tier 3:
Cells
Membrane
Molecules
Nutrients
Organisms

I Can Statements	**The students can identify how cells take in nutrients and energy to perform work.** **The students can explain how a membrane works in cells.** **The students can explain the role of cells that carry out life functions for organisms.** **The students can explain the role of tissues that carry out life functions for organisms.** **The students can explain the role of organs that carry out life functions for organisms.** **The students can explain the role of organ systems that carry out life functions for organisms.** **The students can recognize specialized parts within cells for transporting materials, energy capture and release, protein building, water disposal, information feedback and movement.**

Misconceptions

- San Diego State University provides a list of naïve ideas that children hold about cells along with the scientific idea that needs to be established to correct misconceptions.

- The Annenberg Media series Essential Science for Teachers: Life Science: Session 1: Children's Ideas provides greater insight to misconceptions children hold about the origin of living things. The students are elementary in this session but the content is relevant for middle school students. Classroom video and lessons are provided to help students avoid these misconceptions.

Instructional Strategies and Resources

- Vision Learning provides teacher background information about the cell and its discovery.

-Khan academy explores how cells, tissues, and organs work together. https://www.khanacademy.org/science/biology/principles-of-physiology/body-structure-and-homeostasis/a/tissues-organs-organ-systems

- Video: This video explores the basics of human anatomy. At 4.20 the organization of cells, tissues, and organs are discussed. https://www.youtube.com/watch?v=uBGl2BujkPQ

-Lesson ideas: The 3rd lesson is intended to help students understand how the human body is organized. http://www.ed.gov.nl.ca/edu/k12/curriculum/guides/science/grade8/Unit_4.pdf

-Handout for students to understand role of cell membrane, have students research answers to questions. http://www.shellyssciencespot.com/Worksheets/Cell/CellMembraneQuestions.pdf

- Video: Transportation and the Cell Membrane. https://www.youtube.com/watch?v=dPKvHrD1eS4

- Homeostasis lesson, students record their temperature and observe what happens to them after exercising. Videos, and lesson included on websitehttps://www.pbslearningmedia.org/resource/tdc02.sci.life.reg.lp_humanreg/human-body-regulation/

-Gizmo: Homeostasis- Adjust the levels of clothing, perspiration, and exercise to maintain a stable internal temperature as the external temperature changes. Water and blood sugar levels need to be replenished regularly, and fatigue occurs with heavy exercise. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=519

Career Connections

Histopathologist, Microbiologist, Doctor specializing in genetics, Pathologist, Cytology screener, Work in a histocompatibility and immunogenetics laboratory

Sample Test Question

Not applicable at the grade level

Prior Knowledge	Future Knowledge
PreK-2: Living things have specific traits. Living things require energy, water and a particular temperature range. **Grades 3-5:** Organisms are made of parts.	**Grades 7-8:** Photosynthesis and respiration are compared. **High School:** Details of cellular processes are studied. Molecules enter and leave the cell by the mechanisms of diffusion, osmosis and active transport.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6. LS.4	**CELLULAR TO MULTICELLULAR** **Living systems at all levels of organization demonstrate the complementary nature of structure and function.**

Essential Understandings

- The level of organization within organisms includes cells, tissues, organs, organ systems and whole organisms.
- Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism.
- Organisms have diverse body plans, symmetry and internal structures that contribute to their being able to survive in their environments.

Academic Vocabulary/Language

Tier 3:
Body plans
Cells
Classification
Internal structures
Multicellular
Muscles
Organisms
Organs
Single-cell
Symmetry
Tissues

I Can Statements	**The students can compare and contrast muscles and organs within multicellular organisms.** **The students can classify organisms based on body plans, symmetry, and internal structures.** **The students can investigate the commonality of life for plants and animals.** **The students can compare cells, types of tissues, organs, and organ systems between organisms.** **The students can inquire and show mathematical relationships between cell size and a cell's ability to transport necessary materials into its interior.**

Misconceptions

- San Diego State University provides a list of naïve ideas that children hold about cells along with the scientific idea that needs to be established to correct misconceptions.

-The Annenberg Media series Essential Science for Teachers: Life Science: Session 1: Children's Ideas provides greater insight to misconceptions children hold about the origin of living things. The students are elementary in this session but the content is relevant for middle school students. Classroom video and lessons are provided to help students avoid these misconceptions.

Instructional Strategies and Resources

- Use compare and contrast strategies (e.g., Venn diagrams) to help clarify similarities and differences in types of cells.

-Students complete an 'Organ Trail' report on a specific body organ. Students research function, what system it works in, etc. The end results students create a poster displaying their information. http://sciencespot.net/Media/organtrail.pdf

-Video: Adaptations and why they happen: http://youtu.be/UsDJ3JrnpOI

-Adaptation activity: http://natural-history.uoregon.edu/sites/default/files/mnch/Animal%20Adaptations%20Lesson%20Plan.pdf

-Video: Types of animal symmetry- https://youtu.be/3drtbPZF9yc

-Gizmo: Explore a wide variety of cells, from bacteria to human neurons, using a compound light microscope. Select a sample to study, then focus on the sample using the coarse and fine focus controls of the microscope. Compare the structures found in different cells, then perform tests to see if the sample is alive. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=1066

-Video: Explain the importance of the surface area to volume ratio as a factor limiting cell size.
https://www.youtube.com/watch?v=xuG4ZZ1GbzI

-Video: Why are cells so small? https://www.youtube.com/watch?v=wuXSEOKNxN8

Career Connections

Histopathologist, Microbiologist, Doctor specializing in genetics, Pathologist, Cytology screener, Work in a histocompatibility and immunogenetics laboratory

Sample Test Question

Not applicable at the grade level

Prior Knowledge	Future Knowledge
PreK-2: Living things have specific traits. Living things require energy, water and a particular temperature range. **Grades 3-5:** Organisms are made of parts.	**Grade 8:** Cellular reproduction is studied. **High School:** The unity and diversity of life and the evolutionary mechanisms that contribute to the organization of living things are studied.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6. LS.4	**CELLULAR TO MULTICELLULAR** **Living systems at all levels of organization demonstrate the complementary nature of structure and function.**

Essential Understandings

- The level of organization within organisms includes cells, tissues, organs, organ systems and whole organisms.
- Whether the organism is single-celled or multicellular, all of its parts function as a whole to perform the tasks necessary for the survival of the organism.
- Organisms have diverse body plans, symmetry and internal structures that contribute to their being able to survive in their environments.

Academic Vocabulary/Language

Tier 3:
Body plans
Cells
Classification
Internal structures
Multicellular
Muscles
Organisms
Organs
Single-cell
Symmetry
Tissues

I Can Statements	**The students can compare and contrast muscles and organs within multicellular organisms.** **The students can classify organisms based on body plans, symmetry, and internal structures.** **The students can investigate the commonality of life for plants and animals.** **The students can compare cells, types of tissues, organs, and organ systems between organisms.** **The students can inquire and show mathematical relationships between cell size and a cell's ability to transport necessary materials into its interior.**

Misconceptions

- San Diego State University provides a list of naïve ideas that children hold about cells along with the scientific idea that needs to be established to correct misconceptions.

-The Annenberg Media series Essential Science for Teachers: Life Science: Session 1: Children's Ideas provides greater insight to misconceptions children hold about the origin of living things. The students are elementary in this session but the content is relevant for middle school students. Classroom video and lessons are provided to help students avoid these misconceptions.

Instructional Strategies and Resources

- Use compare and contrast strategies (e.g., Venn diagrams) to help clarify similarities and differences in types of cells.

- Prepare slides with a variety of cell samples for viewing under the microscope to examine a variety of cells. The cells should be from different parts of the organism and from different organisms. Make comparisons between the cells based on their locations and origins. Explain why they have the structure and function that they do. Oklahoma City Community College's website has detailed information on how to use a microscope. Click on the Biology button, and then click Introduction to the Microscope. Using information from observations and cell research, build a model of a cell. This organizational tool can be used to document findings.

- Wisc-Online offers an interactive opportunity to examine an animal cell and learn about the functions of its organelles.

- The University of Utah's Genetic Learning Center has an interactive (move the scroll bar from left to right) site to explore cell size and scale. This helps make the connection between cell size and how many cells are required to make tissues, organs and organ systems of entire organisms.

-Explore the body's organ system: http://ssds-science.weebly.com/human-body-organ-systems.html

- Types of animal symmetry- https://youtu.be/3drtbPZF9yc

- Vision Learning provides teacher background information about the cell and its discovery.

-Gizmo: There are several gizmos which explore organ systems within the human body-

Digestive System: Digestion is a complex process, involving a wide variety of organs and chemicals that work together to break down food, absorb nutrients, and eliminate wastes. But have you ever wondered what would happen if some of those organs were eliminated, or if the sequence was changed? Can the digestive system be improved? Find out by designing your own digestive system with the Digestive System Gizmo. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&resourceID=1050

Circulatory System: Trace the path of blood through a beating heart and the network of blood vessels that supplies blood to the body. Take blood samples from different blood vessels to observe blood cells and measure the levels of oxygen, carbon dioxide, sugar, and urea. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&resourceID=662

Career Connections Histopathologist, Microbiologist, Doctor specializing in genetics, Pathologist, Cytology screener, Work in a histocompatibility and immunogenetics laboratory	
Sample Test Question **Not applicable at the grade level**	
Prior Knowledge **PreK-2:** Living things have specific traits. Living things require energy, water and a particular temperature range. **Grades 3-5:** Organisms are made of parts.	**Future Knowledge** **Grade 8:** Cellular reproduction is studied. **High School:** The unity and diversity of life and the evolutionary mechanisms that contribute to the organization of living things are studied.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.PS.1	**MATTER AND MOTION** **All matter is made up of small particles called atoms.**

Essential Understandings

- Each atom takes up space, has mass and is in constant motion. Mass is the amount of matter in an object.
- Elements are a class of substances composed of a single kind of atom.
- Molecules are the combination of two or more atoms that are joined together chemically.
- Compounds are composed of two or more different elements. Each element and compound has properties, which are independent of the amount of the sample.

Academic Vocabulary/Language

Tier 3:
Atom
Atomic composition
Compounds
Density
Element
Mass
Matter
Molecules
Volume

I Can Statements	**The students can recognize that all matter is made up of atoms.** **The students can explain that atoms take up space, have mass, and are in constant motion.** **The students can create models of elements, compounds, and molecules to show atomic differences.** **The students can describe the composition of substances in terms of elements and/or compounds.** **The students can measure the mass and volume of a substance, and calculate density by dividing mass by the volume.** **The students can compare substances by the amount of mass a substance has in a given amount of volume (density).** **The students can construct and interpret mass vs. volume graphs.**

Misconceptions

- Gases do not have mass.

- Mass and volume, which both describe an amount of matter, are the same property.

- Air and oxygen are the same gas.

- Particles of solids have no motion. Particles possess the same properties as the materials they compose. For example, atoms of copper are "orange and shiny," gas molecules are "transparent," and solid molecules are "hard."

- Particles are misrepresented in sketches with no differentiation between atoms and molecules.

- Molecules of a gas just float rather than being kept in the gaseous state by their motion.

- There is not empty space between molecules; rather students believe there is dust, germs or air between the particles of air.

- Although some students may think that substances can be divided up into small particles, they do not recognize the particles as building blocks, but as formed of basically continuous substances under certain conditions. Students of all ages show a wide range of beliefs about the nature and behavior of particles, including a lack of appreciation of very small size of particles. (AAAS 1993).

- Students often reason that because atoms are so small they have no mass. Several studies of students' initial conception of an atom show they perceive it as either "a small piece of material" or the "ultimate bit of material obtained when a portion of material is progressively subdivided." Such bits are thought to vary in size and shape and possess properties similar to the properties of the parent material. For example, some students consider atoms of a solid to have all or most of the macro properties that they associate with the solid, such as hardness, hotness/coldness, color and state of matter (Driver, Squire, Rushworth & Wood-Robinson, 1994, p. 74).

- Essential Science for Teachers: Physical Science: Session 2: The Particle Nature of Matter highlights different ideas that students have about matter, illustrated through interviews with students. The first half of the program shows how students can progress from a continuous model of matter to a model of matter that is made of discrete particles with nothing between them. It demonstrates activities to help students move from a continuous model to a particle model of matter. Notice that the real learning does not necessarily come from doing the activities, but from the discussions and questioning that occur after the experiences.

Instructional Strategies and Resources

- The Annenberg Media series Essential Science for Teachers: Physical Science: Session 2: The Particle Nature of Matter is a video on demand produced by Annenberg. It guides teachers through the essential concepts, includes student interviews that highlight common misconceptions and shows experiments and classroom instructional strategies that can be used to address these misconceptions.

https://learner.org/courses/essential/physicalsci/session1/index.html

- Bill Nye explains Matter and its phases: https://www.youtube.com/watch?v=MBgM73DLK1s

-Students investigate how atoms make up all matter. Using water droplets to demonstrate this concept. Video, student worksheets, and teacher key are included. http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson1

-Video: What are atoms? https://youtu.be/vlSOESXQI7o

-Video: Understanding atoms, molecules, and compounds. https://www.youtube.com/watch?v=cV4jJZCIMPo

-Introduce density to students by exploring how to find volume, and mass first. Use this lab for kids to practice finding mass with a triple beam scale, and volume of an irregular shaped object. Once they have mastered the concept, density will be much easier to understand. Use formative assessments to see where your students are with the material. http://www.carlisle.k12.ky.us/userfiles/924/Classes/562/Metric%20Measurement%20Lab.pdf (These activities can also be used in the minerals unit as density is a property used to identify minerals.)

-Finding density through water displacement Gizmo: Drop objects in a beaker that is filled with water, and measure the water that flows over the edge. Using Archimedes' principle, determine the density of objects based on the amount of displaced water. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=400

-Gizmo: Finding density of objects- With a scale to measure mass, a graduated cylinder to measure volume, and a large beaker of liquid to observe flotation, the relationship between mass, volume, density, and flotation can be investigated. The density of the liquid in the beaker can be adjusted, and a variety of objects can be studied during the investigation. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=362

-Density lab activities: several lab cavities, videos, and teacher lab sheets to help students understand density. Sinking and floating activities are also included. http://www.middleschoolchemistry.com/lessonplans/chapter3

-Graphing density- students will use this activity to help them graph mass vs volume. Students will also have to determine whether an object would sink or float in water based on their graph. http://newyorkscienceteacher.com/sci/files/user-submitted/Density.pdf

-Interpreting mass vs volume graph: students will plot mass and volume points onto a graph and have to find density from the slope of the line.http://lhsblogs.typepad.com/files/basic-graphing-density-and-slope-worksheet.pdf

-Video: 5 facts about density- https://youtu.be/zlkpZZW29b0

Career Connections

Nuclear physicist, Career in nuclear medicine, Rheologist, Solid state physicist

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Properties are descriptions that can be observed using the senses. Materials can be sorted according to their properties. Changes in materials are investigated.

Grades 3-5: Objects are composed of matter, which has mass* and takes up space. Matter includes solids, liquids and gases (air). Volume is the amount of space an object takes up. The total amount of matter and mass* remains the same when it undergoes a change.

**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.*

Future Knowledge

Grades 7-8: Differences between pure substances and mixtures and acids and bases are explored. Elements in the periodic table can be classified as a metal, nonmetal or nonreactive gas based on their properties and position on the periodic table. Atoms can be joined together to form separate molecules or large three-dimensional networks. Changes are classified into two groups, chemical or physical, depending upon whether the atomic composition of the materials changes.

High School: Protons, neutrons and electrons make up atoms. The relationship between atomic structure and the periodic table is explored. The nature of ionic, covalent and metallic bonding is also studied.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.PS.2	**MATTER AND MOTION** **Changes of state are explained by a model of matter composed of atoms and/or molecules that are in motion.**

Essential Understandings

- When substances undergo changes of state, neither atoms nor molecules themselves are changed in structure.
- Thermal energy is a measure of the motion of the atoms and molecules in a substance.
- Mass is conserved when substances undergo changes of state.

Academic Vocabulary/Language

Tier 1:

Attraction	Gases
Liquids	Solids
Substance	

Tier 3:

Atoms	Collide
Mass	Molecules
Particles	Phase change
Thermal energy	

I Can Statements	**The students can explain that thermal energy is a measure of the motion of the atoms and molecules (kinetic energy) in a substance.** **The students can describe the factors that affect thermal energy.** **The students can investigate temperature change in order to infer changes in thermal energy.** **The students can describe solids, liquids, and gases in terms of motion of and spacing and attractions between particles.** **The students can model and explain how mass is conserved when substances undergo a change of state.**

Misconceptions

- Gases are not matter because most are invisible.

- Gases do not have mass.

- A thick liquid has a higher density than water.

- Mass and volume, which both describe an amount of matter, are the same property.

- Air and oxygen are the same gas.

- Helium and hot air are the same gas.

- Expansion of matter is due to the expansion of particles, rather than the increased particle spacing.

- Particles of solids have no motion.

- Relative particle spacing among solids, liquids and gasses is incorrectly perceived and not generally related to the densities of the states.

- Materials can only exhibit properties of one state of matter.

- Melting/freezing and boiling/condensation are often understood only in terms of water.

- The smoke seen with dry ice is carbon dioxide vapor.

- The temperature of an object drops when it freezes.

- Steam is visible water gas molecules.

- Melting and dissolving are confused.

- Dew formed on the outside of glass comes from the inside of the glass.

- Molecules of a gas just float rather than being kept in the gaseous state by their motion.

- From a time of about 27:50 to49:00 this video on demand produced by Annenberg, shows student interviews and classroom discussions that illustrate common misconceptions about evaporating, boiling and condensing. Strategies to address these misconceptions also are illustrated, including a series of experiments guiding students to construct an accurate particle model of matter that can explain the properties of gases and liquids and changes between them.

- Students regard powders as liquids and any non-rigid material, such as a sponge or a cloth as being somewhere in between a solid and a liquid.

- Students have difficulty recognizing the vibration of particles. (Driver, Squire, Rushworth & Wood-Robinson, 1994).

- Molecules and atoms disappear during burning, boiling and evaporation.

- Science in Focus: Energy produced by Annenberg is a series of videos on demand dealing with energy. This segment deals with heat. The video series is designed to make teachers aware of common student misconceptions. While not all concepts addressed are appropriate to be taught at this grade level, being aware of them can help avoid perpetuating common misconceptions.

Instructional Strategies and Resources

- The Phenomena and Representations for Instruction of Science in Middle Schools (PRISMS) website has a collection of representations to help students visualize atoms in a crystalline array. This website is part of the National Science Digital Library and also can be accessed through http://nsdl.org.

- Changing State, an interactive simulation from BBC Schools, allows students to heat and cool water and observe phase changes. The final section dealing with heating the gas further can be explained by the motion of the gas particles.
http://www.bbc.co.uk/bitesize/ks2/science/materials/changing_states/read/1/

- From the series of videos on demand Essential Science for Teachers: Physical Science produced by Annenberg, the second part of The Particle Nature of Matter, starting at about 28:00, deals with differences in gases, liquids and solids and the idea that all particles are in motion. Notice the discussions and questioning strategies used to get students thinking at higher levels.
https://www.learner.org/courses/essential/physicalsci/session2/

- The beginning of this segment of Essential Science for Teachers: Physical Science, produced by Annenberg, shows how the properties and changes of phases of matter can be explained with a particle model. Student interviews identify common misconceptions. Experiments and questioning strategies are shown that can guide students to a more accurate understanding of these concepts.

- Gizmo: Phases of Water. Heat or cool a container of water and observe the phase changes that take place. Use a magnifying glass to observe water molecules as a solid, liquid, or gas. Compare the volumes of the three phases of water.
https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=661

- Use this lab to understand thermal energy and the factors that effect it-
http://www.middleschoolchemistry.com/lessonplans/chapter2/lesson1

- This resource includes 5 inquiry lesson ideas (student lab sheet provided) where students explore states of matter. The first lesson is exploring how molecules move depending on their temperature. Using food colors and different temperatures of water, students can see how the food color moves. http://www.inquiryinaction.org/pdf/chapter6/Inv6.pdf

- http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson4 Use this lab to help students understand how particles in a solid move when heated/ cooled.

- http://www.middleschoolchemistry.com/lessonplans/chapter1/lesson5 students will be able to explain how gas molecules move with this lab activity.

-Changing states- 5 lessons to use to show how matter changes state, and what favors effect changing states of matter. http://www.middleschoolchemistry.com/lessonplans/chapter2

- States of matter explained with this short video: https://youtu.be/wclY8F-UoTE-

- Help students understand how molecules move in the states of matter by using this phet interactive. Lab materials are included, https://phet.colorado.edu/en/contributions/view/2816

-Video: Conservation of mass explanation-https://youtu.be/3lHHOiTdmK4

- Using water and an alka seltzer tab students investigate the conservation of matter with this lab activity: http://www.troup.org/userfiles/929/My%20Files/Science/MS%20Science/8th%20Science/Matter/conservation_matter/conservation_mass_lab3.pdf?id=8055

-In order to understand the conservation of mass, students need to have an understanding of chemical/physical changes. These resources can help to refresh students on topics.

Video: https://youtu.be/M8tyjwB42X4

Physical and Chemical changes lab: http://alex.state.al.us/uploads/7023/Observation%20Sheet.doc

-Sort through examples of physical and chemical changes, student will cut and paste into journal or lab sheet and explain their reasoning. Students will also be given a recipe that they will need to point out chemical/physical changes that are taking place through the recipe. http://curriculum.austinisd.org/adv_ac/GT/documents/4th_Science_PhysicalandChemicalChanges.pdf

Career Connections

Design geothermal plants, Geologist, Molecular physicist

Sample Test Question

Not applicable at the grade level

Prior Knowledge	Future Knowledge
PreK-2: Properties can be observed and used to sort	**Grades 7-8:** Acids, bases, mixtures and pure substances are investigated.

materials. Changes in materials are investigated, including solid-liquid phase changes. **Grades 3-5:** Matter has mass* and volume. Properties of solids, liquids and gases, and phase changes are reversible and do not change the identity of the material. The total amount of matter remains the same when it undergoes a change. Mass* stays constant during phase changes.	Elements are classified as metals, nonmetals or nonreactive gases based on their properties and position on the periodic table. Atoms can be joined together into separate molecules or large three-dimensional networks. Changes are classified as chemical or physical, depending upon whether the atomic composition of the materials changes.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.PS.3	**MATTER AND MOTION** **There are two categories of energy: kinetic and potential.**

Essential Understandings

- Objects and substances in motion have kinetic energy.
- Objects and substances can have energy as a result of their position (potential energy).

Academic Vocabulary/Language

Tier 3:
Electrical energy
Gravitational potential energy
Kinetic energy
Medium
Potential energy
Sound energy

I Can Statements	**The students can explain that objects and substances in motion have kinetic energy.** **The students can explain that objects and substances can have energy as a result of their position.** **The students can explore, investigate, and explain various types of potential and kinetic energy.**

Misconceptions

- Things use up energy.

- Energy is confined to some particular origin, such as what we get from food or what the electric company sells.

- An object at rest has no energy.

- The only type of potential energy is gravitational.

- Energy is a thing.

- The terms “energy” and “force” are interchangeable.

Instructional Strategies and Resources

- Interactive roller skating park helps students understanding kinetic and potential energy with a simulation. Student lab sheets included. https://phet.colorado.edu/en/contributions/view/3749

-Gizmo: Potential Energy. Compare the potential energy of several objects when you place them on shelves of different heights. Learn that two objects at different heights can have the same potential energy, while two objects at the same height can have different potential energies. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=399

-Lab Activity: Using a bouncy ball to help students demonstrate kinetic and potential energy- http://camillasenior.homestead.com/Energy-bouncing_ball_activity.pdf

- Video- Kinetic and Potential Energy explained with these short videos: https://youtu.be/IqV5L66EP2E https://youtu.be/T5WJoup-RD8

-Explore types of energy with this web quest- http://brettlagrange.cmswiki.wikispaces.net/file/view/FormsofEnergyWebQuest-15zjl04.pdf (The last link regarding circuits in this web quest is no longer is active so you can skip that part, or you can have students use this website for the same information-https://www.dkfindout.com/us/science/electricity/circuits/)

Career Connections

Career in kinesiology, Engineer that designs roller coasters

Sample Test Question

Not applicable at the grade level

Prior Knowledge	Future Knowledge
PreK-2: A variety of sounds and motions are experienced. The sun is the principal source of energy (ESS). Plants get energy	**Grades 7-8:** Conservation of Energy and methods of energy transfer, including waves, are introduced. Chemical and elastic potential energy

from sunlight (LS). **Grades 3-5**: Objects with energy have the ability to cause 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).	are explored. **High School:** Standard formulas are used to calculate energy for different objects and systems.

Ohio's Learning Standards- Clear Learning Targets

Science Grade 6

6.PS.4	**MATTER AND MOTION** **An object's motion can be described by its speed and the direction in which it is moving.**
Essential Understandings • An object's position and speed can be measured and graphed as a function of time.	

Academic Vocabulary/Language

Tier 3:
Distance
Hypothesis
Motion
Position vs. Time Graph
Reference Point
Speed
Speed vs. Time Graph
Time

I Can Statements	**The students can describe an objects motion in relation to a reference point.** **The students can calculate an object's speed based on the amount of time it takes to travel a certain distance.** **The students can analyze and interpret position vs. time and speed vs. time graphs in order to describe an object's motion.**

Misconceptions

- Some students think that an object traveling at constant speed requires a force.

- Some students think that time can be measured without establishing the beginning of the interval. The location of an object can be described by stating its distance from a given point, ignoring direction.

-Students believe that a line with a negative slope represents a falling object.

Instructional Strategies and Resources

- CCS curriculum guide lessons: Speed Racers (6.PS.4)

-Websites: YouTube or Bing videos, Physics Tutorial: How to solve physics problems, 6:06 minutes, www.youtube.com/watch?v=calsn76D9gA

- The Moving Man is an interactive simulation from PhET shows graphs for different types of motion. https://phet.colorado.edu/en/contributions/view/2818

-Motion, reference point and speed explained in this handout: http://www.westerville.k12.oh.us/userfiles/4170/Classes/5610/Measuring%20Motion%20HW%202013.pdf

- Students can have difficulty solving equations and remembering them. This equation triangle for solving speed really helps students understand and it is super simple to do. Students can visually recall the triangle and solve for speed, distance, or time. This website explains how to use the triangle, a video is also included. https://owlcation.com/stem/Using-the-magic-triangle-for-speed-distance-and-time-compound-measures (I include the triangle on homework sheets, and reference it during class. You could also use this with the density equation as well.)

-Calculating speed lab- students will find their own speed! Groups will work together finding out how fast students can travel in a certain distance (don't worry, it's walking speed). http://wp.lps.org/mtest/files/2012/08/Determing-speed-lab.pdf

-Marble speed lab- students will use difference size marbles and different heights to see how that effects the speed of the marble.http://www.chatham-nj.org/cms/lib/NJ01000518/Centricity/Domain/871/lab_marble%20motion%2014.pdf (To help students practice their graphing skills, have them create a line graph that goes with their data.)

-Video: Calculating speed explained https://youtu.be/e28-IcdAMHg

-Interpreting distance vs time graphs. Students match the d v t graph with the descriptions. This will help students assess relative speed of an object with the direction of motion. http://www.cpalms.org/Public/PreviewResourceLesson/Preview/18945

-Speed vs time graphs-http://map.mathshell.org/download.php?fileid=1680

-Gizmo: Distance vs Time graph. Create a graph of a runner's position versus time and watch the runner complete a 40-yard dash based on the graph you made. https://www.explorelearning.com/index.cfm?method=cResource.dspDetail&ResourceID=260

-Phet interactive provideds students with demonstration on how speed is related to slope. Students explore the relationship between the

speed of an object and the slope of a line. Does not require that students know how to calculate slope. Included an optional math extension. https://phet.colorado.edu/en/contributions/view/4191

Career Connections

Race car driver, Work as a part of a racing crew, Engineer

Sample Test Question

Not applicable at the grade level

Prior Knowledge

PreK-2: Sound is produced from vibrating motions. Motion is a change in an object's position with respect to another object. Forces are pushes and pulls that are necessary to change the motion of an object. Greater changes of motion for an object require larger forces.

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 can be calculated from the distance traveled in a period 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.*

Future Knowledge

Grades 7-8: The concept of fields is introduced to describe forces at a distance. The concept of force is expanded to include magnitude and direction.

High School: Acceleration is introduced. Complex problems involving motion in two-dimensions and free fall will be solved. Complex position vs. time graphs, velocity vs. time graphs, and acceleration vs. time graphs will be analyzed conceptually and mathematically with connections made to the laws of motion.