CONNECTING ART-CREATING SOLUTIONS

A Hexagonal In-Depth Inquiry into AMD for the Classroom

ABSTRACT

Inside…a STEAM Unit plan for both Environmental Education and Science teachers which allows students to demonstrate understanding of issues relating to Abandoned Mine Drainage through involvement in the International Interdependence Hexagon Project, a visual art opportunity for students and communities worldwide. Hexagons are metaphors for our commonalities and seeing ourselves as interconnected in a world in which we share similar problems across borders and boundaries and must learn to collaborate on solutions.

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Planning:

Investigate

1. Topic of Interest: Can we create Art from Earth Elements from Abandoned Mine Drainage (AMD)?.
2. Topic my students struggle with: Environmental Issues. What affects us and our local environment? How can we express this visually? Do you know the name of the local rivers, streams, or tributaries within your community? What ways do you enjoy our local water sources? What kind of feelings do you have towards your local environment and the conditions that you find it in as you walk among your neighborhood streets, woods, streams, and rivers? Can we develop a place-based philosophy of learning how to become more keenly aware of our immediate surroundings, landscapes, and watersheds?
3. Art topic is: Resist Art with Earth Elements from Abandoned Mine Drainage (AMD).

Discover

Ways we could approach the topic selected:

- **Supporting Content:** In PA, we have abandoned mines or abandoned mine lands (AML) or waste coal piles and culm banks (Eastern PA) and bony or gob piles (Western PA) and AMD, underground abandoned mine water commonly found in mined out groundwater aquifers called mine pool complexes or multi-colliery hydrogeologic units that discharge from abandoned mines. Many of these mines do not have a responsible party to treat the AMD due to the way the Surface Mining Control & Reclamation Act law was written and passed on August 12, 1977. These collection areas have devastating impacts from an aquatic, ambient, ecological, societal, economical, and community health standpoints on our environment.
- **Supporting Content:** These unreclaimed and unremediated landscapes can be remediated and reclaimed allowing for the resource recovery of earth elements such as iron, aluminum, and manganese that settle to the bottom of rivers, streams, and constructed AMD treatment systems commonly found in the water can be collected, harvested, processed, dried, filtered, screened of leave and woody debris litter, and used for Art Projects.
- **Supporting Content:** Some pigments are made from Iron Oxide.
- **Supporting Content:** The Hexagon Project is an International Social Justice Project about connecting people through Hexagons and Art in a way that uses the connecting shape found in nature, hexagons, to look for ways of solving social problems.

- **Supporting Content:** How are Oxides formed? Show the chemical equation for the formation of iron oxide. What are other ways we see or use oxides or antioxidant agents? Eg. Lime juice and avocado, lemon juice and apples.
- **Supporting Content:** Students can use technology to research the atomic structure of Black Iron Oxide and draw the structure. The structure contains Hexagons. This mini artistic step shows chemically how two elements bond and in a manner that relates to our connecting shape. It is laying the groundwork for future learning of chemical bonds in chemistry. Without learning about electrons and why they bond the way they do, they can just understand the basis that all elements bond in unique ways and sometimes create interesting shapes that can be used in art.
- **Supporting Content:** Drawing, expressing our concerns visually, using the universally understood language of pictures, best connects us around the globe and strengthens our unified message. Give examples of early civilizations use of iron oxide for wall art, symbolism, interpreting constellations and movements of the stars, ancient civilizations cultural symbology, Egyptian hieroglyphics, Native American art in caves, etc.
- **Supporting Content:** The water cycle is needed to gather these pigments, mainly, the evaporation part to get them out of the water to be collected. At The Eastern Pennsylvania Coalition for Abandoned Mine Reclamation (EPCAMR), members of the non-profit regional environmental organization and volunteers called Iron Oxide Processors utilize a mobile solar kiln they constructed to initially decant the water from the iron hydroxide precipitate before it becomes a dried iron oxide pigment. This evaporation process is 100 percent off-grid and utilizes a 45-watt solar panel system and a motor-cycle battery to store any excess electricity generated by the sun that is used to evaporate the water from the precipitate during the early stages of the drying process. The iron oxide pigment is then screened for sticks, leaves, twigs, insects, leaf litter, and then run through a sieve to create a more uniform powder consistency that is comparable to cake mix or flour. This creates one predominant iron oxide pigment called Yellow Boy Orange. When heated one step further, it is chelated and converts from a ferrous iron to a ferric iron and turns a darker red in a soil oven.

4. Connect
    - 2 Supporting Contents to best fit to teach my topic:
        1. **(First Content Area) Environmental Science:** Mines, Mines Waste/Earth Elements and Potential Uses. : Resource Recovery of the Iron Oxides; What markets might it be used in? What various types of artistic medium can it be used in? (Water color, venetian oils, pastels, chalk, acrylics, fabric dies, batiki, raku, pottery glazes, wood stains, concrete stains, dry, powdered, binder, glue, gels use in photography, etc.)
        2. **(Second Content Area) Art:** How can we visually express our concern about AMD and how it affects us and our environment using the Resist Method with the Earth Element Pigments from Abandoned Mine Drainage?

Science and Environmental Resources:

http://epcamr.org/home/

http://epcamr.org/store/listing/iron-oxide-pigment-1-ounce/

http://epcamr.org/home/2015/epcamr-mobile-solar-kiln-for-processing-recycling-oxides-from-amd-off-grid-wins-1st-place-award-from-ncac/

https://pa.water.usgs.gov/reports/fs116-02.pdf

http://www.pdesas.org/module/content/resources/16286/view.ashx

Materials

- Water Cycle Diagram (S-8-8-3_Water Cycle Diagram.doc)
- Follow a Drop Through the Water Cycle (S-8-8-3_Follow a Drop.doc)
- The Water Cycle (S-8-8-3_The Water Cycle and KEY.doc)
- Our Watershed (S-8-8-3_Our Watershed and KEY.doc)
- Types of Wetlands (S-8-8-3_Types of Wetlands.doc)

http://fergusonfoundation.org/hbf-kids-zone/lets-take-a-dip/

http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/k-5/water-quailty

http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/k-5/maintaining-watersheds

http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water/k-5/clean-water

http://ecosystems.psu.edu/youth/sftrc/lesson-plans/water

https://www.nap.edu/read/13165/chapter/8

ARTS Resources:

http://www.pbs.org/program/art21/ **environmental artists**

http://www.hexagonproject.org

https://www.arteducators.org/learn-tools/national-visual-arts-standards

http://nationalartsstandards.org

Figure 1. (above) Kistler Elementary Summer Program students creating Hexagon Art with AMD in the Wilkes-Barre Area School District, Luzerne County, PA

Figure 2. (below) Kistler Elementary Summer Program in the Wilkes-Barre Area School District with completed Hexagon AMD Art Pieces, Luzerne County, PA

Iron-Oxide Pigment Wax Resist Hexagon **STEAM UNIT PLAN**

(Complete with Assessment Rubrics, Science and Art Standards, and Enrichment Extensions)

By: Melissa Cruise, Beth Burkhauser and Robert E. Hughes

Big Idea: Since the beginning of art (cave art), artists have manipulated Earth Elements and the natural pigments available to them to create art. Post-modern artists (students) will use Earth Elements from Abandoned Mine Drainage (AMD) using the wax resist method to visually express their concerns about their local environment issues such as Mine Waste, Pollution, and Water Quality. Students will attain knowledge and use of primitive and contemporary Art media as well as knowledge of Environmental Science concerns as well as solutions to problems facing their environment and awareness of agencies and programs out there to support these issues.

Essential Questions:

Do you have active mines in your local area?

Do you have abandoned mines in your area and do you know the difference between an active and abandoned mine?

What are the names of the local streams or rivers in your area that are impacted by AMD? Do you know what watershed(s) are located within your school district?

Do any students have miners in their family? If so, what mine did they work in? What was the name of the colliery or coal breaker?

What do you know about AMD or Abandoned mine lands (AML), including culm banks or waste coal piles of refuse??

Does AMD affect your fresh water drinking supplies?

How can AMD be used beneficially? What impacts do you see on the flora and fauna that AMD has on the landscapes that surround you?

What are your concerns about AMD?

How does AMD affect you?

How can we use Earth Elements?

What are some of the colors of AMD?

What is an Oxide? Antioxidant? Ways we use them in everyday life?

Why is awareness important? How is knowledge about your local environment beneficial?

How can Art spread Awareness?

Student Learning Outcomes [suggested]:

1. Students will demonstrate newly acquired knowledge about local mines and mine water pollution known as Abandoned Mine Drainage (AMD).
2. Students will demonstrate how two elements bond chemically by recreating the Atomic Structure of Iron-Oxide in a drawing.
3. Students will identify which parts of the water cycle can help eliminate this pollution to use as a benefit.
4. Students will visually express, on Hexagons with Wax Resist using iron-oxide mine waste pigments/Earth elements, an original and creative composition showing their concerns about local Environmental Issues involving AMD demonstrating new knowledge or solutions - utilizing the elements and principles of design, craftsmanship and skill.
5. Students will write an artist statement for their Hexagons clearly referencing Mine Drainage and their identified local water concerns.

21st Century Skills: Environmental Awareness, Drawing, Painting, Activism, Technology Utilization, Investigations, Teamwork, Global presence.

Key Vocabulary: Earth Elements, Pigments, Oxide, Antioxidant, Chemical reaction, Abandoned Mine Drainage (AMD) (mine water), Wax Resist, Reclamation, Stream Restoration, Recreation, Habitats, Watershed, Water Quality, Diversity Index, and Best Management Practices (BMP).

Materials List: Hexagons, crayons, oil pastels, Mine Waste Pigments from EPCAMR, containers to mix pigments, water to mix pigments, paintbrushes, paper towels, newspaper or other table cover, smocks, stampers of nature/water related items, ink pads, Teacher Example, and reference materials.

Scope and Sequence: Time Allotment: 5-6 Classes

Before Unit: Print Hexagons from Website, Gather Materials, Order Pigments, Prepare Pigments, Plan Stations, Prepare Example and informational handouts. If needed Plan to have Science teacher or Environmental Speaker come to present information on Environmental Issue/Solutions on Day One of Lesson. Plan having computer lab for students on Day Two of Lesson.

Pre-Engagement: Put out some books from the library on tables about mining and mine waste or printouts with information to start initializing conversation about mine experiences. You may be surprised who in the class knows someone who works at a mine or maybe visited one on a rock mining excursion with their parents.

Day One: (first 10-15 minutes) Introduce Environmental Issue (If possible and Art teacher is not comfortable seek Science Teacher or environmental speaker to come into class and aid with presentation of information), Vocabulary, and Social Problem. Teacher discusses Oxides, Earth Elements, Chemical Reactions, everyday chemical reactions (avocado and lime, apples and lemon juice, water and copper, findings on mines, drainage, and treatment options. (20-25 min) Give Students discovery time to discuss problem information. Handout Pre-Learning Assessment Sheet with Talking Points. In groups students discuss mining experiences, pollution, and solutions to pollution. Teacher Reviews group discussions with group spokesperson from each group. Teacher gives an extra credit option at this point in lesson: in

small groups students can do extra research on a related topic of Reclaimed Mines, wetlands, watersheds, and rivers (while at comp lab) and complete a group Hexagon based on their research. (This may extend lesson by a day for creating)

Day Two: Students have Research/learning development day in computer lab. Students will research local mines, AMD, and Iron Oxide Atomic Structure to recreate while students complete information sheet for assessment (can also be given for homework if not complete).

Day Three: Discuss AMD and solutions (5 min), Introduce Art Example (Teacher Example) Teacher Introduces Earth Elements/ Pigments from Abandoned Mine Drainage and discuss expectations for Hexagon (rubric) (10min), Give students idea planning time –sketch sheet- help students with transitioning to stations to complete Wax Resist Hexagon (20-30 mins) Teacher gives Demonstration on Use of Wax drawing tools like crayons and oil pastels, stampers and stamp pads and then uses pigments as a wash on top.

Day Four: Continue with stations to complete Hexagon and Finish Painting with Oxide wash (30 mins), cleanup (5 min), and students complete information sheet for assessment.

Day Five: Teacher will review of information and worksheet/data collection as well as review Lesson goals, have class critique/sharing. Formative Lesson Assessment. (How did the lesson go? Anything to add or reinforce?)

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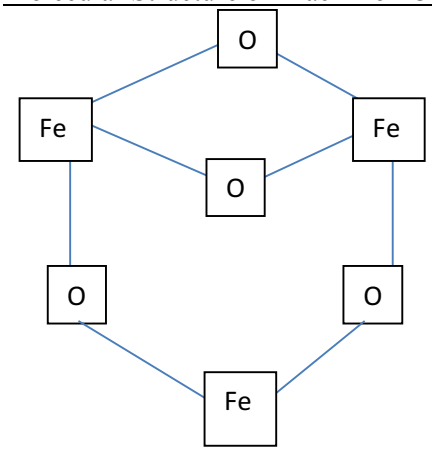
After Unit: Exhibit (Show Hexagons - online or local event), Assess (measure growth) Products -Student Learning Worksheets (using pre-assessment questions and student responses), Assess Creations – Hexagons (using Rubric), Lesson Review/Reflection, Submit Hexagons to Hexagon Project.

Molecular Structure of Black Iron Oxide 740:



Best Management Practices: is a term used in the United States and Canada to describe a type of **water pollution control**. This includes regulation on industrial wastewater. Historically the term has referred to auxiliary pollution controls in the fields of industrial wastewater control and municipal sewage control,

while in storm water management (both urban and rural) and wetland management, BMPs may refer to a principal control or treatment technique as well. Examples of BMP solutions:

- filters
- clarifiers
- biological reactors
- Retention ponds
- Minimizing chemical fertilizers and pesticides

Diversity Index: is a quantitative measure that reflects how many different types (such as species) are there in a dataset (a community), and simultaneously takes into account how evenly the basic entities (such as individuals) are distributed among those types.

Stream Restoration: or river restoration, sometimes called river reclamation in the UK, describes a set of activities that help improve the environmental health of a river or stream. These activities aim to restore the natural state and functioning of the river system in support of biodiversity, recreation, flood management and landscape development.

The water cycle is needed to gather these pigments, mainly, the evaporation part to get them out of the water to be collected. At EPCAMR, they use a solar kiln to facilitate the evaporation process and heat to make the pigments darker in a soil oven.

Content Assessment: Student Learning Worksheet, Hexagon Rubric, Formative Assessment.

Arts Assessment: See Iron-Oxide Atomic Structure Drawings using Rubric see Rubric for Art Assessment

Content Extension: What other Environmental Issues should we know about? How do they affect us? Microbeads, Global Warming…

Arts Extension: What other ways can we use these pigments? Batik, Tie-Dye, and Acrylic Polymer. Other Environmental Issues. Iron Oxide Paintings or Sculptures.

Student Reflection Prompts: What did you learn from this lesson? What are our biggest concerns about Environmental Mine Waste? Is awareness a way of solving the problem?

Teacher Reflection Prompts: How did the students enjoy the lesson? Were students engaged and motivated? What could have been done differently? What could be added?

Figure 3. (left) 20 acre Water-filled Stripping Pit in Newport Township, Luzerne County

Figure 4. (above) EPCAMR's iron oxide pigments

Figure 5. EPCAMR Iron Oxide graphic promoting their recycled pigment from mine water pollution.

Student Learning Worksheet

Name:_____

Pre-Assessment

List any local mines in your area:_____

What do you know about Abandoned Mine Drainage or AMD? _____

_____

Does it affect your local water?_____ If so, are you concerned?_____

Are you aware of any solutions to abandoned mine water pollution?_____

Talking Points:

Mine Experiences, have you ever been to one? Do you know anyone who works at a mine or for mine reclamation?

Pollution, what is it and how does it affect you and your surrounding habitats?

Pollution Solutions, what are they?

Does climate affect pollution or solutions?

Student Research Questionnaire:

Use Computer to answer the following Questions:

1. Look Up the Molecular Structure of Black Iron-Oxide 740 and Draw Below. (8pts.)

Black Iron Oxide Drawing Rubric: Students will express learning about Black Iron-Oxide composition by

Criteria	Excellent (4)	Advanced (3)	Adequate (2)	Basic (1)
Drawing is complete with Elements.	Drawing is fully complete with no missing Elements.	Drawing is almost complete with little missing elements.	Drawing is not complete with some missing parts.	Drawing is not complete or with many missing parts or not done.
Drawing is correct.	All parts of Drawing are correct.	Most parts of Drawing are correct.	Few parts of the drawing are correct.	Drawing is not done or completely incorrect.

Table 1. Drawing the molecular structure.

2. Search and name Three local mines. (Mines near us)_____

_____.

3. What is AMD?_____.

4. Identify wetlands near these mines (Google Maps). _____

_____.

5. Identify parts of the water cycle._____ _____

_____ _____.

6. Identify which part of the water cycle could make it possible to gather Earth Elements/pigments?_____

7. How can Best Management Practices (filters, clarifiers, biological reactors, Retention ponds) help to resolve the problem AMD?_____

_____

8. Does AMD affect our local water supply?

_____

9. Do we have regulations on water quality?_____

10. How is a diversity index used to assess water quality?_____

_____

11.Your ideas about solutions to mine waste?_____

_____

12. Currently used solutions?_____

_____

13. CONNECT ART: Go to pbs.org/program/art21/. Search Environmental Artists. Did you find any you like or found interesting? List and tell why.

_____

_____

ART: Wax Resist Project Student Learning and Reflection Sheet:

What are the names of the three Iron-Oxide Pigments used for Wax Resist Hexagon Project?

_____ _____ _____

What contemporary media was used to make this project?_____

What traditional processes were used to make this project?_____

Describe how a Wax Resist Works. _____

What did you like best about this project?:_____

_____.

How do you think this project connects us with others around the world?_____.

_____.

What did you learn about art and environmental art?_____

_____.

Artist Statement: Please describe you completed hexagon below. Describe what your issue of concern was and how you interpreted it and how you solved it. . Did you create any new or novel solutions for using AMD or controlling AMD? Explain.

Focal Assessment Questions

Science: Can this student identify where mine waste comes from, that it is a form of pollution to local water sources including wetlands and how it affects the local environment as well as possible benefits?

Art: Can this student create an original piece of art reflecting their concerns for this newly learned environmental issue? Did this student utilize the Wax Resist Method using pigments from Mine Water pollution to help express their learning of the issue and solutions?

Science Look-Fors	Art Look-Fors
☐ Student can identify three local mines. ☐ Student identifies AMD as pollution. ☐ Student can identify solutions to mine water pollution. ☐ Student identifies part of water cycle essential for stream restoration. ☐ Student can recreate Atomic Structure of Iron-Oxide. ☐ Student can envision a solution for a self - selected water pollution issue encountered through research. ☐ Student can accurately reflect upon his or her scientific growth in a written statement.	☐ Student can express environmental issues through drawing. ☐ Student can create an original composition using mixed media. ☐ Student can identify three pigments made from mine water pollution. ☐ Student can apply artistic skill to create a multi-layered artwork using two dimensional shapes. ☐ Students can identify traditional (Earth Elements) and contemporary (Polymer, markers, etc.) media and processes. ☐ Student can demonstrate an environmental concern or solution in an effective artistic composition. ☐ Student can accurately reflect upon his or her artistic growth in a written statement.

Reflection Opportunities	
Student Reflection Prompts: 1. Why is awareness important? 2. How is knowledge about your environment beneficial? 3. How can Art spread Awareness?	Teacher Reflection Prompts: 1. Is there a seamless connection between the art and science in this lesson? 2. What pieces of this lesson were a challenge? Which were the most engaging for my students and me?

Figure 6. (left) EPCAMR Art Piece with charcoal and iron oxide of coal miners.

Figure 7. (above) EPCAMR Iron Oxide tiles pieces created by art students at Verve Vertu Art Studio in Dallas, Luzerne County, PA

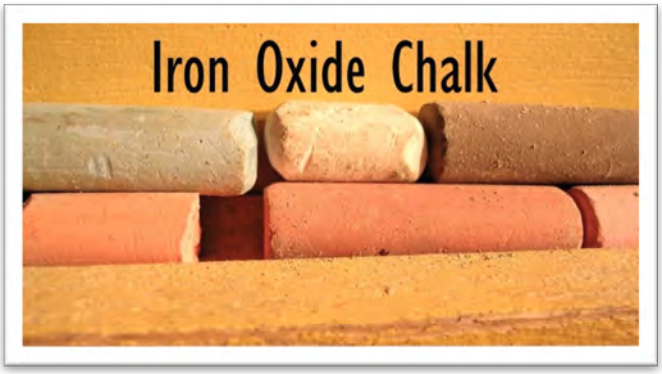


Figure 8. (left) EPCAMR's Iron Oxide Chalk

Rubric for Hexagon Product Assessment

Criteria	Distinguished (4)	Excelled (3)	Adequate (2)	Basic (1)
The Artist Statement clearly referenced Mine Waste and identifies local water concerns.	Student demonstrates their knowledge in sophisticated terms with critical analysis.	Student demonstrates their knowledge in adequate terms with critical analysis.	Student demonstrates their knowledge of topic through critical analysis.	Student barely demonstrates their knowledge with no reference to topic using little critical analysis.
The Completed Hexagon has an original and creative composition utilizing elements and principles of design.	Student clearly has an original and creative composition utilizing elements and principles of design.	Student clearly has and original and creative composition using some elements and principles of design.	Student composition could be stronger, more creative and more original using little elements and principles of design.	Student composition was not original enough, or worse, copied, could have been more creative using little or no elements and principles of design.
Hexagon drawings show craftsmanship and skill.	Student uses all available mixed media with great craftsmanship for a neat presentation.	Student uses most Mixed media with craftsmanship for neat presentation.	Student uses few Mixed media and craftsmanship is adequate for presentation.	Student uses only one Medium. Craftsmanship is poor for presentation.
Design shows clear relation to AMD Problem/Solutions Topic.	Students design was well thought out and executed showing clear relation to topic.	Students design was fairly executed showing relation to the topic.	Students design was adequately executed showing some relation to topic.	Students design was not well thought out and did not show relation to topic.
Completed Hexagon shows skills and knowledge obtained during this lesson intentionally.	Students work shows great artistic skills and knowledge gained during this lesson and referenced in Student Learning Worksheet.	Students work shows artistic skills and knowledge gained during this lesson and referenced in Student Learning Worksheet.	Students work shows skills gained and little knowledge gained but did not reference in Worksheet or with little reference.	Students work shows no gained skills or knowledge from this lesson and were not referenced in Worksheet.
Student used media with safety and care and cleaned up their workspace.	Student used media with the most safe means and care and cleaned up their workspace.	Student used media with mostly safe means and care and cleaned up their workspace.	Student used media with little safe means and care and could have cleaned up their workspace better.	Student used media with no safe means or care and did not help to clean up their workspace.

Table 2. Rubric for Hexagon Project Assessment.

Standards to Address and Assess [suggested]:

- Standards these Contents reference? (list)

Content Area: Environmental Science and Fine Arts Area: Wax Resist, Drawing, Painting

Content Standards:

4.2.5.A Explain the water cycle.

4.2.5.B Identify important wetlands in the United States.

4.5.8.C Describe how humans can reduce pollution.

4.5..5.D Explain how different items are recycled and reused.

4.3.5.C Describe relationships using inference and prediction.

4.5.8.A Explain how **Best Management Practices** (BMP) can be used to mitigate environmental problems.

4.5.8.A Describe factors that affect the quality of ground and surface waters.

4.2.8.C Describe how a **diversity index** is used to assess water quality.

4.2.5.C Identify physical, chemical, and biological factors that affect water quality.

Next Generation Science Standards:

MS-PS1-2.	Analyze and interpret data on the properties of substances before and after the substances interact to determine if a chemical reaction has occurred. [Clarification Statement: Examples of reactions could include burning sugar or steel wool, fat reacting with sodium hydroxide, and mixing zinc with hydrogen chloride.] [*Assessment boundary: Assessment is limited to analysis of the following properties: density, melting point, boiling point, solubility, flammability, and odor.*]
3-LS4-4.	Make a claim about the merit of a solution to a problem caused when the environment changes and the types of plants and animals that live there LS2.C: Ecosystem Dynamics, Functioning, and Resilience

When the environment changes in ways that affect a place's physical characteristics, temperature, or availability of resources, some organisms survive and reproduce, others move to new locations, yet others move into the transformed environment, and some die.

LS4.D: Biodiversity and Humans

- Populations live in a variety of habitats, and change in those habitats affects the organisms living there.

may change.* [Clarification Statement: Examples of environmental changes could include changes in land characteristics, water distribution, temperature, food, and other organisms.] [*Assessment Boundary: Assessment is limited to a single environmental change. Assessment does not include the greenhouse effect or climate change.*]

Analyze and interpret data to make sense of phenomena using logical reasoning. (3-LS4-1)

MS-ESS2-1. Develop a model to describe the cycling of Earth's materials and the flow of energy that drives this process. [Clarification Statement: Emphasis is on the processes of melting, crystallization, weathering, deformation, and sedimentation, which act together to form minerals and rocks through the cycling of Earth's materials.] [*Assessment Boundary: Assessment does not include the identification and naming of minerals.*]

MS-ESS2-4. Develop a model to describe the cycling of water through Earth's systems driven by energy from the sun and the force of gravity. [Clarification Statement: Emphasis is on the ways water changes its state as it moves through the multiple pathways of the hydrologic cycle. Examples of models can be conceptual or physical.] [*Assessment Boundary: A quantitative understanding of the latent heats of vaporization and fusion is not assessed.*]

MS-ESS3-1. Construct a scientific explanation based on evidence for how the uneven distributions of Earth's mineral, energy, and groundwater resources are the result of past and current geoscience processes. [Clarification Statement: Emphasis is on how these resources are limited and typically non-renewable, and how their distributions are significantly changing as a result of removal by humans. Examples of uneven distributions of resources as a result of past processes include but are not limited to petroleum (locations of the burial of organic marine sediments and subsequent geologic traps), metal ores (locations of past volcanic and hydrothermal activity associated with subduction zones), and soil (locations of active weathering and/or deposition of rock).]

K-PS3-1.

Cause and Effect -Events have causes that generate observable patterns.

Make observations to determine the effect of sunlight on Earth's surface. [Clarification Statement: Examples of Earth's surface could include sand, soil, rocks, and water.] [*Assessment Boundary: Assessment of temperature is limited to relative measures such as warmer/cooler.*]

K-ESS2-1.
Use and share observations of local weather conditions to describe patterns over time. [Clarification Statement: Examples of qualitative observations could include descriptions of the weather (such as sunny, cloudy, rainy, and warm); examples of quantitative observations could include numbers of sunny, windy, and rainy days in a month. Examples of patterns could include that it is usually cooler in the morning than in the afternoon and the number of sunny days versus cloudy days in different months.] [*Assessment Boundary: Assessment of quantitative observations limited to whole numbers and relative measures such as warmer/cooler.*]

People depend on various technologies in their lives; human life would be very different without technology. (K-ESS3-2)

Common Core Standards: (Possibly related Standards)

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.6-8.7
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.6-8.10
By the end of grade 8, read and comprehend science/technical texts in the grades 6-8 text complexity band independently and proficiently.

CCSS.ELA-Literacy.WHST.6-8.1.b
Support claim(s) with logical reasoning and relevant, accurate data and evidence that demonstrate an understanding of the topic or text, using credible sources

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.d
Use precise language and domain-specific vocabulary to inform about or explain the topic.

CCSS.ELA-Literacy.WHST.6-8.1.e
Provide a concluding statement or section that follows from and supports the argument presented.

PA Arts and Humanities Standards:

9.1.5.A Know and use the elements and principles of each art form to create works in the arts and humanities. Elements**: Visual Arts: • color • form/shape • line • space • texture • value.** Principles:

Visual Arts: • balance • contrast • emphasis/focal point • movement/rhythm • proportion/scale • repetition • unity/harmony.

9.1.5.B Recognize, know, use and demonstrate a variety of appropriate arts elements and principles to produce, review and revise original works in the arts.

9.1.5.C Know and use fundamental vocabulary within each of the arts forms.

9.1.5.E Know and demonstrate how arts can communicate experiences, stories or emotions through the production of works in the arts.

9.1.5.H Use and maintain materials, equipment and tools safely at work and performance spaces.

- Describe some materials used.
- Describe issues of cleanliness related to the arts.
- Describe types of mechanical/electrical equipment usage.
- Know how to work in selected physical space/environments.
- Identify the qualities of safe props/stage equipment.
- Describe methods for storing materials in the arts.

9.1.5.K Apply traditional and contemporary technology in furthering knowledge and understanding in the humanities.

9.2.5.A Explain the historical, cultural and social context of an individual work in the arts.

9.2.5.E Analyze how historical events and culture impact forms, techniques and purposes of works in the arts. (e.g., Gilbert and Sullivan operettas)

9.2.5.G Relate works in the arts to geographic regions: North America. (Wherever you are from.)

9.4.5.D Explain choices made regarding media, technique, form, subject matter and themes that communicate the artist's philosophy within a work in the arts and humanities.

Student Learning Worksheet Assessment Guidelines:

Content Standard Assessed:

4.2.5.A Explain the water cycle.

4.2.5.B Identify important wetlands in the United States.

4.5.8.C Describe how humans can reduce pollution.

4.5.5.D Explain how different items are recycled and reused.

4.3.5.C Describe relationships using inference and prediction.

4.5.8.A Explain how **Best Management Practices** (BMP) can be used to mitigate environmental problems.

4.5.8.A Describe factors that affect the quality of ground and surface waters.

4.2.8.C Describe how a **diversity index** is used to assess water quality.

4.2.5.C Identify physical, chemical, and biological factors that affect water quality.

Comparing PA Arts & Humanities Standards and National Core Arts Standards

Pennsylvania Standards Series	Pennsylvania Curriculum Framework Big Idea	National Core Arts Standards Artistic Process	National Core Arts Standards Anchor Standard	National Core Arts Standards Series
9.1 Production, Performance and Exhibition	1. The **skills, techniques**, elements and principles of the arts **can be learned, studied, refined and practiced.**	CREATING	1. **Generate and conceptualize artistic ideas and work.** 2. **Organize and develop artistic ideas and work.** 3. **Refine and complete artistic work.**	**Dance:** DA:Cr1 Series, DA:Cr2 Series, DA:Cr3 Series **Music:** MU:Cr1 Series, MU:Cr2 Series, MU:Cr3 Series **Theatre:** TH:Cr1 series, TH:Cr2 Series, TH:Cr3 Series **Visual Arts:** VA:Cr1 Series, VA:Cr2 Series, VA:Cr3 Series
9.1 Production, Performance and Exhibition	2. **Artists use tools and resources as well as their own experiences and skills** to create art.	CONNECTING	10. **Synthesize and relate knowledge and personal experiences** to make art.	**Dance:** DA:Cn10 Series **Music:** Mu: CN10 series and embedded standards **Theatre:** TH:Cn10 series **Visual Arts:** VA:Cn10 Series
9.1 Production, Performance and Exhibition	3. **The arts provide a medium to understand and exchange ideas**.	PERFORMING	1. **Select, analyze and interpret artistic work for presentation.** 2. **Develop and refine artistic techniques and work for presentation.** 3. **Convey meaning through the presentation of artistic work.**	**Dance:** DA:Pr4 Series, DA:Pr5 Series, DA:Pr6 Series **Music:** MU:Pr4Series, MU:Pr5 Series, MU:PR6 Series **Theatre:** TH:PR4 series, TH:Pr5 Series, TH:Pr6 Series **Visual Arts:** VA:PR4 Series, VA:Pr5 Series, VA:Pr6 Series
9.2 Historical and Cultural Context	4. Humans have expressed experiences and ideas through the **arts throughout time and across cultures.**	CONNECTING RESPONDING	11. **Relate artistic ideas and works with societal, cultural and historical context to deepen understanding**. 9. **Apply criteria to evaluate artistic work**.	**Dance:** DA:Cn11 Series DA:Re9 **Music:** Mu: CN11 series and embedded standards MU: Re9 series **Theatre:** TH:Cn11 series TH:Re9 series **Visual Arts:** VA:Cn11 series VA Re9 series
9.3 Critical Response	5. There are formal and informal processes used to **assess the quality of works in the arts**.	RESPONDING	7. **Perceive and analyze artistic work**. 9. **Apply criteria to evaluate artistic work**.	**Dance:** DA:Pr7 Series, DA:Pr9 Series **Music:** MU:Pr7Series, MU:Pr9 Series **Theatre:** TH:PR7 series, TH:Pr9 Series **Visual Arts:** VA:PR7 Series, VA:Pr9 Series
1. *Critical Response* 2. *Aesthetic Response*	6. People use both aesthetic and critical processes to assess quality, **interpret meaning and determine value.**	RESPONDING	8. **Interpret intent and meaning in artistic work.** 7. **Perceive and analyze artistic work**.	**Dance:** DA:Pr8 Series, DA:Pr7 Series **Music:** MU:Pr8Series, MU:Pr7 Series **Theatre:** TH:PR8 series, TH:Pr7Series **Visual Arts:** VA:PR8 Series, VA:Pr7 Series