Explore the Connections: Art, Computer Science, and Math

KANSAS
STATE DEPARTMENT OF
EDUCATION
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Kansas leads the world in the success of each student.

Presentation Recordings

- Thursday, August 6: Secondary Grades
  - https://ksde.zoom.us/rec/share/45FfLLbU8ltLAZX86mPuXZ9-Ipb-T6a8gXMY__ZbmUg6BN5Q4w7rk3bWgiyIC6K2 Password: m4sd%?Wy
- Tuesday, August 4: Secondary Grades
  - https://ksde.zoom.us/rec/share/38FEBvarzW1Le5WU-RHVZYgGA5TUaaa823RMqKUOmkauhUP5Dl3Ns5P0zAWD_UOc Password: 2sbH2Lc=
- Monday, August 3: Middle Grades
  - https://ksde.zoom.us/rec/share/25MyL-rI_HlJZ8_t1HvwWIcPNK7qT6a80SYW_aEOy00g1WpMfVNnujqaUWQm_Y_x Password: c#F0ck?B

PATTERNS, GEOMETRY, AND TESELLATIONS

And a little bit of computer programming…

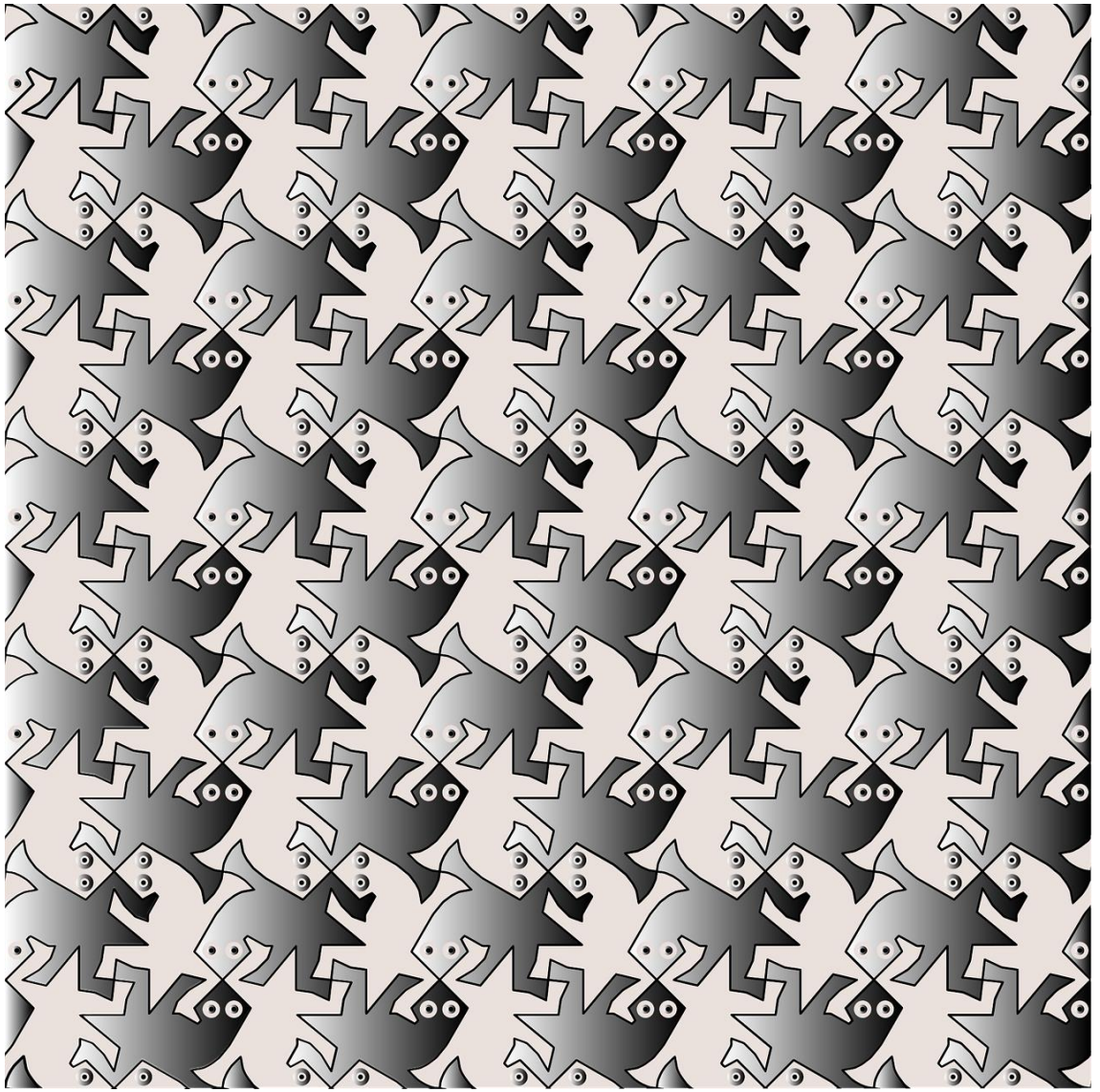
KANSAS STATE DEPARTMENT OF EDUCATION

Introductions

Joyce Huser is the Fine Arts Education Program Consultant for the Kansas State Department of Education. She is one of the writers for the National Core Arts Standards. She is a National Board Certified teacher with many years of experience teaching K-12 Art Education with an emphasis on Arts Integration.

Stephen King is the Computer Science Education Consultant for the Kansas Department of Education. With a doctorate in education and a masters in telecommunications management, he has over twenty years of experience leading and teaching IT and computer science to high school and college students.

Marcia Fiorentino has enjoyed teaching mathematics for 14 years as well as serving as an administrator for 16 years. Real world and cross-curricular instructional planning have been key in her experiences to learner engagement for all levels and content areas. Marcia is the Mathematics Education Consultant for the Kansas State Department of Education.

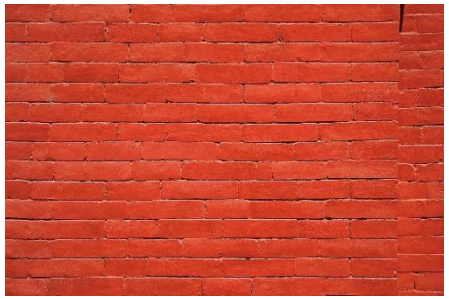


What Will Our Takeaways Be Today?

Visual Arts	Computer Science	Mathematics
Provide resources and strategies for modeling a growth mindset.	Understand how basic control loops work.	Recognize the importance of the study of patterns for real world application
Promote STEAM practices for enhancing well-rounded individuals in preparation for the workforce.	Design and implement an algorithm to solve a problem. Troubleshoot that algorithm.	Understand the three types of tessellations and their linkage standards/competencies
Promote learning dispositions, mindfulness, playfulness.	Learn the basics of a block coding language (Scratch).	Determine categories for motivating students to find patterns in the world around them.

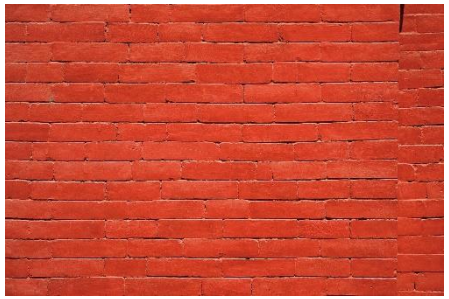
What is Our Why?

Define “pattern” in your own words.



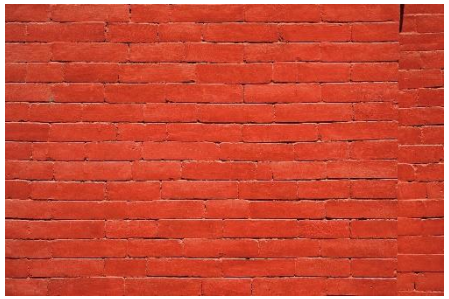
Definition of Pattern:

https://www.merriam-webster.com/dictionary/patterns



- 1: a form or model proposed for imitation : EXEMPLAR
- 2: something designed or used as a model for making things: a dressmaker's *pattern*
- 3: an artistic, musical, literary, or mechanical design or form: the geometrical *pattern* of the carpet the strict *pattern* of rhythm and rhyme for a sonnet— Gigi Marino
- 4: a natural or chance configuration: frost *patterns,* the *pattern* of events
- 5*dated* : a length of fabric sufficient for an article (as of clothing)
- 6a: the distribution of shrapnel, bombs on a target, or shot from a shotgun
- b: the grouping made on a target by bullets
- 7: a reliable sample of traits, acts, tendencies, or other observable characteristics of a person, group, or institutional behavior *patterns*, the prevailing *pattern* of speech
- 8a: the flight path prescribed for an airplane that is coming in for a landing
- b: a prescribed route to be followed by a pass receiver in football
- 9: TEST PATTERN
- 10: a discernible coherent system based on the intended interrelationship of component parts: foreign policy *patterns*
- 11: frequent or widespread incidence: a *pattern* of dissenta *pattern* of violence

What is Our Why?



Why do we teach patterns in math?

https://www.nctm.org/Research-and-Advocacy/Research-Brief-and-Clips/Algebraic-Thinking-in-Arithmetic/

https://www.nctm.org/Research-and-Advocacy/Research-Brief-and-Clips/Using-Data/

What is Our Why?

How do we, as educators, use patterns outside of the classroom?

Patterns in the Real World

We will watch just a brief part of this pattern Tedtalk:
https://www.ted.com/talks/david_mccandless_the_beauty_of_data_visualization

Resources for teachers to use with students:

https://blog.ted.com/8-ted-talks-about-patterns/

Connections to Language:

Tessellations

- Brief Tessellation Demo
  https://www.youtube.com/watch?v=7GiKeeWSf4s

- Famous Tessellation

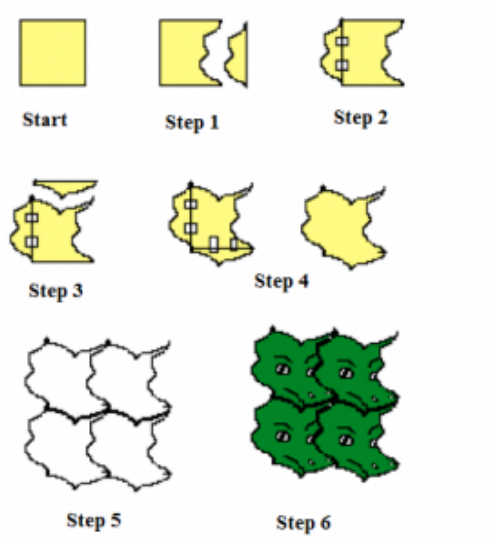
https://www.youtube.com/watch?v=Kcc56fRtrKU

Creating Yo

- http://mathengaged.org/resources/activities/art-projects/tessellations/

2-Step Cutting Tessellation

These tessellations are nearly identical to the ones just explained, but have an extra step that allow for even more creative designs!



STEPS:

1. Take a small square piece of paper (about 4"x4") and cut a weird shape out of one side of the square, just as before.

2. Tape your cut-out shape to the opposite side of the square, maintaining its orientation and lining up the long flat edges.

3. Pick one of the two remaining untouched sides of the square and cut another odd shape out of that side.

4. Repeat Step 2: Tape your new odd shape to the opposite side, maintaining orientation and lining up the long edges. You should now have a unique shape that no longer has any flat long sides.

5. Trace your tessellation shape onto a piece of paper over and over again, fitting the shapes together.

6. Use crayons, markers, glitter, or any extras you wish to make your tessellation art extra incredible!

Mathematical Practices, Standards and Competencies

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Mathematical Practices, Standards and Competencies

Standards

Similarity, Right Triangles, and Trigonometry (G.SRT.1-9)

- Understand similarity in terms of similarity transformations.
- Construct arguments about theorems involving similarity.

Geometric Measurement and Dimensions (G.GMD.1,2)

- Explain volume formulas and use them to solve problems.

Modeling with Geometry (G.MG)1,2,3(★)

- Apply geometric concepts in modeling situations.

Mathematical Practices, Standards and Competencies

Competencies (HS)

Apply geometric shapes, measurements and properties by validating/communicating/ proving arguments and modeling to describe objects and then apply to solve and design problems. MATH.HS 4.1

Use algebraic concepts by explaining arguments and creating proofs to validate geometric concepts and apply in a real-world context. MATH.HS 4.2

Demonstrate understanding of similarity and trigonometric ratios by constructing and explaining to validate geometric concepts and apply in a real-world context. MATH.HS 4.3

Math and Art - Inspire the *Imagination*

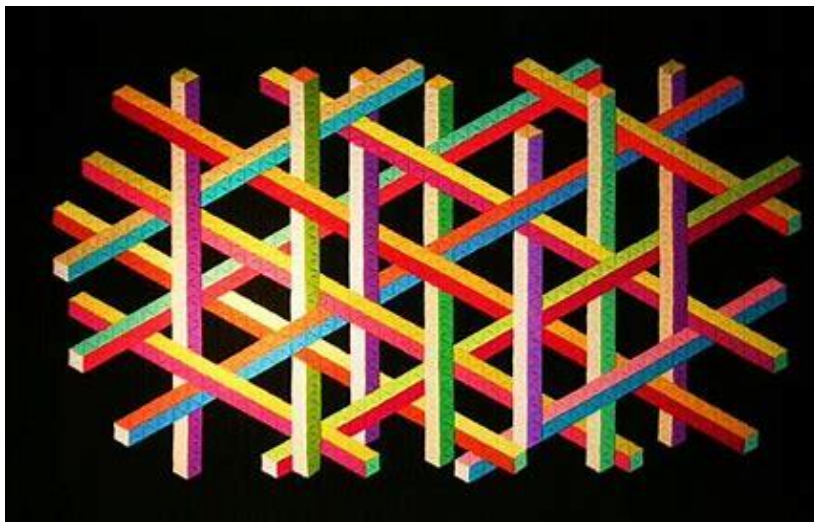
Math and Art have core skills that are identical!

- Spatial reasoning
- Recognizing Patterns and Shapes
- Geometry, Proportion, Symmetry
- Measurements

When we help kids see the overlap between art and math, we not only strengthen their skills in each, we expand their vision of what it means to be an artist and a mathematician. Math can be creative! Art can be analytical! Both can inspire our imagination.

Maths and Art

Mathematics and art intersect in our world in beautiful ways. Many mathematicians draw upon art and many artists draw upon mathematics. When mathematics and art come together, students are often inspired and they can start to see mathematics as a beautiful and creative subject. Poetry is also very mathematical and filled with rich patterns. This page shares some tasks that show mathematics through art.



Successful Multi-Disciplinary Collaborative Lessons Support Opportunities for:

- Increased student engagement
- Transfer of skills and knowledge
- Differentiation
- Peer interactions and mentoring
- Extension activities
- Flipped classroom
- Project-Based Learning
- Higher teacher to student ratio

Art Terminology

- **Tessellation**: A Pattern made using congruent shapes
- **Congruent Shapes**: Shapes that have exactly the same size and shape
- **Rotation**: A transformation of a tessellation in which a figure is turned
- **Reflection**: A transformation of a tessellation in which a figure is flipped
- **Translation**: A transformation of a tessellation that involves a slide or glide of a figure
- **Line of Symmetry:** Axis or imaginary line that passes through the center of the shape and divides it into identical halves.
- **Kaleidoscope**: An optical instrument with two or more reflecting surfaces tilted to each other at an angle' Objects are seen as a regular symmetrical pattern showing multiple reflections

Math Terminology

- **Area**: The space occupied by a flat shape or the surface of an object.
- **Perimeter**: The continuous line forming the boundary of a closed geometric figure
- **Triangle Area**: A triangle is half as big as the rectangle that surrounds it, which is why the area of a triangle is one-half base times height.
- **Trapezoid Area**: Multiply one half by the sum of the lengths of its bases (the parallel sides) by its height (the perpendicular distance between the bases).
- **Hexagon**: A plane figure with six straight sides and angles.
- **Polygon**: A plane figure with at least three straight sides and angles, and typically five or more.
- **Rectilinear Figure:** A polygon where all angles are right angles.
- **Parallelogram**: A four-sided plane rectilinear figure with opposite sides parallel
- **Kite:** A quadrilateral figure having two pairs of equal adjacent sides, symmetrical only about its diagonals.

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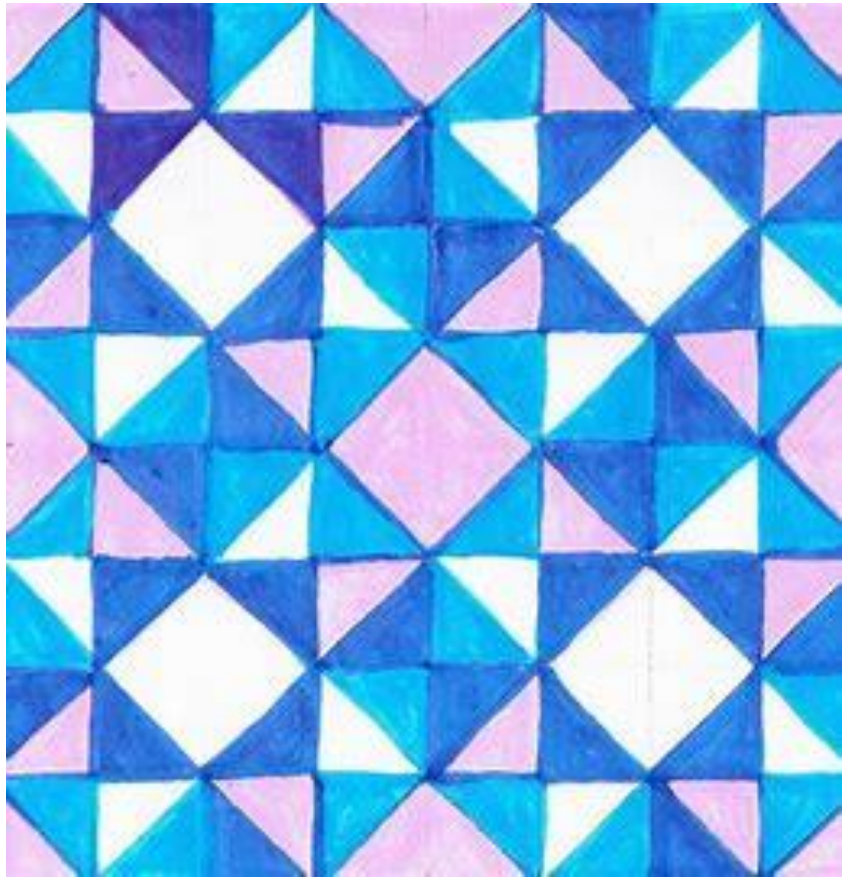

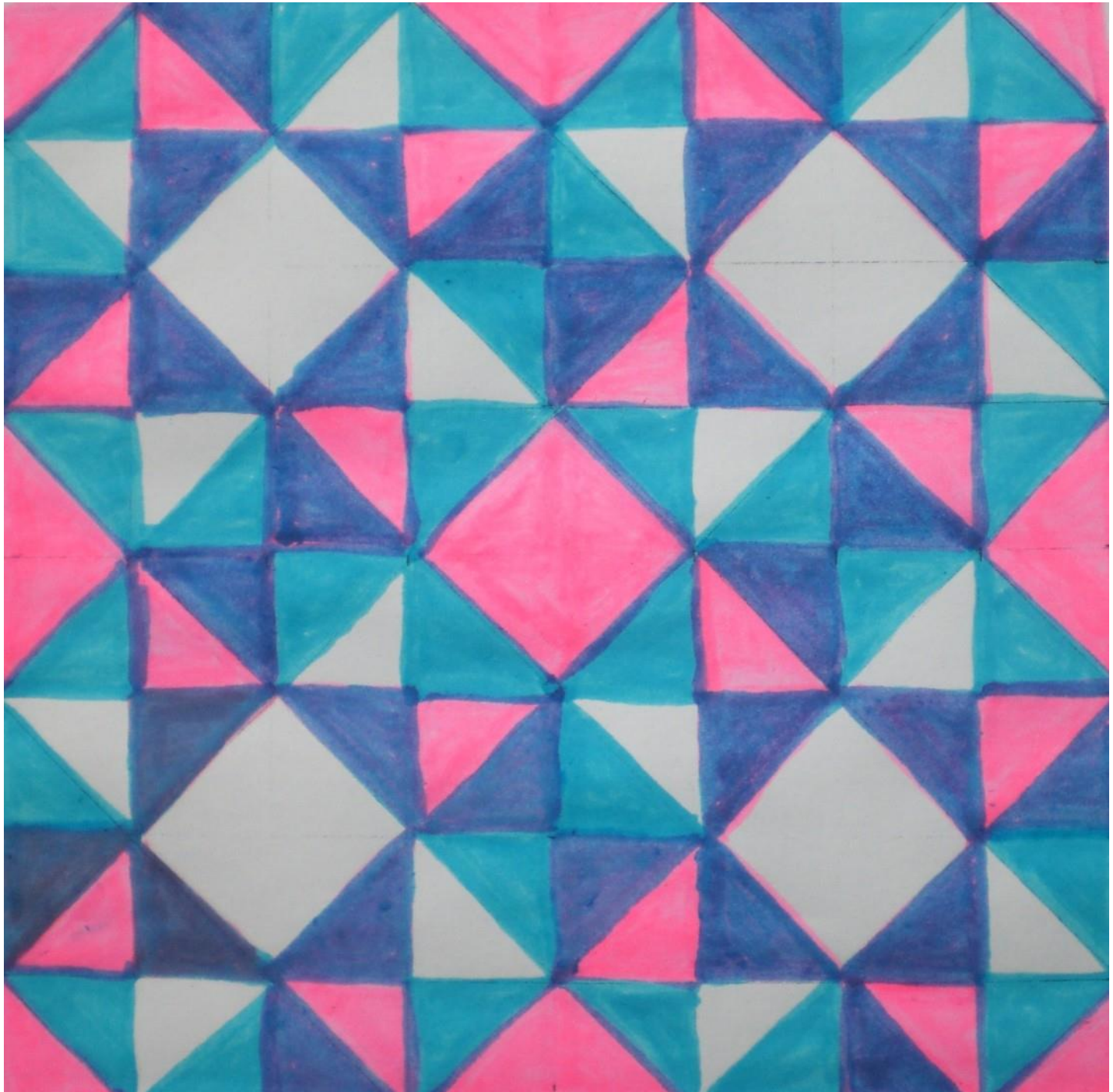

The Art and Math Standards focus on preparing students for their future beyond high school. They teach the following creative practices:

- Problem finding
- Critical thinking
- Innovative thinking
- Imagination
- Investigation
- Construction
- Reflection
- Collaboration
- Communication

WHAT DOES IT MEAN TO BE ARTISTICALLY LITERATE?

Two tenets exist within **Artistic Literacy** —creating and responding. Combined, these cultivate wisdom, innovative thinking, and intrinsic values.

Vital to lifelong learning in an increasingly technological, commercial, global society.

“Artistic Literacy (is) the ability to encode and decode (“read” and “write”) aesthetic wisdom that is expressed and received in symbolic and metaphoric forms.”1

“Artistic Literacy affords the opportunity to develop personal value systems within our 21st Century world through the discernment of historical and cultural information to foster growth in making informed decisions in order to live and work well with others.”2

1 “Wisdom Lost: Artistic Literacy as a 21st-Century Skill” by Charles E. Combs (2009)

2 *The Arts and the Creation of Mind* by Elliot Eisner (2002)

Artistic Processes

Creating - Conceiving and developing new artistic ideas and work.

Presenting - Interpreting and sharing artistic work.

Responding - Understanding and evaluating how the arts convey meaning.

Connecting – Relating artistic ideas and work with personal meaning and external context.

Process Components

Creating	Presenting	Responding	Connecting
Investigate/Plan/Make	Select	Perceive	Synthesize
Investigate	Analyze	Analyze	Relate
Reflect/Refine/Continue	Share	Interpret	

Essential Questions

Complex questions – no easy answers

Aim to stimulate thought, provoke inquiry, and spark more questions

To help students become Artistically literate

Enduring Understandings

Statements summarizing important ideas and core processes that are central to a discipline and have lasting value beyond the classroom

They synthesize what students should come to understand as a result of studying a particular content area.

“These are the ideas that need to endure when details and certain minimal skills fade away (Stewart, 2014, p. 6).”

Performance Standards

Creating

A:Cr1.1.3

Elaborate on an imaginative idea.

VA: Cr1.2.3

Apply knowledge of available resources, tools, and technologies to investigate personal ideas through the art-making process.

VA:Cr3.1.3

Elaborate visual information by adding details in an artwork to enhance emerging learning.

Closing thought:

There are lots of ways to get these opportunities—for example building with blocks, decorating doll houses, putting toy cars in garages, and doing puzzles are all examples of playful ways to practice organizing space.

Resources

At home

https://littlefingersbigart.com/2013/07/26/big-ideas-stained-glass-window-tessellations/

High School Trigonometric

https://robertlovespi.net/2015/01/03/trignonometric-stained-glass-windows/

A Brilliant Tutorial for Kids to Understand Tessellations

https://craftcue.com/tessellations-for-kids

Stained Glass Craft for Kids

https://www.123homeschool4me.com/stained-glass-craft-for-kids/

MC Escher

Piet Mondrian

Computer Science and Tessellations

- Where does CS fit in?
  - MG.AP.A.01 Design algorithms in natural language, flow and control diagrams, comments within code, and/or pseudocode to solve complex problems.
  - MG.AP.C.01 Develop programs that utilize combinations of nested repetition, compound conditionals, procedures without parameters, and the manipulation of variables representing different data types.
  - L1.AP.A.01 Create prototypes that use algorithms to solve computational problems by leveraging prior student knowledge and personal interests.
  - L1.AP.C.01 Justify the selection of specific control structures when tradeoffs involve implementation, readability, and program performance, and explain the benefits and drawbacks of choices made

Fine, but what's an algorithm?

From Merriam-Webster:

- : a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation
- *broadly* : a step-by-step procedure for solving a problem or accomplishing some end
- Critical component of Computational Thinking
- Related to the PB&J sandwich instruction exercise
- In computer science, think "lazy."

But I can’t code!

- Sure, you can. We’ll walk through a simple exercise, and there are a ton of resources you and your students can use.
- Three “types” of code:
  - Text-based (Python, Java, Javascript, etc.)
  - Block-based (Scratch, Kodable, Code.org, etc.)
  - Pseudocode
- Let’s start with pseudocode.

Why would I pseudocode if I can't code?

- Everybody can code, but we should start with pseudocode in all cases.
- It's a way of writing out what the code needs to do without focusing on syntax.
- Simple tessellation pseudocode:
  - Place object in one corner of palette
  - Duplicate object and move/flip/translate duplicate
  - Place new object
  - Repeat two steps above till palette is full
- What sorts of controls might you put on this?

Scratch programming resources

- https://scratch.mit.edu/
- https://www.youtube.com/watch?v=Jd58feIf8Zo – 10 minute video demo, 1/5 (series on building Breakout Game in Scratch)
- https://www.youtube.com/watch?v=K0T7zuxEIgw – 21 minute "Complete overview for beginners"
- https://www.youtube.com/watch?v=GQo7s7XUfFg – 17 minute "Scratch Absolute Beginner Game"
- https://www.youtube.com/watch?v=QXru0rSV2ZQ – 11 minute "How To Make A Shooter Game" (lots of fun!)

Kansans Can Do Patterns Challenge:

- What are some categories we can challenge students with including their own tessellation creations and finding patterns in Kansas? (We can list as many as we need and will narrow down to 5 to be rolled out after Labor day!)

Let's DO THIS!

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