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+ Introduction: Finding a Place for Art in Education

Art has always been an integral part of students’ educational experiences. How many can remember their first experiences as a child manipulating crayons, markers and paintbrushes to express themselves without fear of judgement or criticism? Yet, art is more than a fond childhood memory. Art is creativity, an outlet of ideas, and a powerful tool to express the deepest thoughts and dreams of an individual. Art knows no language or boundary. Art is always innovative, as each image bears the unique identity of the artist who created it.

Unfortunately as many art educators know all too well, in schools art is the typically among the first subjects on the chopping block during budget shortfalls or the last to be mentioned in a conversation about which subjects students should be learning. Art is marginalized, pushed to the side and counted as an “if-we-have-time” subject. You may draw...if we have time after our math lesson. We will have time art in our class...after we have prepared for the ISAT tests. The refrain from administrators, educators and the public is familiar to those who practice and study in the field of art education.

This introduction is not meant to demean the importance of traditional subjects in schools. Math and science are continually noted for their importance in the development of a 21st century workforce. We need engineers, physicians, computer programmers, web developers, and many other skilled professionals who utilize these subjects to propel innovation and contribute to our global economy. STEM, the acronym for Science, Technology, Engineering and Math education initiatives, is being promoted in order to better prepare students with the knowledge and skills they will need beyond school. Common Core State Standards are being implemented as this resource is being developed. Yet, by limiting, ignoring or pushing aside the skills, habits and ways of thinking the arts teach, our vision for students’ futures becomes short-sighted.

As mentioned at the outset of this Introduction, art is also innovative. Artists conceptualize, draft, revise, process, fabricate, configure and refine. Artists challenge themselves and those around them. They express ideas through the language of creation. A study of the skills artists regularly use to create works of art suggest overlaps amongst the subjects deemed valuable for students in today’s schools.
This curricular resource aspires to find connections and common ground between scientific disciplines, mathematical concepts and visual art. The integration of these subjects derives from the challenges being issued by STEM initiatives: to prepare students as socio-critical thinkers, equip them with skills needed in the 21st century workplace, and engage their curiosity to learn and create.

+ Philosophy of a STEM+VISUAL ART Curriculum

The concept of an integrated STEM curriculum is not new. Many variations of the acronym exist, with the popular “STEAM” being used to denote the inclusion of ‘A’ for arts. STEAM is rapidly gaining ground, and is even being championed by some schools, researchers and think-tanks. The title of this particular curricular resource uses the “+” symbol between the acronym STEM and term “visual art.” The purpose of this placement is to visually and conceptually highlight visual art as an “added boost” for learning about STEM subjects, and an important, viable subject on its own. Additionally, the STEAM movement seeks to incorporate all disciplines under the umbrella of the arts, including music, drama, and dance. The sole focus of this resource is the integration of visual art, though this resource may provide inspiration for the integration of other arts disciplines.

The lessons within this curricular resource were designed to emphasize inquiry-based collaborative teaching and learning styles. Educators are encouraged to share content in a way that promotes student expression and sharing of ideas to build understanding, and go above and beyond the direct instruction of facts. The process of discovery through inquiry, or asking questions to guide student discussion and understanding about the topics presented, lends itself to teaching content from multiple disciplines, and allows students to develop natural inferences and make connections between concepts.

+ Suggestions for Using this Curricular Resource

The goals for this resource are two-fold: to provide teachers with a resource for integrating STEM and visual art and to empower teachers across all subjects and grade levels to explore art-making and artwork as a viable instructional tool for learning. Teachers can consider utilizing this resource to become acquainted with the language of art and use this as a gateway for implementing true art integrated lessons.

We know that all students are different, and the same holds true for teachers. Each classroom carries its own set of needs. Teachers are prepared to intervene and enrich their students’ learning experiences at all moments. This curricular resource is designed so that it can be adapted, revised, edited and changed to fit the needs of any classroom. Each lesson is
accompanied by suggestions for and extensions to enrich lessons, as well as further resources for teachers.

**Lesson Plan Design**

The development of this curricular resource was completed with valuable feedback and suggestions from K-12 teachers in various content areas. Teachers were asked to provide feedback regarding clarity, usefulness and content of the lessons. This helped shape the design of the lessons, with the goal of providing an accessible, useful and comprehensive resource for any classroom teacher.

Each lesson presents the following: objectives or goals for the lesson, materials needed, steps for completion, adaptations or extensions, a suggested method for assessment, and further resources. The content is designed to promote student learning through exploration of ideas and materials. Use of technology and/or the design process is emphasized during project steps to assist in delivery of content or enhance art-making.

The lessons in this curricular resource are also designed to be flexible and adaptable. Teachers are encouraged to use or change the lessons as they deem necessary for their classroom. Each lesson features an “Adapt+Enrich” section with suggestions for ways to extend and alter the lesson to fit the needs of diverse classroom environments and allow for further exploration of concepts and materials.

Assessment is equally important as the content being taught. The benefits and outcomes of a lesson should be evaluated to determine how and what students are learning. The “Assess” portion of the lesson contains a rubric-based assessment designed for teachers to evaluate learning based upon observations, artwork and discussions. Along with assessment, information is provided to show how the lessons can be aligned with Idaho State Content Standards and Common Core State Standards.
**Tips for Teaching Art**

**Looking at Art**
Use art vocabulary to help identify and recognize how artists use the elements in works of art. Share and encourage students’ use of vocabulary to help them familiarize themselves with the language of art. Give students time to look, absorb, feel and think about what they see.

**Talking about Art**
Ask open-ended questions to help generate student responses to what they see. Don’t be afraid to challenge students by asking them to share opinions and thoughts. The goal is to help students feel comfortable expressing and exploring their ideas about artwork.

**Creating Art**
Gather and organize materials early. Create an example before using the lesson with students to become familiar with the materials and potential challenges and successes students may experience. Ask students to draft, revise, edit and experiment during the process.

**Cycle of Art Exploration**
Consider the act of teaching art as an ongoing cycle, or process. At any point, students can enter the cycle and move through the various phases of looking at, discussing, sharing, planning and creating artwork.

1. **Create**
2. **Look**
3. **Plan**
4. **Discuss**
5. **Share**
Artist Catalogue

This section contains artwork images and a brief overview of artists whose work connects to STEM concepts. Explore the works of these artists in conjunction with the lessons presented in this curricular resource or as inspiration for other lessons.

Robert Adams

Artist Robert Adams uses photography to document the American West. His black and white images illustrate the ways in which human life has affected the landscape. This photograph shows a forest that has been partially cleared for lumber.

LEARN MORE
www.getty.edu/art/gettyguide/
www.art21.org

From the series "Turning Back"
Gelatin silver print, 14 x 11 inches
© Robert Adams

Erik Demaine & Martin Demaine

Artists Erik Demaine and Martin Demaine use mathematics as the basis for works of art. This work is known as a “curved-crease sculpture,” artwork created from folded paper. The artists were interested in determining the mathematical curved surface that resulted from this method of folding paper.

LEARN MORE
www.erikdemaine.org
www.martindemaine.org
www.moma.org

Computational Origami, 2003-07
Elephant hide paper, 16” x 12” (40.6 x 30.5 cm)
Gift of the designers
Copyright: © 2013 Erik Demaine and Martin Demaine
(Retrieved from source: www.moma.org)
Mark Dion

Artist Mark Dion creates installations that explore how environment and policy are shaped by human ideas and other influences. This particular work of art, displayed in the Olympic Sculpture Park in Seattle, is a recreated habitat that surrounds a decaying tree.

LEARN MORE
www.artistsrespond.org/artists/dion/
www.art21.org

“Neukom Vivarium,” 2006
Mixed-media installation, greenhouse structure: 80 feet
Installation view: Olympic Sculpture Park, Seattle. Gift of Sally and William Neukom, American Express Company, Seattle Garden Club, Mark Torrance Foundation, and Committee of 33
Courtesy the Seattle Art Museum
(Retrieved from source: www.art21.org)

M.C. Escher

Artist MC Escher was known for his works of art which explored themes such as metamorphosis, perspective, architecture and pattern. His patterned compositions, known as tessellations, combined concepts from geometry such as shape and symmetry.

LEARN MORE
www.mcscher.com
www.nga.gov

Development I, 1937
woodcut
Cornélus Van S. Roosevelt Collection
All M.C. Escher works © Cordon Art-Baarn-the Netherlands. All rights reserved.
**Sally Finch**

Artist Sally Finch represents numerical data through colorful, abstract paintings and drawings. Her artwork presents visualized information, such as weather patterns, rainfall, demographic data, and random numerical sets.

**LEARN MORE**

www.sallyfinch.com

*Weather Study 5, El Flasher*, 2011
Paper, graphite, acrylic ink
18" x 18"
Copyright: © Sally Finch
(Retrieved from source: http://sallyfinch.com)

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**Allan McCollum**

Allan McCollum is an artist who explores mass production, such as the ongoing *Shapes* project. In the *Shapes* project, the artist used Adobe Illustrator vector files to combine various small shapes into larger ones, forming unique symbols representing each individual in the estimated world population. The symbols are generated by the artist himself, not scripted computer programs.

**LEARN MORE**

www.allanmccollum.net/allanmcnyc/
www.art21.org

"Shapes from Maine: Shapes Silhouettes," detail, 2005/08
Hand cut black paper on museum board, approximately 3 3/4 x 2 1/2 inches each, each unique; 7 x 5 inches framed
Produced in collaboration with Ruth Monsell, founder of Artpul Heirlooms, Damariscotta, Maine
Photo by Lamay Photo
© Allan McCollum
Frank Stella

Artist Frank Stella created abstract prints, paintings, sculptures and architectural projects. In many of these works of art, Stella explored concepts from geometry, pattern, color and repetition.

LEARN MORE
www.theartstory.org/artist-stella-frank
www.moma.org

Harran II, detail, 1967
Polymer and fluorescent polymer paint on canvas - Solomon R. Guggenheim Museum, New York
(Retrieved from source: http://www.theartstory.org/artist-stella-frank.htm)

Rachel Sussman

Artist Rachel Sussman explores art and science in a series of photographs entitled “The Oldest Living Things in the World.” She has traveled around the globe with researchers and biologists to capture photographs that document living organisms, the environment and natural phenomena.

LEARN MORE
www.rachelsussman.com
www.ted.com/talks/lang/en/rachel_sussman_the_world_s_oldest_living_things

sagole baobab #0707-00505 (2,000 years old; limpopo province, south africa), from the Oldest Living Things series
(Retrieved from source: http://rachelsussman.com/portfolios/OLTW/baobab_1.html)
Artist Carolyn Yackel is a mathematics professor with an interest in expressing mathematical concepts through knitting and other textile works of art.

LEARN MORE
faculty.mercer.edu/yackel_ca/

Truncated Temari. 2011
10 in x 6 in x 3.25 in
styrofoam, thread, pearl cotton, embroidery
(Retrieved from source: http://gallery.bridgestmathart.org/exhibitions/2012-bridges-conference/cyackel)

Suggestions for Classroom Use

Connect to Subject Matter
- Find artists whose work explores similar concepts to what students are learning.
- Let students discuss an artist’s work and make their own comparisons to learning content.

Preview and Adapt
- Visit artist websites in advance to ensure content is appropriate for your class.
- Create your own presentations - remember to cite references or link to online content.

Share
- Show students pre-selected high-res images on a large screen, such as a SMARTboard.
- When possible, include images that show smaller details.
- Include video and audio content from artists for a multimedia experience.
STEM+ VISUAL ART

A Curricular Resource for K-12 Idaho Teachers

+ Lesson Plans: K-3
Lesson Plan

Patterned Prints

STEM Subject Focus: Math
Suggested Grade Levels: K - 3

Summary
Students will create printed works of art based on mathematical patterns.

Objectives
+ Students will be able to define the term “pattern” and identify patterns in math and various works of art.
+ Students will draw their own patterns.
+ Students will be able to utilize the design process of drafting and revising to create patterned prints.

Key Concepts+Vocabulary
Printmaking, pattern, design, lines, shapes, geometry, textiles

Materials
+ Drawing paper
+ Pencils
+ Colored pencils
+ Sticky-backed foam
+ Brayers (rollers) or brushes
+ Scissors
+ Markers
+ Cardboard (cut into squares)
+ Paint

Brainstorm+Discuss
+ To begin, explain to students that they will be learning about artists who create works of art with patterns. Students may already have learned to identify and complete patterns with shapes, colors or numbers in math that look like this: • △ ○ △
+ In art, the term “pattern” can describe things that are repeated (shapes and colors), or the way these elements are arranged in a design. Encourage students to brainstorm and share examples of patterns from everyday life. (Examples may include patterns on fabric, etc.)
such as clothing or quilts, or patterns found in nature such as animals, insects, or flowers.) Can students find other examples of patterns in the classroom or school?

+ Share examples of patterns made from shapes and lines in a variety of artworks, such as quilts, textiles, paintings, drawings, and ceramics. (See figures 1, 2 and 3 for examples.)

+ While looking at examples of patterns, help students compare and contrast attributes of the shapes they see. For example, show students how both a parallelogram and rectangle have four sides. How are they different? Can they find another shape with four sides?

![Fig. 1. Some quilt patterns, such as the tumbling block in the image above, are well known.](image1)

![Fig. 2. Patterns with lines and geometric shapes can decorate ceramic artwork, such as this coffee pot.](image2)

![Fig. 3. The image above shows a detail from a drawing with many patterns by Idaho artist James Castle.](image3)

+ Have students identify the lines, shapes and colors in examples of patterns aloud and practice drawing their own patterns with similar or different lines and shapes.

**Imagine+Create**

+ Explain to students that they will design their own patterns for a printed work of art. **Printmaking** is a type of artwork that transfers an image from one surface to another. Students will draw and make prints of patterns inspired by geometrical shapes, nature, art, or their imaginations.

+ Have students practice drawing their patterns using paper and colored pencils. Remind students that these sketches are for practice, to help them plan their final works of art in the same way many artists work.

+ Provide materials for students to begin construction of their printing “plates” – these will be the surfaces they use to paint and print later. Students can use markers to draw on the sticky foam (on the paper side) and cut out shapes. Have students peel and stick the shapes onto a piece of cardboard or another sturdy surface to create a patterned image.

+ After students have finished creating their plates, they may begin the printing process. Demonstrate how to brush paint on the printing plate and then carefully press the painted surface to paper – students should see the printed design from the sticky foam shapes on the paper. Then, let students try printing on their own. They may want to create “practice” prints first. Repeat this process to make more prints.
M.C. Escher was known for his works of art which explored themes such as metamorphosis, perspective, architecture and pattern. His patterned compositions, known as tessellations, combined concepts from geometry such as shape and symmetry. Learn More www.mcscher.com, www.nga.gov
**Assessment**

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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<th>4</th>
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<tr>
<td>Student demonstrates a clear understanding of the term “pattern,” and can identify patterns aloud.</td>
<td>Student demonstrates an understanding of the term “pattern” and can identify most patterns aloud.</td>
<td>Student demonstrates an understanding of the term “pattern” and can identify most patterns aloud.</td>
<td>Student does not demonstrate a clear understanding of the term “pattern,” or cannot identify patterns aloud.</td>
</tr>
<tr>
<td>Student can compare and contrast patterns from math and artwork examples.</td>
<td>Student can compare and contrast patterns from math to patterns in art.</td>
<td>Student can compare and contrast patterns from math to patterns in art.</td>
<td>Student is unable to compare and contrast patterns from math to patterns in art.</td>
</tr>
<tr>
<td>Student creates a practice drawing and an original pattern for a printed work of art with a variety of shapes.</td>
<td>Student creates a practice drawing and original pattern for a printed work of art.</td>
<td>Student creates a pattern for a printed work of art, but does not complete a practice drawing.</td>
<td>Student does not create a practice drawing or printed artwork does not show a pattern.</td>
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**Standards**

This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

- Grades K-3, Humanities, Visual Art, Standard 3: Performance
  K.VA.3.2.2 Apply artistic concepts, knowledge, and skills to original artwork.

- CCSS for Mathematics, Grade K
  Geometry: Analyze, compare, create, and compose shapes.

- CCSS for Mathematics, Grades 1, 2, 3
  Geometry: Reason with shapes and their attributes.

**Resources+References**

Figure 1
Harris Sears, A. (1856). *Tumbling Blocks with Signatures pattern* [Quilt]
Figure 2
Janáček, P. (1912). Coffee Pot [Earthenware]

Figure 3
Castle, J. (ND). Untitled [Drawing, found paper and soot]
Lesson Plan

Nature Portraits

STEM Subject Focus: Science
Suggested Grade Levels: K - 3

Summary
Students will explore watercolor media to create portraits that capture the unique qualities of natural environments.

Objectives
+ Students will be able to define the term “portrait” and identify portraits in works of art.
+ Students will identify unique characteristics of places in nature and use this as inspiration to create visual “portraits” of places.
+ Students will experiment with the materials and techniques used in watercolor painting.

Key Concepts+Vocabulary
Nature, portrait, environment, watercolors, experimentation

Materials
+ Drawing paper
+ Pencils/markers
+ Practice Paper
+ Watercolor paint
+ Brushes
+ Cups for water
+ Watercolor paper, or other thick paper for painting surface

Brainstorm+Discuss
+ To begin, show students examples of portraits from artists.
+ Ask students to share: Have you ever created a work of art about yourself or another person? What did it look like?
+ Share the definition with students: A portrait is usually a work of art that shows a face. Portraits do not always have to be people. For example, what might a portrait of their favorite animal look like?
Rachel Sussman explores art and science in a series of photographs entitled “The Oldest Living Things in the World.” She has traveled around the globe with researchers and biologists to capture photographs that document living organisms, the environment and natural phenomena.

Learn More www.rachelsussman.com
www.ted.com/talks/lang/en/rachel_sussman_the_world_s_oldest_living_things
Imagine+Create

+ Explain to students what they will use to create their portraits – **watercolor** paint. Challenge students to imagine they are artists and scientists and will be experimenting with the different colors, techniques and effects that can be created with watercolors.

+ Have students **experiment** with watercolors before beginning their paintings. Show students how to apply a small amount of water to their brushes, and carefully dip the tip of the brush into the paint. They can create thin lines with the tip of their brush, and thick lines with the side of their brush. Show students how to treat their materials nicely, carefully dipping their brushes into paint and water so as not to “smash” the brush bristles or drip excess water across their paper. Give students time to experiment with watercolor techniques, such as those detailed below.

+ Students may very lightly sketch their places on paper first. Students may use permanent (*not water-based*) markers to outline their features, or paint over pencil lines.

+ When students have finished drawing their places, they may begin painting. Encourage students to use the watercolor techniques to completely fill their space.

Conclude+Reinforce

+ When the nature portraits are completed, have students share their artwork aloud. Each student can discuss the place they created, what elements make their place unique, and why they included these things in the portrait.

Adapt+Enrich

+ Adjust this lesson as needed for specific units of study. For example, students can create personal portraits in a lesson about identity, or animal portraits in a study of wildlife.

Assessment

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level
of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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<tr>
<td><strong>4</strong></td>
<td>Student can explain the meaning of the term “portrait” and can share examples.</td>
<td>Student can explain the meaning of the term “portrait” and share some examples.</td>
<td>Student definition of the term “portrait” is incorrect, or student cannot share examples.</td>
<td>Student cannot explain the meaning of the term “portrait” or share examples.</td>
</tr>
<tr>
<td><strong>3</strong></td>
<td>Student can identify places in nature and can share many unique examples.</td>
<td>Student can identify places in nature and share some examples.</td>
<td>Student can identify places in nature, but has difficulty identifying their characteristics.</td>
<td>Student cannot identify places in nature or share examples.</td>
</tr>
<tr>
<td><strong>2</strong></td>
<td>Student creates an original watercolor painting that shows a place in nature. Student uses many examples of watercolor techniques effectively.</td>
<td>Student creates an original watercolor painting that shows a place in nature. Student uses watercolor techniques effectively.</td>
<td>Student creates an original watercolor painting that shows a place in nature, but with few details. Student uses watercolor materials appropriately.</td>
<td>Student creates an original watercolor painting, but does not show a place in nature. Student does not attempt different watercolor techniques.</td>
</tr>
<tr>
<td><strong>1</strong></td>
<td>Student creates an original watercolor painting, but does not show a place in nature. Student does not attempt different watercolor techniques.</td>
<td></td>
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</table>

**Standards**
This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

- **Grades K-3, Humanities, Visual Art, Standard 3: Performance**
  - K.VA.3.2.2 Apply artistic concepts, knowledge, and skills to original artwork.
  - K.VA.3.3.2 Create artwork about self, family, and personal experiences.

- **Grade 6, Science, Standard 5: Personal and Social Perspectives; Technology**
  - Goal 5.3: Understand the Importance of Natural Resources and the Need to Manage and Conserve Them

- **CCSS Writing Standards, grades K-5**
  - Research to Build and Present Knowledge, Standard 7: Conduct short research projects that build knowledge through investigation of different aspects of a topic.

**Resources+References**
Watercolor Techniques: Depicting a Landmark, the Paul J. Getty Museum
http://www.getty.edu/education/teachers/classroom_resources/tips_tools/
Lesson Plan

Artist Habitats

STEM Subject Focus: Science
Suggested Grade Levels: 4 - 6

Summary
Students will learn about habitats before creating their own unique visual representation of a habitat in the form of a mixed media sculpture.

Objectives
+ Students will be able to define habitats and the environmental elements that are needed to sustain them.
+ Students will create a visual representation of a habitat with sculptural materials.
+ Students will be able to utilize the design process of drafting and revising to create works of art.

Key Concepts + Vocabulary
Habitat, home, environment, the design process, mixed media

Materials
+ Drawing paper
+ Pencils
+ Colored Pencils
+ Rulers
+ Scissors
+ Glue
+ Pipe cleaners
+ String
+ Flat cardboard pieces or shoe boxes
+ Assorted types of paper in all colors
+ Various objects for mixed media sculpture such as toothpicks, q-tips, popsicle sticks, and plastic utensils

Brainstorm + Discuss
+ To begin, explain to students that they will be learning about habitats. Divide students into small groups and have them brainstorm about the meaning of the word “habitat.”
Students can create a web and connect words that they relate with habitats. Prompt students to think about what features are needed for a place to be considered a habitat.

* Show students examples of habitats. Explain that habitat is like a **home**, a place for animals to have all the basic elements they need for survival. All habitats must have these features for survival: **water**, **food**, **cover or shelter**, and **space**.

* Compare and contrast the meaning of “habitat” with “home.” Ask students to consider their “habitats.” How is the classroom like a habitat? How is their home a habitat? Ask students to provide examples to check for understanding.

**Imagine+Create**

* Explain to students that they will design their own habitats. Each student will imagine a habitat, or home, they would like to live in and create a mixed media sculpture as a visual representation, or model.

* Share the installation by artist Mark Dion to show students how an artist created a habitat.

Mark Dion creates installations that explore how environment and policy are shaped by human ideas and other influences. This particular work of art is a recreated habitat surrounding a decaying tree. Learn More www.art21.org

* In visual art, the term “**mixed media**” simply refers to use of multiple art materials. Students will need to think about what their habitats will contain and imagine what it
would look like. Challenge students to pretend they are architects or engineers as they design their habitats – what features will their habitat need to provide for survival? What will these features look like? Are there any additional features they will need for a comfortable and safe habitat? How will their habitat reflect their individual needs and style?

+ Have students begin drafting designs for their habitat-based artwork. Students can use paper, rulers, pencils and colored pencils to sketch their designs and plan the materials they will need to create their habitats. Challenge students to consider how the materials and designs of their works of art will reflect the habitats they portray.

+ Provide materials for students to begin construction of their habitats once they have completed their original drafts. Remind students that they may need to revise their original concepts as they work with the materials or find unexpected challenges. *(Finding solutions and revising original plans as needed is part of the design process, just as they draft and revise written work.)*

+ Provide each student with a base for their sculptures, such as a flat piece of cardboard, shoe box or lid. Show students the materials they may use to create their habitat sculptures and challenge students to completely cover the surface of their base with colored paper and objects. Challenge students to use and alter the materials in different ways to reflect their habitats. *(Students can build features with bent or rolled strips of construction paper, twist pipe cleaners around objects, and layer wooden sticks or q-tips across surfaces. Glue can be used to adhere paper, cardboard and plastic, and objects can also be tied or twisted into place with pipe cleaners or string.)*

**Conclude+Reinforce**

+ When the students’ final works of art are completed, have students discuss their habitats and reflect on the process of creating them. Students can present their work in front of the class, explaining the habitat they chose, the materials they used to represent the key features of their habitat and the challenges and successes they encountered while making their works of art.

+ Discuss conclusions about habitats as a group. Compare students’ artwork with actual habitats discussed earlier in the lesson. Ask students to consider what their artwork would be like without a certain material or feature. How would it change? Would they consider their artwork as successful without this, or not? Why? Then, ask students how habitats in the environment would survive and thrive without specific elements, such as insects, rainfall, or plant life. How would this missing element affect the delicate balance of the habitat and the organisms within it?
Adapt+Enrich

+ Adjust this lesson as needed for specific units of study. Students can focus on a single habitat being studied, such as the rainforest.
+ Have students collaborate to create their visual habitats. Students can work in small groups or in pairs to design and construct their works of art.
+ Consider the concept of an artist studio as a habitat. The Habitat for Artists project uses small studios set-up in various locations as a way to create dialog between artists and the public. Visit the project website for more information: http://habitatforartists.org/
+ Discuss the fragility of their works of art in relation to the delicate balance needed for habitats to exist. Consider how artwork is conserved and cared for and use this as a way to understand the issues surrounding conservation of habitats and environment.

Assessment

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

<table>
<thead>
<tr>
<th></th>
<th>4</th>
<th>3</th>
<th>2</th>
<th>1</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Student demonstrates a clear understanding of the term “habitat” and can provide examples of habitats and describe key features.</td>
<td>Student demonstrates understanding of the term “habitat,” and can provide examples.</td>
<td>Student demonstrates understanding of the term “habitat,” but cannot provide examples.</td>
<td>Student does not demonstrate correct understanding of the term “habitat.” Examples are incorrect or incomplete.</td>
</tr>
<tr>
<td></td>
<td>Student compares the concept of “habitat” with home and can describe the features both need for animal or human survival.</td>
<td>Student compares the concept of “habitat” with home and can provide examples of features in habitats or homes, but not both.</td>
<td>Student compares the concept of “habitat” with home, but cannot provide examples to support the concept.</td>
<td>Student understands the concept of “habitat” but cannot connect the concept with home.</td>
</tr>
<tr>
<td></td>
<td>Student creates an original design for a habitat and revises as necessary. Student uses materials appropriately and completes a finished artwork with color and detail to effectively illustrate their habitat.</td>
<td>Student creates an original design of a habitat and revises as necessary. Student uses materials appropriately and completes a finished artwork. Not all features are illustrated in their final artwork.</td>
<td>Student creates an original work of art, but does not complete all of the steps in the design process. The finished artwork conveys only some features of a habitat, but is missing details.</td>
<td>Student creates an original work of art, but does not complete all of the steps in the design process. The finished artwork does not include sufficient details to convey a habitat.</td>
</tr>
</tbody>
</table>
Standards
This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

+ Grades 4-5, Humanities, Visual Art, Standard 2: Critical Thinking
  4-5.VA.2.2.6 Write an artist’s statement (what the work depicts and why and how the work was created).

+ Grades 4-5, Humanities, Visual Art, Standard 3: Performance
  4-5.VA.3.2.1 Demonstrate how different media, techniques, and processes are used to communicate ideas.
  4-5.VA.3.3.3 Use the creative process (brainstorm, research, rough sketch, final product) to create a work of art.

+ Grade 6, Science, Standard 5: Personal and Social Perspectives; Technology
  Goal 5.3: Understand the Importance of Natural Resources and the Need to Manage and Conserve Them

+ CCSS Writing Standards, grades K-5
  Research to Build and Present Knowledge, Standard 7:
  Conduct short research projects that build knowledge through investigation of different aspects of a topic.

+ CCSS Reading Standards for Informational Text, grades 6-12
  Integration of Knowledge and Ideas, Standard 7:
  Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

Resources+References
The Habitat for Artists Project
http://habitatforartists.org/

Olympic Sculpture Park, Seattle Art Museum
http://www.seattleartmuseum.org/visit/OSP
Lesson Plan

Shaped by Design

STEM Subject Focus: Math
Suggested Grade Levels: 4 - 6

Summary
Students will learn about the application of geometry in artwork, and create works of art inspired by concepts of line and shape in geometry.

Objectives
+ Students will compare concepts from geometry with those seen in works of art.
+ Students will identify geometric shapes, lines and angles.
+ Students will use geometric concepts to create their own unique shape-based artwork.

Key Concepts+Vocabulary
Geometry, line, segment, ray, angle, plane, shape, symmetry, contrast

Materials
+ Drawing paper and pencils
+ Rulers
+ Glue
+ Canvas or other surface for background
+ Yarn or string

Brainstorm+Discuss
+ To begin, explain to students that they will be learning about geometry in art.
+ Compare and contrast the definitions of line in geometry and art. In geometry, a line is straight, has no thickness, and extends in both directions without end. A line with two ends is a segment. A line with one end is a ray.
+ In art, a line is a path created by a point moving in space. Lines can vary in width, direction and length. There are many ways to describe lines in works of art – the only limit is the imagination. Ask students to brainstorm of a list of words that describe lines. (curly, zig-zag, straight, curvy, sharp)
Explain: Lines in geometry and art both define shapes. Ask students to share examples of shapes.

Share an example of artwork from an artist who is interested in shapes. Artist Allan McCollum makes works of art that show different shapes and forms.

Allan McCollum is an artist who explores mass production, such as the ongoing Shapes project. In the Shapes project, the artist used Adobe Illustrator vector files to combine various small shapes into larger ones, forming unique symbols representing in each individual in the estimated world population. The symbols are generated by the artist himself, not scripted computer programs.

Learn More
www.allanmccollum.net/allanmcnyc/, www.art21.org

Divide students into groups. Provide each group with an artwork image OR blank sheet of paper. Give each group a bag of small, geometric shapes and ask them to work together to try and identify different shapes and lines they see in the artwork, or create their own unique shape by combining the shapes and lines on a blank sheet of paper. When finished, compare and contrast the variety of shapes/lines students used.

Shapes

Lines
Imagine+Create

+ Explain to students that they will design their own unique shape-based artwork inspired by plane (two-dimensional) geometry. They will make design decisions to create an original plane shape on a two-dimensional surface (canvas/background).
+ Have students begin with pencil and paper to practice sketching designs. Students can use tools such as stencils, protractors, and rulers to help them create their designs. Challenge students to experiment with lines and shapes to “build” their unique designs. Ask students to consider: will their shape be symmetrical (the same on both sides) or asymmetrical?
+ After students have completed their initial drawings, show them materials they will use to create their artwork. Provide canvas or other background materials and have students lightly re-sketch their designs on the surface with pencils.
+ Using glue, students will coat their string and carefully place and arrange it on their background surface. Students will want to take their time to carefully place the string over the top of their pencil lines, and avoid re-arranging or moving the string to keep glue to a minimum.
+ Once the glue has dried completely, have students paint the surface of their artwork. Students can choose two different colors to fill in the positive (inside of shape) and negative (outside of shape) spaces. Challenge students to choose colors that provide contrast between the positive and negative spaces on their canvas.

Conclude+Reinforce

+ When the students’ final works of art are completed, have students share and discuss their shapes. Are any of their works of art identical? Why not? How are their works of art similar to the works they viewed by artists?
+ To complete the project, students can give their shapes unique names based on the lines, angles and shapes used. Ask students to share their titles, and explain or write why they chose them.

Adapt+Enrich

+ Students can trade their works of art and answer questions or solve calculations about each other’s shapes. They can examine symmetry, angles, area and perimeter.
+ Discuss the concept of parallel and perpendicular lines. Have students identify these characteristics in their works of art.
+ Incorporate technology in the creation of the design or finished work of art. Artist Allan McCollum uses vector-based designs to create artwork for The Shapes Project. Students can compose their designs by arranging shapes and lines using basic software such as Microsoft Paint or Word.
Extend the lesson to learn about the connections between geometry, art and nature. Have students create designs based on mathematical concepts found in nature such as the Golden Ratio.

**Assessment**
Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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<tbody>
<tr>
<td>Student demonstrates a clear understanding of the connection between art and math, and can provide examples.</td>
<td>Student demonstrates understanding of the connection between art and math.</td>
<td>Student demonstrates only some understanding of the connection between art and math.</td>
<td>Student does not demonstrate understanding of connection between art and math.</td>
</tr>
<tr>
<td>Student compares different types of shapes, and can provide examples that demonstrate clear understanding of the topic.</td>
<td>Student compares different types of shapes, and can provide examples that demonstrate understanding of the topic.</td>
<td>Student compares different types of shapes, but cannot provide examples to support the concept.</td>
<td>Student cannot distinguish differences between shapes.</td>
</tr>
<tr>
<td>Student creates an original design and revises as necessary. Student uses materials appropriately and completes a finished artwork that shows exemplary time and effort.</td>
<td>Student creates an original design and revises as necessary. Student uses materials appropriately and completes a finished artwork.</td>
<td>Student creates an original work of art, but does not complete all of the steps in the design process. The finished artwork shows little effort has been made to create design, or appears unfinished.</td>
<td>Student creates an original work of art, but does not complete all of the steps in the design process. The finished artwork does not include usage of all materials.</td>
</tr>
</tbody>
</table>

**Standards**
This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

+ **Grades 4-5, Humanities, Visual Art, Standard 3: Performance**
  4-5.VA.3.1.3 Apply the elements of color, shape, line, value, form, texture, and space in artwork.
  4-5.VA.3.3 Use the creative process (brainstorm, research, rough sketch, final product) to create a work of art.

+ **CCSS for Mathematics, grade 4**
  **Geometry:**
  Draw and identify lines and angles, and classify shapes by properties of their lines and angles.
CCSS for Mathematics, grade 5
Geometry:
Classify two-dimensional figures into categories based on their properties.

CCSS for Mathematics, grade 6
Geometry:
Solve real-world and mathematical problems involving area, surface area, and volume.

Resources+References
The Shapes Project, Allan McCollum

Plane Geometry, MathisFun.com
http://www.mathsisfun.com/geometry/plane-geometry.html

The Elements of Art, the Paul J. Getty Museum
http://www.getty.edu/education/teachers/building_lessons/formal_analysis.html
STEM+ VISUAL ART

A Curricular Resource for K-12 Idaho Teachers

Lesson Plans: 6-9
Lesson Plan

Photographic Earth

STEM Subject Focus: Science
Suggested Grade Levels: 6-9

Summary
Students will compare the work of artists who examine the environment, such as photographers Ansel Adams and Robert Adams, with scientific photographs and satellite images of Earth before creating a work of art that documents an environmental impact.

Objectives
+ Students will compare and contrast the ways in which the environment is depicted in art and science.
+ Students will brainstorm the various factors that affect the environment and how technology is tracking and documenting these effects.
+ Students will create their own work of art that combines digital images of landscapes with art media.
+ Students will utilize technology and art materials to transform digital images and depict changes based on forces of nature.

Key Concepts+Vocabulary
Environment, geology, photography, land formations, weathering, photo manipulation

Materials
+ Satellite or aerial images of Earth
+ Computer, access to the internet and basic editing software photo such as Adobe Photoshop, Microsoft PhotoDraw, or other product that allows photo manipulation (see the ‘Adapt+Enrich’ section below for alternative material suggestions)
+ “Earth as Art” projected on a screen or printed (a link to the PDF and iPad app is listed in the ‘Resources’ section of the lesson plan)
+ Drawing materials (pencil, colored pencils, markers, ink, paper)
+ Painting materials (paints, brushes)
**Brainstorm+Discuss**

- To begin, explain to students that they will be learning about how scientists and artists examine the environment. Show students images from “Earth as Art” and scientific photographs from nature, such as land formations, patterns created on landscapes from weather, erosion and other forces. Combine these photographs with photographs from nature by artists Ansel Adams and Robert Adams. These artists are known for their photographs of landscapes, which have helped viewers appreciate these places for their beauty and understand changes that are occurring as a result of nature and human impact.

![Image](image-url)

**Robert Adams** uses photography to document the American West. His black and white images illustrate the ways in which human life has affected the landscape. This photograph shows a forest that has been partially cleared for lumber.

**Learn More** www.art21.org

- Have students compare and contrast the photographs. What patterns, colors and textures do they see? How does each photographer depict the environment? How are the photographs by artists similar and/or different to those from NASA?
- Ask students to discuss as a class or debate in small groups or pairs: Do they consider the NASA photographs “art”? Why or why not? How can photographs be important for both science and artwork at the same time? Why might a scientist choose to document evidence with a photograph? Why might an artist choose to take a photograph of an environment? How has technology changed or shaped the way we look at Earth?

Consider: Ansel Adams used traditional cameras and photo processing (dark room) techniques, while “Earth as Art” shows satellite images.
Imagine+Create

+ Explain to students that they will design works of art that show the effects of a force on the environment using photographs with art media (materials). To begin, have them choose a single physical phenomenon that impacts/shapes or changes the Earth's physical landscape to research and document. Topics for research may include any of the following: mechanical weathering, chemical weathering, the water cycle, storm systems, volcanic activity, currents, formation of canyons, waterfalls, or mountains, erosion from a single source such as groundwater, wind, glaciers, or oceans and waves, pollution, human or animal impact.

+ Student research may be gathered from multiple sources, from textbooks, to photographs and online resources. The research process can be completed in class or as an assignment, depending on length of time available for this lesson.

+ After a topic has been selected and research has been gathered, students may plan their work of art. Encourage students to think about how they might visually share the impact of their environmental topic on the landscape. Students can find and print a satellite or aerial photograph of a place on Earth to use as a starting point.

+ Challenge students to use editing software or art media (drawing or painting materials) to alter their photograph. However, contrast student’s processes of manipulating visual imagery with the photographs by artists and from NASA, which were not altered with art materials.

Conclude+Reinforce

+ When the students’ final works of art are completed, have students discuss and reflect on the process of manipulating digital images. Some guiding questions might include: What changes were you trying to show viewers? Why did you feel this was important to show through visual form? How does your artwork illustrate what you learned about the topic that you researched? Why do they think photographs or artwork are important for sharing scientific research? Who might be affected by this kind of ‘visual evidence’, and why?

+ Display images and have students participate in a ‘Gallery Walk.’ Students can examine the works of art by their peers, and guess the topic shown in the altered photographs.

Adapt+Enrich

+ Adjust the materials for this lesson as needed. Instead of using altering digital images, students can use traditional art media such as markers, paint and colored pencils to alter printed photographs. Photographs printed on regular paper will work best with traditional art materials.
Have students document a natural phenomenon over time. Students can find an area where they live to photograph over a longer period of time, from a week to a month, or longer. Students can process the photographs taken over the time period and display them together as a photo collage or timeline.

Adapt the lesson to study other types of artwork such as Earth works and installations that explore environmental changes and natural processes. For examples of artwork and biographies for more artists, see the ‘Catalogue’ section of this curricular resource.

Use this lesson to examine other environmental or other geological topics specific to certain regions, the impact of humans and animals, or history of the Earth’s formation.

**Assessment**

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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<tbody>
<tr>
<td></td>
<td>Student can identify relationships between science and art in photographs, provide examples, and connect to other topics.</td>
<td>Student can identify relationships between science and art in photographs and provide examples.</td>
<td>Student can identify relationships between science and art in photographs. Examples are incorrect or incomplete.</td>
<td>Student cannot identify relationships between science and art in photographs, or cannot provide examples.</td>
</tr>
<tr>
<td></td>
<td>Student provides evidence of extensive research on a specific aspect of environmental change and communicates reasons for selecting this topic of interest.</td>
<td>Student provides evidence of research on a specific aspect of environmental change.</td>
<td>Student provides some evidence of research on an aspect of environmental change, but information is incomplete.</td>
<td>Student does not provide evidence of research on a specific aspect of environmental change.</td>
</tr>
<tr>
<td></td>
<td>Student creates an original work of art that shows a clear understanding of a specific aspect of environmental change. The student documents this element in a way that is visually appealing and demonstrates strong technique in use of art media.</td>
<td>Student creates an original work of art that shows understanding of a specific aspect of environmental change. The student demonstrates technique in use of art media.</td>
<td>Student creates an original work of art that shows limited or incomplete understanding of a specific aspect of environmental change. The student demonstrates some technique in use of art media.</td>
<td>Student creates an original work of art, but does not show understanding of environmental change or demonstrate technique in use of art media.</td>
</tr>
</tbody>
</table>
Standards
This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

+ Grades 6-8, Humanities, Visual Art, Standard 2: Critical Thinking
  6-8.VA.2.1.1 Identify and respond to characteristics and content of various art forms.
  6-8.VA.2.2.1 Investigate the various purposes art plays in society today.

+ Grades 6-8, Humanities, Visual Art, Standard 3: Performance
  6-8.VA.3.1.7 Locate and use appropriate resources in order to work independently, monitoring one’s own understanding and learning needs.
  6-8.VA.3.2.1 Illustrate how visual structures and functions of art improve communication of one's ideas.
  6-8.VA.3.2.2 Demonstrate the ability to utilize personal interest, current events, media or techniques as sources for expanding artwork.

+ Grade 6, Science, Standard 5: Personal and Social Perspectives; Technology
  Goal 5.3: Understand the Importance of Natural Resources and the Need to Manage and Conserve Them

+ CCSS Reading Standards for Informational Text, grades 6-12
  Integration of Knowledge and Ideas, Standard 7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

Resources+References
Earth Explorer, U.S. Geological Survey
http://earthexplorer.usgs.gov/

Earth as Art, NASA.gov
http://www.nasa.gov/connect/ebooks/earth_art_detail.html

Google Earth
http://www.google.com/earth/index.html

American Photography: A Century of Images, Teaching History.org
http://teachinghistory.org/history-content/website-reviews/22977

Idaho Geological Survey
http://www.idahogeology.org/

Robert Adams, art21
http://www.pbs.org/art21/artists/robert-adams
Lesson Plan

Sculptural Dimensions

STEM Subject Focus: Math
Suggested Grade Levels: 6-9

Summary
Students will learn about the relationship between mathematics and visual art as they create sculptural works of art from folded paper.

Objectives
+ Students will learn about three-dimensional mathematical forms.
+ Students will learn how the art of origami and paper-folding are related to mathematics.
+ Students will utilize the design process to create sculptural works of art that emphasize form and balance.

Key Concepts+Vocabulary
Folded paper, three-dimensional forms, balance, geometry, net, relief, sculpture

Materials
+ Drawing paper
+ Pencils
+ Scissors
+ Cardboard box lid or other surface for sculpture
+ Glue sticks
+ Rulers

Brainstorm+Discuss
+ To begin, explain to students that they will be learning about the relationship between art and mathematical forms. Share artist examples: Erik DeMaine and Martin DeMaine create art from folded paper.
+ Compare and contrast the folded paper forms with forms from geometry. Ask students: how do you think artists created these sculptures? Do you think they planned these forms, or they occurred through experimentation? Why?

+ Share the real-world results of paper folding. Scientists have applied the concepts and methods behind folding techniques to other areas—medical, electrical, optical, or nano-technical devices. Prompt students to brainstorm other examples where understanding paper folding might help. *(For example, what forms can students identify in the classroom through regular objects—cube-shaped desks, cylinder pencils, or sphere globes. How might understanding three-dimensional forms apply to other examples, such as building skyscrapers or bridges?)*

+ Divide students into groups. Show the class a regular cardboard box. Have students draw a smaller scale representation of what they think the box will look like when unfolded, as a two-dimensional shape. Then, have groups carefully take apart small cardboard boxes by unfolding the seams. *(They may use scissors if needed.)* Have students compare their drawings to what the unfolded box actually looks like. Try the activity with other three-dimensional forms.

+ Define the mathematical term related to the activity: in geometry, a “net” is a flattened out three-dimensional solid, such as the shape of the unfolded box. When the net of the unfolded box is folded and attached together, it becomes a cube.

**Imagine+Create**

+ Explain to students that they will create relief sculptures from folded paper forms. Students will need to plan and draft their forms, construct a design, and build their
artwork with paint and folded paper. Origami, an art form rooted in Japanese tradition, involves paper folding without scissors or glue. However, students will eventually glue their folded paper forms to other surfaces to create sculptures.

Challenge students to plan interesting forms for their sculptures. Explain to students that for this project, their challenge is to explore form and balance. As they plan their forms, they will need to consider how many vertices, faces, and edges their forms have. For example:

<table>
<thead>
<tr>
<th>FOLDED PAPER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Triangular Prism</strong></td>
</tr>
<tr>
<td>Number of faces: 5</td>
</tr>
<tr>
<td>Number of edges: 9</td>
</tr>
<tr>
<td>Number of vertices: 6</td>
</tr>
</tbody>
</table>

+ Provide students with materials. Students will begin by drawing and cutting out paper shapes. They can paint their paper on both sides using one shade of paint.
+ Have students paint their base the same color. When all of the forms are dry, students can fold, arrange and glue their forms on the base. Encourage students to think like designers – how will they balance large and small forms on the surface to create balanced compositions?

**Conclude+Reinforce**

+ When the students’ final works of art are completed, have students discuss and reflect on the process of creating works of art based on mathematical forms. What were their challenges?

**Adapt+Enrich**

+ Adjust the materials for the lesson to use different art media, such as having students create graphs on canvas and paint their designs.
+ Have students explore artwork with other concepts from geometry. Students can create drawings or other two-dimensional works of art that show examples of scale, congruence, similarity, rotation, reflection, and translation of shapes.

**Assessment**

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.
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<tbody>
<tr>
<td><strong>Student demonstrates understanding of two-dimensional shape and three-dimensional forms and can provide examples of the relationships between each.</strong></td>
<td><strong>Student demonstrates understanding of two-dimensional shape and three-dimensional forms.</strong></td>
<td><strong>Student demonstrates some understanding of two-dimensional shape and three-dimensional forms.</strong></td>
<td><strong>Student does not demonstrate understanding of two-dimensional shape and three-dimensional forms.</strong></td>
</tr>
<tr>
<td><strong>Student creates a sculpture with a variety of forms. Student uses materials appropriately and completes a finished artwork that shows exemplary time and effort.</strong></td>
<td><strong>Student creates a sculpture with several forms. Student uses materials appropriately and completes a finished artwork.</strong></td>
<td><strong>Student creates a sculpture with forms. Student uses materials appropriately, but artwork is incomplete.</strong></td>
<td><strong>Student creates a sculpture, but forms are incomplete or do not vary. Student does not use materials appropriately and/or complete a finished artwork.</strong></td>
</tr>
</tbody>
</table>

### Standards
This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

- **Grades 4-5, Humanities, Visual Art, Standard 2: Critical Thinking**
  - 4-5.VA.2.2.6 Write an artist’s statement (what the work depicts and why and how the work was created).

- **Grades 4-5, Humanities, Visual Art, Standard 3: Performance**
  - 4-5.VA.3.2.1 Demonstrate how different media, techniques, and processes are used to communicate ideas.
  - 4-5.VA.3.3.3 Use the creative process (brainstorm, research, rough sketch, final product) to create a work of art.

- **CCSS for Mathematics, Grade 6**
  - Geometry: Represent three-dimensional figures using nets made up of rectangles and triangles, and use the nets to find the surface area of these figures. Apply these techniques in the context of solving real-world and mathematical problems.

- **CCSS for Mathematics, Grade 7**
  - Geometry: Draw, construct, and describe geometrical figures and describe the relationships between them.
Resources+References


STEM + VISUAL ART
A Curricular Resource for K-12 Idaho Teachers

+ Lesson Plans: 9-12
Lesson Plan

A Picture is Worth a Thousand Words

STEM Subject Focus: Science/Math
Suggested Grade Levels: 9-12

Summary
Students will learn about the ways in which science, math and art design intersect as they create eye-catching visual representations of scientific data.

Objectives
+ Students will learn how artists and information designers create visual representations of data in various ways.
+ Students will be able to use technology to research and present visual information.
+ Students will utilize the design process and “think like designers” to create works of art using digital tools or media.

Key Concepts+Vocabulary
Design, technology, infographics, data, graphic art

Materials
+ Computer, access to the internet and basic editing software photo such as Adobe Photoshop, Microsoft PhotoDraw, or other software
+ Drawing paper
+ Colored Pencils

Brainstorm+Discuss
+ Ask students to consider what the job title “information designer” might represent. What job responsibilities would go along with this title? Use student responses to introduce the
lesson. Explain that students will be learning about ways in which artists and designers depict information in different ways.

+ Show an example of information presented in graphic form. Explain to students:

Information presented in visual form is known as an “infographic” (info=information, graphic =picture). Ask students: where are some places you have seen infographics? (Examples might include maps, textbooks, the internet, television, newspapers, or other sources.) Have you ever created something visual to represent a number or set of data? If so, what did you make and what did it represent? (See examples below.)

![Image of infographics]

+ Share an artist example: Sally Finch creates paintings to visualize data and number sets. The artist creates colorful, abstract images that show patterns from scientific data, such as weather patterns.

Sally Finch represents numerical data through colorful, abstract paintings and drawings. Her artwork presents visualized information, such as weather patterns, rainfall, demographic data, and random numerical sets.

Learn More www.sallyfinch.com
How are visual grids or graphs similar to works of art? What are some benefits of sharing data (information) in visual form? (Students may share how viewers see the impact of data better when it is visualized, the visual information “looks better”, has more meaning in visual form, or other responses)

Prompt students to consider the meaning behind the saying, “A picture is worth a thousand words.” How does this quote relate to infographics? How does this quote relate to works of art?

Imagine+Create

Explain to students that they will create infographic works of art using data from scientific research. Students can gather information on selected topics of research related to a unit or topic from biology, chemistry, earth science or physics. Students will need to collect data from another source (internet research, almanac, journal article) or create their own surveys to gather information/data on their own for this project. The scope of information gathering may depend on time allotted for this lesson.

Challenge students to consider how they will represent their data in a work of art that is purely visual – with little to no informational text. Students will need to think about the design, or look, of their data.

Students can create drafts of their visual representations using paper/pencils.

Students can use computer software such as Adobe Illustrator, Photoshop, MS Paint, Word or other basic software to design their digital artwork. If access to computers or digital tools is not available, have students create mixed-media artwork by combining photographs with hand-drawn illustrations to create works of art.

Conclude+Reinforce

When the students’ final works of art are completed, have students discuss and reflect on the process of creating works of art. Students can present their works of art to their peers, or participate in a Gallery Walk for students to examine each other’s works of art.

Adapt+Enrich

Have students create designs for unique inventions or products. Students can draft their designs with software, or by hand using traditional art materials. Have students create three-dimensional sculptures that model their inventions/products.

Assessment

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill
and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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<tr>
<td>Student can identify relationships between infographics and art, and provide examples.</td>
<td>Student can identify relationships between infographics and art.</td>
<td>Student can identify some relationships between infographics and art.</td>
<td>Student cannot identify relationships between infographics and art.</td>
</tr>
<tr>
<td>Student creates an original design and revises as necessary. Student creates a visual representation of scientific data or facts with minimal informational text.</td>
<td>Student creates an original design and revises as necessary. Student creates a visual representation of scientific data or facts with some informational text.</td>
<td>Student creates an original design and revises as necessary. Student creates a visual representation of scientific data or facts with informational text.</td>
<td>Student creates an original design and revises as necessary. Student does not create a visual representation of scientific data or facts.</td>
</tr>
</tbody>
</table>

**Standards**

This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

+ Grades 4-5, Humanities, Visual Art, Standard 2: Critical Thinking
  4-5.VA.2.2.6 Write an artist’s statement (what the work depicts and why and how the work was created).

+ Grades 4-5, Humanities, Visual Art, Standard 3: Performance
  4-5.VA.3.2.1 Demonstrate how different media, techniques, and processes are used to communicate ideas.
  4-5.VA.3.3.3 Use the creative process (brainstorm, research, rough sketch, final product) to create a work of art.

+ CCSS Reading Standards for Informational Text, grades 6-12
  Integration of Knowledge and Ideas, Standard 7: Integrate information presented in different media or formats (e.g., visually, quantitatively) as well as in words to develop a coherent understanding of a topic or issue.

**Resources+References**

**Figure 1**
McCandless, D., Quick, M., & Guo, D. (2013). Which Fish are Okay to Eat? [Online image]. Retrieved from
http://www.informationisbeautiful.net/visualizations/which-fish-are-okay-to-eat/

**Figure 2**
http://www.informationisbeautiful.net/visualizations/taste-buds/
Figure 3


50 Most Stunning Examples of Data Visualization and Infographics, Richworks.in http://richworks.in/2010/04/50-most-stunning-examples-of-data-visualization-and-infographics/

Information is Beautiful, informationisbeautiful.net http://www.informationisbeautiful.net/
Lesson Plan

Visual Equations

STEM Subject Focus: Math
Suggested Grade Levels: 9-12

Summary
Students will learn about the relationship between mathematics and visual art as they create unique, colorful designs that express linear equations.

Objectives
- Students will compare the ways artists depict mathematical concepts in their artwork.
- Students will be able to write linear equations and graph them.
- Students will utilize the design process to create works of art that depict linear relationships based on written equations.

Key Concepts+Vocabulary
Graphs, linear equations, patterns

Materials
- Drawing paper
- Colored Pencils
- Pencils
- Graph paper
- Transparencies
- Permanent markers in a variety of colors
- Rulers

Brainstorm+Discuss
- To begin, explain to students that they will be learning about the relationship between art and math.
- Show students examples of artists who work with math concepts, such as Frank Stella and Carolyn Yackel.
Frank Stella created abstract prints, paintings, sculptures and architectural projects. In many of these works of art, Stella explored concepts from geometry, pattern, color and repetition.

Learn More www.theartstory.org/artist-stella-frank

Carolyn Yackel is a mathematics professor with an interest in expressing mathematical concepts through designs on knitted and other textile artwork.

Learn More faculty.mercer.edu/yackel_ca/

Divide students into groups. Give each group an image of a work of art from one of the suggested artists above, and have them work together to guess and discuss what mathematical concepts the artists may have used based on what they see.

Imagine+Create

+ Explain to students that they will create works of art using linear equations as a basis for their designs. Students should understand how to write and graph linear equations.
Show students how to construct a design with **patterns** and lines created by graphed equations. For example, students can begin with a simple equation such as $y = x + 2$ and transform it to create an overall design. Students may need to create a first draft that allows them to practice graphing equations, and use this to create their final design.

Have students use technology to help plan their designs. Students can use web-based resources to plot and graph equations for their designs. Challenge students to plan interesting symbols, shapes and patterns in the designs.

Provide students with graph paper or graph worksheet to help them plot and graph their equation-based designs. Have students place transparencies over the top of their graphs. Demonstrate the use of colored pens/markers to create lines of varying width for added visual interest. Using markers, students can trace the lines, draw shapes and patterns to fill space, and embellish their designs.

**Conclude+Reinforce**

When the students’ final works of art are completed, have students discuss and reflect on the process of creating works of art based on equations. What were their challenges? How did their designs evolve, or change, as they graphed their equations?

**Adapt+Enrich**

Adjust the materials for the lesson to use different art media, such as having students create graphs on canvas and paint their designs.

Challenge students to represent specific objects or images in their graphed designs. Which equations will they use and how will they transform them?

**Assessment**

Teachers may consider using or adapting this rubric to evaluate students’ artwork and understanding of key concepts. In this assessment, the “4” category denotes the highest level of understanding and demonstration of key concepts and the “1” denotes the lowest level of skill and understanding. Students should provide evidence of understanding the lesson’s key concepts through discussion, artwork and written work.

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</tbody>
</table>
Student compares the concept of linear equations with purposeful visual design.

Student compares the concept of linear equations with visual design.

Student compares the concept of linear equations with visual design in a limited capacity.

Student does not understand the relationship between the concepts of linear equations and visual design.

Student creates an original design that reflects the transformation of an equation. Student uses materials appropriately and completes a finished artwork that shows exemplary time and effort.

Student creates an original design that reflects the transformation of an equation. Student uses materials appropriately and completes a finished artwork.

Student creates an original design that reflects the transformation of an equation. Student uses materials appropriately, but artwork appears incomplete.

Student does not create a design that reflects the transformation of an equation. Student does not use materials appropriately and/or complete a finished artwork.

**Standards**

This lesson plan was designed to meet the following Idaho State Content Standards and Common Core Standards:

+ Grades 4-5, Humanities, Visual Art, Standard 2: Critical Thinking
  4-5.VA.2.2.6 Write an artist’s statement (what the work depicts and why and how the work was created).

+ Grades 4-5, Humanities, Visual Art, Standard 3: Performance
  4-5.VA.3.2.1 Demonstrate how different media, techniques, and processes are used to communicate ideas.
  4-5.VA.3.3.3 Use the creative process (brainstorm, research, rough sketch, final product) to create a work of art.

+ CCSS for Mathematics, High School
  Algebra: Create equations that describe numbers or relationships

+ CCSS for Mathematics, High School
  Algebra: Represent and solve equations and inequalities graphically

**Resources+References**

Graphs Use Art and Math Lesson Plan
http://www.dickblick.com/lessonplans/graphsandmath/
Sample Images

The following images represent samples of works of art produced in conjunction with the development of this curricular resource. These are provided as inspiration for possible student works of art that can be produced through these lessons. However, they are not the sole examples of what students may create. Teachers are encouraged to use these images to help students explore new ideas and art-making methods, and make works of art that go above and beyond these samples.

Lesson Plans: K-3

+ Patterned Prints

*Diagonals (plate)*
adhesive-backed foam, cardboard, ink

+ Nature Portraits

*Boise Foothills in the Spring*
watercolor

Lesson Plans: 4-6

+ Artist Habitats

*Treehouse Habitat*
Cardboard, chenille stems, wooden sticks, felt, construction paper

+ Shaped by Design

*Abstract Polygon*
acrylic paint, string, canvas
Lesson Plans: 6-9

+ Photographic Earth

Glacier Melting
photograph and digital media

+ Sculptural Dimensions

Sculptural Forms
paint, cardboard, and paper

Lesson Plans: 9-12

+ A Picture is Worth a Thousand Words

Measuring the Diameter of a Tree Trunk Cross-Section
digital media

+ Visual Equations

X & Y Coordinate Triangles
ink on paper
Resources

Teachers are encouraged to seek other resources for further exploration of art concepts, opportunities for hands-on learning and other areas for art enrichment. The ‘Websites’ sections provide a wealth of information to extend learning through exploration of visual art and STEM subjects with community resources and further research. ‘Technology’ contains teacher-recommended and low- to –no cost tools to utilize with students. ‘Books’ were carefully selected to represent various methods for exploring art and creativity. *(As with any educational resource, it is strongly recommended that teachers preview all exhibitions and media before sharing them with students.)*

Websites: Idaho

- Boise City Department of Art & History, www.boiseartsandhistory.org
- Boise Watershed, bee.cityofboise.org/watershed
- Idaho Art Education Association, www.idahoarted.org

Websites: National

- Edutopia, www.edutopia.org
- National Art Education Association, www.arteducators.org
- Artcyclopedia, www.artcyclopedia.com

Technology

- Artsonia, www.artsonia.com
- Prezi, www.prezi.com
- Edmodo, www.edmodo.com

Books

References


