Engineering Confidence, Focus, and Geometry Through Paper Folding

Katherine Breitbart
Edward Heston Elementary School

Abstract

Today's student in Philadelphia lacks basic skills in focus, attention, and perseverance. This is to say nothing of the average math scores in the School District of Philadelphia. This unit uses origami as an attention-getting and a skill builder to teach both geometry and social-emotional skills like perseverance, focus, and attention. Origami also addresses basic development skills by teaching folding and forcing use of fine motor skills. Students are encouraged to spend all the time they need to create their folds and figures.

This unit uses a fold-along book, a pop-up book, and general materials required for the teaching of K-2 geometry. Students work as a whole class, in small groups, and individually. Students read, write, listen, fold, and use technology to engage all of their senses in learning. Students are given the opportunity to become experts, to feel confident enough to teach their peers, and to be recognized by their peers and teacher as having mastered both the origami and the geometry.

Overview

Today's student in Philadelphia lacks basic skills in focus, attention, and perseverance. This is to say nothing of the average math scores in the School District of Philadelphia. This unit uses origami as an attention-getting and a skill builder to teach both geometry and social-emotional skills like perseverance, focus, and attention. Origami also addresses basic development skills by teaching folding and forcing use of fine motor skills. Students are encouraged to spend all the time they need to create their folds and figures.

This unit uses a fold-along book, a pop up/fold out book, and general materials required for the teaching of K-2 geometry. Students work as a whole class, in small groups, and individually. Students read, write, listen, fold, and use technology to engage all of their senses in learning. Students are given the opportunity to become experts, to feel confident enough to teach their peers, and to be recognized by their peers and teacher as having mastered both the origami and the geometry.

Beyond the written mathematics unit, there are endless applications to other curricular areas in social studies of the origins of origami, science of paper, as well as applying origami to other areas of mathematics and writing.

Rationale

My West Philadelphia students are noticeably lacking in attention, focus, and perseverance. Students are quick to exclaim "I'm done!" before any real effort has been put in to a project. Introducing origami into the art curriculum seeks to solve this problem by bringing students work that requires step-by-step action, projects that require attention

to detail, allow for some level of collaboration and peer mentoring, and invite students to follow directions all the way through to create a finished project.

Origami has been noted to bring a number of both physical and emotional benefits to children of all ages. Paper folding increases hand-eye coordination, promotes the development of fine motor skills, and allows students to develop their focus and attention skills. Origami also helps children to develop patience, self-esteem, and social skills working with other students (Raimundo, 166). Additionally, the art of origami can tie into to multiple curricular areas throughout the school day, such as physical science, social science, math, and literature (Krisztian, 240). So origami is, quite literally, crossing curricula to make connections throughout academic subjects and social-emotional areas of development.

Once students learn the basics, origami lessons can be tailored to students individual and group interests. Once a student can understand an origami diagram, the possibilities are endless. For students who require some more explanation or a visual demonstration, there are a plethora of widely available video tutorials on every imaginable origami animal and structure in addition to the teacher facilitating the lesson. Once the teacher does not have to directly instruct the class, she is free to circulate and provide assistance an insight to students who might require some extra assistance.

Essentially, teaching origami to students is one, long extended version of the I do, we do, you do model of instruction. The I do portion is short, the teacher quickly demonstrates the project being done. The “we do” takes up to a few class sessions until the students gain the necessary skills to be able to work independently. Some students may still use a modified “we do” phase of instruction by using videos and visual tutorials. The “you do” however has infinite possibilities. The student is not only capable of going back to a “we do” for more complicated projects and sculpture pieces, but also capable of going beyond “I do” to “I create” where the student is modifying patterns or in fact creating their own patterns. Because the instruction model is so extended, it allows for differentiation at every stage of learning, creating opportunities for every students to succeed.

Origami is never explicitly mentioned in the mathematics curriculum, but the applications are obvious (Wares, 123). Geometry at the elementary level includes basics such as symmetry, basic shapes, and equal parts. These are evident in nearly every origami pattern in children's’ books (and books of patterns for adults as well!) Origami and math are a clear pair, and makes connections to not only visual arts, but to literacy and writing. Origami can cover pretty much every academic area in the elementary grades. Just because the common core introduces paper folding at grade 3, why should we wait that long when the connections are so evident even in kindergarten? (Yuzawa, 462).

Students often tell me “this is hard!” Origami makes things a little easier for them, having the instructions, and in some cases videos, right in front of them guiding them through every step for as long as they need help. At some point, it becomes less hard and students become bored with the slow speeds of folding videos, and at that point they move on to following written and graphic instruction on paper. When students have

something to copy, it's not quite so hard anymore. And when the proficient students get bored while some are still struggling? We reach two divergent options. First, a peer mentoring model can be implemented, where proficient students become the "experts" and teach a struggling student or two how to create the sculpture. This not only raises the self-esteem and focus of the "experts", but motivates the struggling student to work harder because they're being instructed by their peer and not an adult (Edison, 169). The second option is to allow these students more freedom to choose more difficult projects, more self-directed assignments, and to continue to hone their skills (Edison, 171). This allows the students to understand the benefit of hard work and perseverance, and also shows students who have yet to master the skill that there's an advantage to not giving up because they get to choose their own projects after they get the basics down.

Background

Origami

Origami can be traced back to as early as the 2nd century in China, and the 6th century in Japan. Some of the earliest known origami is thought to be folded paper made to look like money, burned as a sacrifice. Origami is more recently traced to the 1900s, where the origami renaissance brought back the art of paper folding. Origami is derived from the Japanese *oru* (to fold) and *kami* (paper). Japanese origins of origami are largely ceremonial folds with no set specific fold patterns. Paper in Japan in the 6th century was an expensive commodity, and not done by most common people (History of Origami). Origami (and paper in general) were for religious rituals and formal ceremonies only.

Recreational origami wasn't really prevalent until the 16th century, when paper cranes start popping up. The first book on recreational origami was published in 1797, "Folding of 1000 Cranes" (Senbazuru Orikata). Around this time, origami began to also become very popular in Europe (although it had been around in Europe before that). European models are known for pattern grids and very specific fold patterns requiring accuracy and precision.

Contemporary origami as we know it today came to be around 1950. In 1952, Akira Yoshizawa, a factory worker in Japan, published a series of 12 zodiac animals as origami patterns in a magazine. In 1954, he introduced his new system of diagramming, Yoshizawa-Randlett system, which is the diagram system we recognize as standard for origami patterns. This diagramming systems shows mountain and valley folds, as well as orientations of the model as it's being worked on. A mountain fold is a fold where the paper is folded behind itself, and the resulting creased paper resembles a mountain-like shape. A valley fold is when a paper is folded up in front of itself, producing a V-shaped crease paper. (Lang, Origami Diagramming Conventions).

Origami was not used for mathematical applications until the 1990s. Mathematical applications in origami range from the elementary concepts of geometry and shapes, to middle-level angles and vertices, to higher level engineering and more calculus-based applications. Hundreds of papers have been written on the applications of origami for mathematical purposes for students in elementary school all the way to college and beyond.

Currently, origami is widespread and available almost anywhere. There are hundreds of books about origami for all ages, thousands of online videos, and even classes and conventions around the globe. Origami is accessible, which makes it a great for the classroom. Students see origami in pop-up books on a regular basis, and don't even recognize it as origami!

Geometry

Specifically, origami applications to geometry are obvious. Basic shapes and symmetry are core parts of origami, and are also part of the elementary common core curriculum. Geometry at the elementary level builds on the skills learned in previous years in terms of shapes, lines, and angles. Kindergarten geometry standards include: naming shapes, composing shapes from other shapes, and describing shapes. First grade geometry standards include: distinguishing shapes, composing and creating composite shapes, and partitioning shapes into halves and quarters. These three standards have very clear applications in origami, and can be taught using the most basic of origami folding patterns (Cakmak, 60).

Distinguishing shapes is the first and most basic principle revisited in first grade. Students learn about both 2-dimensional and 3-dimensional shapes, what defines each shape, and how to classify them. Shapes covered are included, but not limited to: squares, rectangles, triangles, circles, rhombuses, pentagons, hexagons, octagons, diamonds, ovals, spheres, cubes, cylinders, cones, and pyramids. Students learn the difference between flats and solids, and how to classify classroom and real-world objects into categories by shape.

Composing and creating shapes has students using shapes they know to create other shapes. This could mean taking rectangles to make a bigger rectangle, using triangles to make a square, or using multiple shapes to create a different shape. Students learn that shapes can be broken down and built up.

Geometry then begins to look a lot like fractions. Students learn halves and quarters (also calling them fourths), how to make them, and to talk about them using appropriate terms. This is where students begin to talk about fractions, and learn to state how many parts of the whole are shaded/colored as compared to the total number of parts. Students are also meant to understand that dividing halves in half creates quarters.

Origametria, an origami and geometry curriculum developed in Israel, focuses on geometrical applications of geometry from preschool through 6 grade. This model has several key features that differentiates it from standard models of teaching and promotes social-emotional learning as well. The hallmarks of this curriculum are that the students are not informed what the model will look like when they are done (to promote self-confidence), teachers never touch the students' work, only demonstrate on their own paper (to ensure that it's truly the students work), and make absolutely zero negative comments (actively encouraging them to try their best, complimenting the work, etc). This curriculum does not currently run training in the US, but the principles can be applied to create a new origami curriculum that promotes the same social-emotional

learning concepts while explicitly teaching geometry in a fun and hands-on method (Golan, 460-463).

Strategies

The following are a wide range of strategies to be used throughout the 9-lesson unit. Each strategy caters to different learners, and using many of them in one lesson is designed for differentiation to help all learners succeed.

Gradual Release

This is an I do-We do-You do model that allows the teacher to demonstrate, guide the students through the process, and then have the students work independently once they understand what to do.

Inquiry-Based Learning

Inquiry based learning begins with a question and has students explore to find the answer on their own.

Technology

Students interact with technology to increase their skills for a technology-driven world. They can research, make and edit videos, and create digital artworks.

Cooperative learning

Students learn in groups in order to share knowledge and increase their confidence by teaching other students what they know and what they've learned.

Think-Pair-Share

Students think on their own for a moment, pair up, and share with their partner what they're thinking. This gives students a chance to talk out their own thinking and to hear others explain theirs.

Read Aloud

The teacher reads a book for the students, stopping frequently to check for understanding and ask for predictions. This allows the students to develop their reading skills as the teacher models reading.

Think Aloud

The teacher speaks through the thinking process aloud, allowing students to hear how the teacher is doing something and gives the students an idea of what is expected from them and how to get it done.

Hands-On Activities

Students gain a tremendous amount from moving their bodies while they're learning, so hands-on activities that engage their gross motor and fine motor skills help the brain link up all the new information to promote recollection and understanding.

Writing Math

Writing math is a technique where students explain their math thinking, how and why they've solved a problem. This encourages the students to think critically about the work they're doing and forces them to go step by step as they write it down.

Spiral Review

Students go back to review other lessons and units they've studied during the year, as they begin to apply to the current unit. This encourages students to make connections between prior knowledge and new knowledge.

Objectives

In this 9-lesson unit, students will be able to understand and show an understanding of many concepts and skills across curricular units. These include areas in geometry, data measurement, writing, verbal expression, as well as focus and attention (for which there are no common core standards, so they are not explicitly addressed as official objectives in lessons but are still an overarching objective for the entire unit).

In geometry, students will be learning all about basic shapes and how to classify them. They will explore how rectangles and squares are different, and will be able to articulate why they are different. Students will explain the why a triangle is not any other shape, and how triangles come in all sizes. Students will identify composite shapes, both creating them and breaking them down. Students will explore, identify, and verbally explain parts of a whole including halves and quarters.

In data measurement, students will review graphing (which is covered earlier in the common core curriculum) by graphing answers to brainstorming and think-pair-share discussions. Students will analyze the data and figure out how they can use numbers and graphs to inform their practice and what they're going to be doing next. Spiral review keeps this important skills fresh in student's minds, to the point where using graphs and data becomes second nature and it can be used all the time with ease and quick understanding.

Writing is a part of nearly every lesson for this unit, as it's important for students not only to be able to analyze their explorations and verbally express their thinking, but to be able to write out their higher order thinking skills. Students work on not only their fine motor skills, but on putting their thoughts and actions into words, and those words onto paper. Students in higher grades often have much difficulty expressing themselves verbally and in writing, so addressing these deficits at the lower grade levels will give the students more skills when they reach testing grades.

Classroom Activities

<u>Lesson 1:</u>

Students will be able to sequence the events in *The Pirate Girl's Treasure* in order to practice sequencing.

Students will be able to recall and define *mountain fold, valley fold,* and *crease* in order to build origami vocabulary.

CCSS.ELA-LITERACY.RL.1.1, CCSS.ELA-LITERACY.RL.1.2, CCSS.ELA-LITERACY.RL.1.3, CCSS.ELA-LITERACY.L.1.6

Instructional Strategies:
Read Aloud
Kinesthetic learning
Group Instruction
Think-Pair-Share

Materials: *The Pirate Girl's Treasure*, writing utensil, writing surface, paper, sequencing worksheet, scissors, glue sticks, crayons

New Vocabulary: Crease, Mountain Fold, Valley Fold

Lesson Introduction:
Teacher will gather students on the carpet or other area for read-aloud. Teacher will ask students to make predictions about the book, and record them on chart paper (or whiteboard).

Read Aloud and Check for Understanding:
Teacher will then read *The Pirate Girl's Treasure* aloud, stopping periodically to check for understanding. Teacher will fold along with the book to engage the students. Students will sum up what has happened so far as the teacher stops. After the story, the teacher will slowly release students to their desks to complete a cut-and-paste sequencing worksheet. Students who finish before the allotted time is up may color their worksheets.

Hands-On Activity:
Teacher will collect worksheets and hand out plain paper to students. Teacher will preview all three new vocabulary words, then one at a time explain what they mean and have the students practice the folds, holding them up for the teacher to see as they are completed. Teacher will have the students pair up and discuss what happens to a mountain fold when you turn the paper upside down (establishing that a valley fold is essentially an upside down mountain fold.) This may be difficult for some students to understand, encourage them to explain to each other.

Closure:
Teacher will select pairs to share their thinking with the class. Teacher will wrap up with a demonstration of how mountain and valley folds are similar, and review vocabulary. Teacher will give students a preview of the next lesson, telling the students that the following lesson will be during math time and not reading time.

Lesson 2:
Students will be able to create an accurate and precise fold to create two equal sides in order to build basic origami skills.

Students will be able to write a sentence explaining how they folded their paper and what resulted in order to explain their thinking.
CCSS.MATH.CONTENT.1.G.A.3, CCSS.ELA-LITERACY.W.1.3

Instructional Strategies:
Gradual Release
Group Instruction
Cooperative learning
Writing Math

Materials: Small paper, lined paper, pencils

New Vocabulary: Corner, Edge, Equal

Lesson Introduction:
Teacher will remind students of previous lesson on creases and folds. Teacher will hand out paper, and demonstrate how to fold paper into two halves, emphasizing vocabulary words. Teacher will explain to students how to match corner to corner, edge to edge to create a perfect crease.

Hands on Activity:
Teacher will hand out paper and remind students to wait for the whole class to work together to practice folding in half. Teacher will prompt students "corner to corner, edge to edge," and have them repeat it. After some practice, the students will continue to practice on their own with small pieces of paper.

Higher Order Thinking:
Students will pair up and explain in a full sentence how they got their paper exactly in half (put "corner to corner, edge to edge into a full sentence). Once they decide on a sentence, each student will write independently how they folded their paper into 2 equal parts. Words that are tricky to spell can be put on the board for students to reference.

Closure:
Students will have an opportunity to share their sentences with the class, and demonstrate the fold as they read. Teacher will collect sentences from students to assess understanding.

Lesson 3:
Students will be able to create many rectangles from a rectangular sheet of paper in order to understand that the same shape can be multiple sizes.
Students will be able to create a crease in order to prepare for more complex origami folding patterns.
CCSS.MATH.CONTENT.1.G.A.1

Instructional Strategies:
Inquiry-based learning
Spiral review
Cooperative learning
Technology

Materials: Origami paper, video-capable technology

Lesson Introduction:
Teacher will remind students what a rectangle is (4 sided shape with squared corners). Teacher will challenge students to create as many different sized rectangles as they can from their paper. Teacher will remind students to make strong creases using their fingernails. Students will work in pairs or alone, based on learning style preference.

Hands On Activity:
Students will work to create as many rectangles as they can, the teacher will walk amongst the students and ask questions about what they're doing and why. When students believe they are done, they will video the "unfolding" of their shapes and counting the number of individual rectangles on their paper (as well as any shapes that are not rectangles).

Higher Order Thinking:
Students will continue their video by explaining how they made their rectangles and how they chose to fold. Students who create any shapes other than rectangles will explain how they think those shapes got there. The teacher, as well as technically inclined students, can help manipulate the technology.

Closure:
Students who have successfully created only rectangles will share their videos with the class. Time permitting, students who created other shapes will share their explanations as well. The teacher will share with the students that the key to making rectangles is using the straight-folding technique of folding corner to corner, and edge to edge. The teacher will preview to the students that the next lesson will be a new kind of fold.

Lesson 4:
Students will be able to create a square from a rectangular paper in order to understand the characteristics of a square.
Students will be able to follow step-by-step directions in order to create a paper square.
CCSS.MATH.CONTENT.1.G.A.1

Instructional Strategies:
Hands-on Learning
Think Aloud
Guided Instruction
Small group instruction
Group practice
Exit ticket

Materials: rectangular paper, scissors, sticky notes, pencils, origami patterns (printouts or slideshow and necessary computer equipment)

New Vocabulary: Diagonal

Lesson introduction:
Teacher will begin by showing students several origami patterns (either paper printouts or by computer slideshow), asking them how the patterns starts (looking for the answer that the patterns start with squares). The teacher will explain to the students that they do not need to buy special origami paper to fold origami forms, and that they can make squares from ordinary copy paper.

Guided Instruction:
The teacher will demonstrate how to fold the paper short edge to long edge, folding through the corner of the paper to match up the edges (creating a diagonal fold). The teacher will explain that since a square has 4 equal side, if we match up one short side to a side that it next to it, and cut them to match, we know that all our sides are equal and we have a square. The teacher will show the students how to cut the excess paper away to create a square. The teacher will then, and only then, hand out paper to the students and guide them through creating the square step by step. Additional instruction will be done in small groups for students who require it. Students will continue to practice “folding through the corner”. Students who master the concept can continue to make squares on their own. The teacher can even ask students to use their squares to create rectangles like they did the day before to practice what they learned previously. Advanced students can work in small groups to create more squares from the squares they just made by folding.

Exit Ticket:
The teacher will hand out sticky notes and pencils to students and ask them to write (in addition to name and date) what makes a square different from a rectangle. Teacher will collect notes and use to assess and alter future instruction as necessary.

Lesson 5:
Students will be able to create and identify triangles in order to classify 2-dimensional figures.
Students will be able to recognize triangles as used in pop-ups in order to understand how pop-ups work.
Students will be able to graph the number of triangles they make in order to make graph and interpret data.
CCSS.MATH.CONTENT.1.G.A.1, CCSS.MATH.CONTENT.1.MD.C.4

Instructional Strategies:
Hands-On Activity
Read Aloud
Think Aloud
Spiral Review

Materials:
Rectangular paper, Scissors, *Papa Please Get the Moon for Me*, chart paper, chart markers

New Vocabulary: Compress

Lesson Introduction:
Students will begin by creating a square from the rectangle paper, recapping the previous lesson. The teacher will prompt the students to think about what shapes they have created by folding and cutting the paper. (Rectangle cut from the paper, square made, two triangles by folding). The teacher will have the students put the paper aside and transition to a reading area (as appropriate).

Read Aloud:
Teacher will read *Papa Please Get the Moon For Me* to the students, asking them to notice the folding and pop-ups in the book as they read. The teacher will stop frequently for questions and to check for understanding. As the teacher reaches the largest pop-out page in the book, the teacher will ask the students to name shapes they can recognize within the page that are created by the folds. The teacher will ask the students why they think the triangles are there, while unfolding and refolding the page several times. If no students can answer, the teacher will explain that the triangles allow the shape to

compress a lot of paper into a smaller space. After the book, students will return to their instructional seats.

Hands-On Activity:
Students will return to the square they made at the beginning of class. The teacher will ask what kind of fold they made to create that square, and how they created that diagonal fold (folding through the corners and matching up edges). The teacher will ask the students what makes a triangle different from other shapes. Students will be challenged to create more triangles out of their squares by using folding.

Closure:
Teacher will have the students supply their data to create a chart, and then a graph of the number of triangles each student made (graph type to be determined by student data and input). Students will think-pair-share to end the lesson, using the prompt "how many triangles made up your square? Do you think other shapes could also make a square? How do you know?"

Lesson 6:
Students will be able to create a folded origami page in order to understand that triangles can compress a paper into a smaller space.
Students will be able to identify characteristics of triangles, rectangles, and squares in order to classify shapes.
CCSS.MATH.CONTENT.1.G.A.1

Instructional Strategies:
Gradual Release
Small Group Instruction
Cooperative Learning

Materials: Origami paper, *Papa, Please Get the Moon For Me,* crayons, pencils, colored pencils, markers

Lesson Introduction:
Teacher will refer back to *Papa, Please Get the Moon For Me*, and the large fold-out page that they read about in the previous lesson. The teacher will demonstrate the foldable they are about to create as an information fold-out "book".

Hands On Activity:
Teacher will guide students through creating their folded, one page "book," one fold at a time. When all the folds are complete, the teacher will challenge the students to figure out

how to manipulate the folds to make the compressed paper. The teacher will assist those students who still require assistance.

Cooperative Learning:
Students will work in small groups to create their "books", using each square/diamond shaped section to draw and write about one shape covered so far in the unit. Ideally, this would be groups of three and each student takes one shape (triangle, square, rectangle), but could work in other ways as well. Teacher will circulate and assist as necessary.

Closure:
Students will share their books with the class, each group sharing one shape in detail. Share will continue until each group has had a chance to present their foldable. Foldables can be displayed on classroom walls or outside the classroom.

Lesson 7:
Students will be able to create and identify shapes that can compose a square in order to understand composite shapes.
Students will be able to create a unique fold pattern without instruction in order to use creative thinking.
CCSS.MATH.CONTENT.1.G.A.2

Instructional Strategies:

Think Aloud
Cooperative Learning
Small Group Instruction
Hands-On Activities

Materials: Origami paper, shape blocks, composite shape cards, composite shape worksheet, copy paper, pencils (video technology optional)

New Vocabulary: Composite

Lesson Introduction:
Teacher will create a chart for centers, assigning who is at what center and for what amount of time. (4 centers: 3 independent [all with shape or pattern blocks] and 1 teacher-led). The teacher will briefly explain what a composite shape is, and how to identify shapes within a shape. The teacher will remind students that the sound of a bell is the transition notice, so when they hear it they need to clean up and transition to the next center (using the rotation on the chart). The class will try this several times until they get the hang of moving with the bell sound (though this will be done all year, so it shouldn't be something new for them.)

Hands on Centers:
Centers that are independent for this lesson include having students use shape blocks to compose designs, having students look at composite shape cards and decompose them, and working cooperatively on a composite shape worksheet (see appendices E and F). The teacher-led center is composite shapes with origami. The teacher will ask students to make several folds in their paper, any way they want to. The students will then unfold the papers, trace, and name the shapes they have created (drawing lines over the folds.) Students will then create a second folded paper, writing down (or dictating, or videotaping) the directions as they go step-by-step, and then following the same procedure of unfolding, tracing, and naming shapes.

Closure:
When all the students have rotated through the stations once, they will come back together to discuss what they have learned about composite shapes. Students will share their custom fold patterns, talking about what shapes and how many of them they made.

Lesson 8:

Students will be able to demonstrate halves using folded paper in order to understand parts of a whole.
Students will be able to write a sentence describing how to divide a shape in half in order to explain their thinking.
CCSS.MATH.CONTENT.1.G.A.2, CCSS.ELA-LITERACY.W.1.3

Instructional Strategies:
Think Aloud
Think-Pair-Share
Cooperative Learning

Materials: origami paper, pencils, copy paper, chart paper, chart markers

New Vocabulary: Half, halves, whole, part

Lesson Introduction:
The teacher will prompt the students to think-pair-share about what a half is, and how they would describe half. The teacher will record shares on chart paper. The teacher will explain that the plural of half is halves, just like the plural of knife is knives.

Cooperative Learning:
Students will work in small groups to revisit folding corner to corner and edge to edge, helping each other get a crease down the center of their origami paper. The teacher will ask the students how many halves they have, and how many halves make a whole. The

teacher will think aloud that a half looks like ½, so that means that there are 2 parts that make up the whole.

Closure:
Students will share what was easy and hard for them about folding halves of the paper. The teacher will fold the paper in half diagonally and ask if those are also halves, and have the students explain why or why not. Teacher will preview the next lesson by telling the students that they will look at what happens when you fold a half in half.

Lesson 9:
Students will be able to demonstrate halves and quarters using folded paper in order to understand parts of a whole.
Students will explain their folding process in two sentences, using appropriate terms (half, fourth, quarter) in order to understand parts of a whole.
CCSS.MATH.CONTENT.1.G.A.3, CCSS.ELA-LITERACY.W.1.3

Instructional Strategies:
Think Aloud
Small Group Instruction
Cooperative Learning

Materials: Origami paper, pencils, markers, paper

New Vocabulary: quarter, fourth

Lesson Introduction:
Teacher will begin with a brief recap of the previous lesson, folding the paper neatly in half and creasing it tightly. The teacher will ask the students how many parts there will be if the half is folded in half again. Students' answers will be recorded. The teacher will unfold the paper, then re-fold while thinking aloud as to why the paper would have 4 pieces. The teacher will show the students the fraction ¼, and show how it represents a part of the whole

Hands on Activity:
Students will work in small cooperative groups to explore folding in halves and quarters. Students will fold the paper in half straight or diagonally (or both!) to create quarters and explore why it only takes a second fold to create quarters. Students will work as a group to create their narrative of how they folded their paper into quarters, using at least 2 sentences. The teacher will circulate to make sure that students are on task and on the road to success.

Closure:
Students will regroup as a whole class and share each group's narratives. The class will discuss how each narrative is similar and different, and what they all have in common. The teacher will wrap up with a call for questions, and let the students know that the following class will be the end of the geometry and origami unit.

End of Unit Assessment:
Students will be able to create their own origami design, representational or not, in order to show an understanding of triangles and composite shapes.
Students will be able to write about their folded designs in order to show an understanding of triangles and shapes.
Students will be able to write about their designs in terms of halves and quarters in order to show an understanding of parts of a whole.
CCSS.MATH.CONTENT.1.G.A.1, CCSS.MATH.CONTENT.1.G.A.2, CCSS.MATH.CONTENT.1.G.A.3, CCSS.ELA-LITERACY.W.1.2

Lesson Introduction: Teacher will remind students that this is the end of the geometry and origami unit, but they may continue to do origami through the rest of the year.

Independent Practice: Teacher will tell students that they need to create their own origami design using composite shapes, and then write 2-3 sentences about what they have done using the new vocabulary. The teacher will remind the students that the words are all on the word wall in the classroom. Finished folded papers and sentences will be collected and graded using a rubric (see Appendix G).

Resources

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-Children’s book using folding and pop-up pages to get large images into small spaces (like the size of a book).

“Composing 2D Shapes Free Center Cards!” *Susan Jones*, 14 Dec. 2017, susanjonesteaching.com/composing-2d-shapes-free-center-cards/
-Free task cards for students to use in centers (see appendix E)

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-A fold-along children’s book, written on an elementary level, to introduce origami and folding to children.

Appendix A: Common Core Standards

CCSS.MATH.CONTENT.1.G.A.1
Distinguish between defining attributes (e.g., triangles are closed and three-sided) versus non-defining attributes (e.g., color, orientation, overall size); build and draw shapes to possess defining attributes.

CCSS.MATH.CONTENT.1.G.A.2
Compose two-dimensional shapes (rectangles, squares, trapezoids, triangles, half-circles, and quarter-circles) or three-dimensional shapes (cubes, right rectangular prisms, right circular cones, and right circular cylinders) to create a composite shape, and compose new shapes from the composite shape.

CCSS.MATH.CONTENT.1.G.A.3
Partition circles and rectangles into two and four equal shares, describe the shares using the words halves, fourths, and quarters, and use the phrases half of, fourth of, and quarter of. Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.

CCSS.MATH.CONTENT.1.MD.C.4
Organize, represent, and interpret data with up to three categories; ask and answer questions about the total number of data points, how many in each category, and how many more or less are in one category than in another.

CCSS.ELA-LITERACY.RL.1.1
Ask and answer questions about key details in a text.

CCSS.ELA-LITERACY.RL.1.2
Retell stories, including key details, and demonstrate understanding of their central message or lesson.

CCSS.ELA-LITERACY.RL.1.3
Describe characters, settings, and major events in a story, using key details.

CCSS.ELA-LITERACY.L.1.6
Use words and phrases acquired through conversations, reading and being read to, and responding to texts

CCSS.ELA-LITERACY.W.1.2
Write informative/explanatory texts in which they name a topic, supply some facts about the topic, and provide some sense of closure.

CCSS.ELA-LITERACY.W.1.3
Write narratives in which they recount two or more appropriately sequenced events, include some details regarding what happened, use temporal words to signal event order, and provide some sense of closure.

Appendix B - Complete list of Materials Needed for Unit

The Pirate Girl's Treasure: An Origami Adventure
Papa Please Get the Moon for Me
Writing utensil (chalk, chart marker, whiteboard marker, etc)
Writing surface (chalkboard, chart paper, whiteboard, etc)
Copy Paper
Lined Paper
Origami Paper
Sequencing worksheet
Scissors
Glue sticks
Crayons
Markers
Colored Pencils
Computer
Speakers
Projector
Origami Patterns
Shape Blocks/Pattern Blocks
Composite shape cards
Composite shape worksheet

Appendix C- Story Sequencing Worksheet

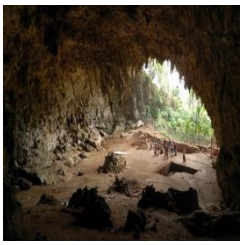
Name: _____ Date: _____

Story Sequencing: The Pirate Girl's Adventure

Directions: Cut out the picture/text boxes from the second page and glue them on the page in the correct order on this page, in the boxes.

First What happened at the beginning of the story?	
Next What happened next?	
Then Then what happened?	
Last How did the story end?	

Directions: Cut on dotted lines, glue on sequencing page



The Pirate Girl ran to hide in a cave.

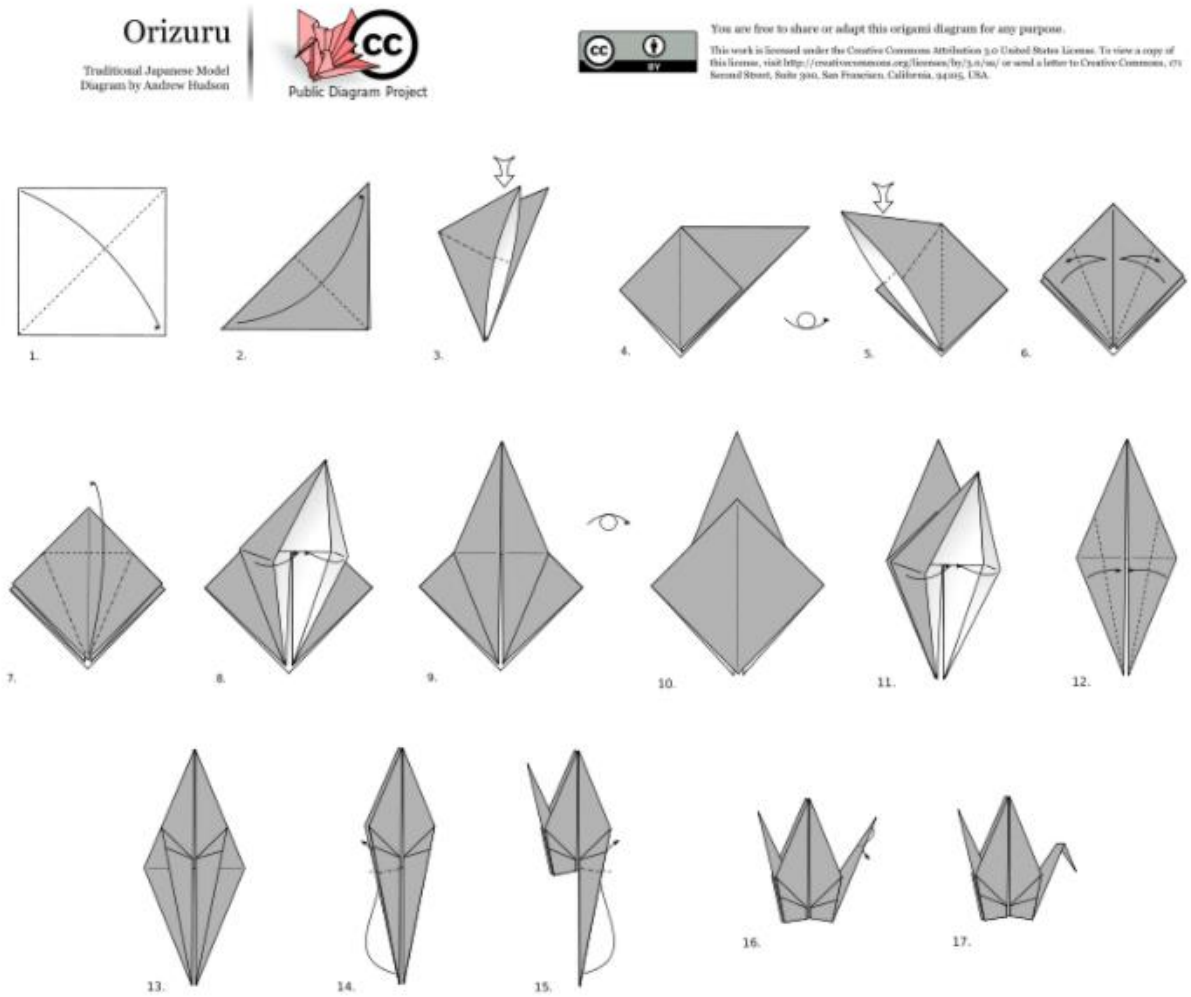
The Pirate Girl found her treasure, a pirate shirt!

The Pirate Girl opened her treasure map to have an adventure.

The Pirate Girl took her boat out on the water.

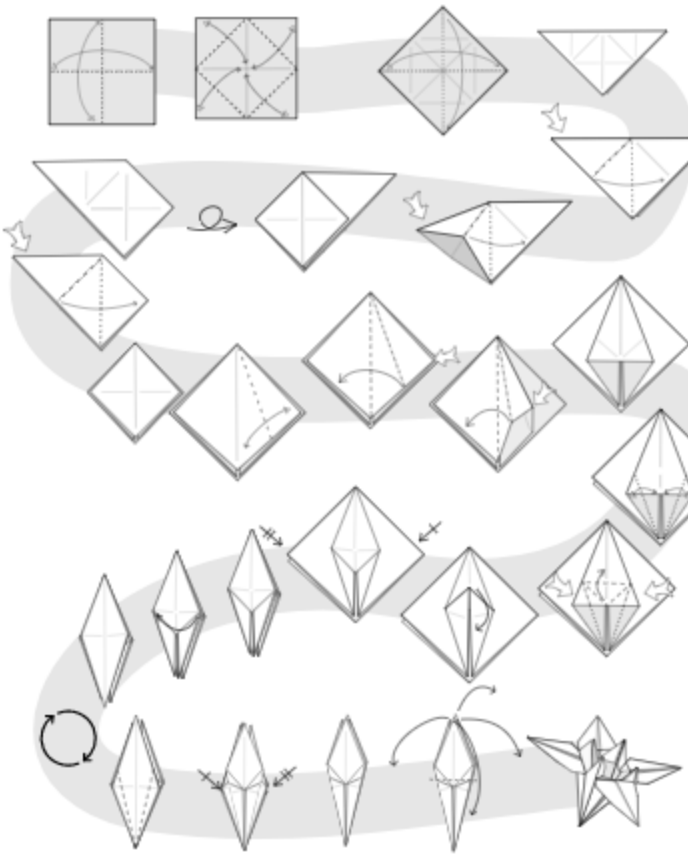
Appendix D - Origami Patterns

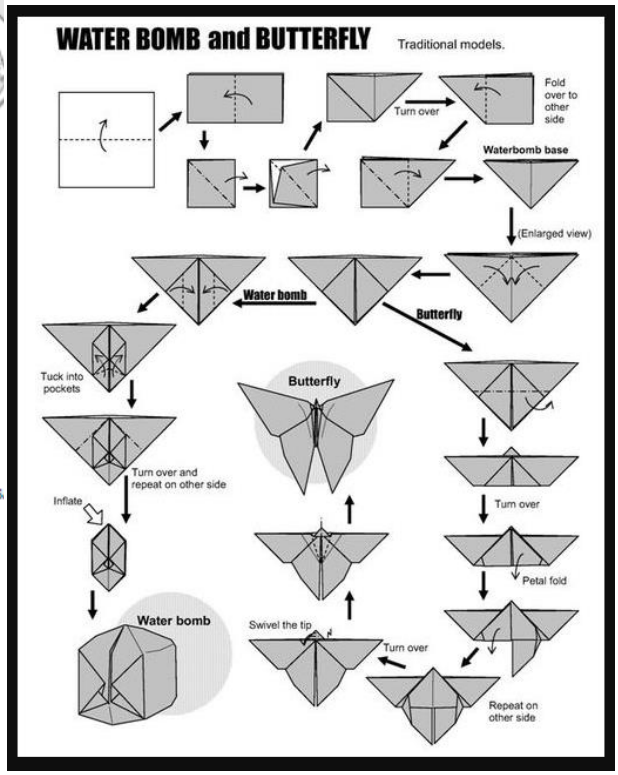
All patterns used are traditional models, and thereby in the public domain, or are licensed under creative commons.



Lily

Design: traditior
Diagram: Tavin
tavinsorigami.co





Appendix E - Composite Shape Cards (Jones, 2017)

Build a HEXAGON using:

6 triangles

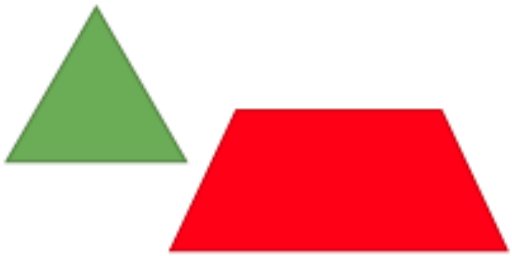
Build a TRAPEZIOD using:

3 triangles

Build a HEXAGON using:

3 triangles

1 trapezoid



Build a HEXAGON using:

4 triangles

1 rhombus

Build a HEXAGON using:

3 triangles

5 trapezoids

1 hexagon

Build a HEXAGON using:

2 rhombuses

2 trapezoids

1 hexagon

Build a HEXAGON using:

1 rhombus

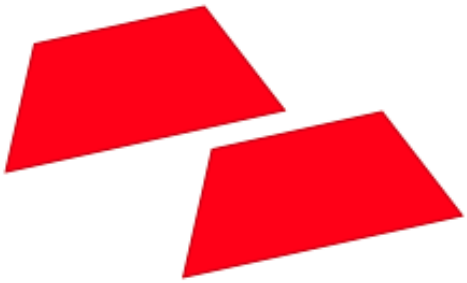
4 triangles

Build a RHOMBUS using:

4 rhombuses

Build a HEXAGON using:

2 trapezoids



Build a RHOMBUS using:

2 triangles

Build a RECTANGLE using:

2 squares

Build a HEXAGON using:

1 triangle
1 rhombus
1 trapezoid

Appendix F- Composite Shape Worksheet

Name: _____ Date: _____

Composite Shape Worksheet

Directions: Use shape blocks to make a new shape. Trace each block when you are finished to show how you made the composite shape. Write the number of each shape you used at the bottom.

I used:

_____ Squares 

_____ Hexagons 

_____ Rectangles 

_____ Rhombuses 

_____Triangles 

_____ Trapeziods 

Appendix G - Origami and Geometry Unit: Assessment Rubric

	5 points	10 points	15 points	20 points
Originality	I copied most or all of my work from someone else.	I copied some of my work from someone else.	I did most of my work. I copied a step or two from someone else.	I did all my work by myself. I did not copy from anyone else at all.
Accuracy	My folds are sloppy and I didn't show attention to detail.	Most of my folds are neat and accurate. Some of my folds are a little sloppy.	My folds are neat, and my creases are okay but not perfect.	All my folds are neat and exact. I gave extra attention to being accurate.
Writing about shapes	My writing names 1 or fewer shapes and 1 or fewer accurate descriptions.	My writing names 2 shapes and 2 accurate descriptions.	My writing names all 3 shapes, but does not contain 3 accurate descriptions.	My writing names three shapes and describes them accurately.
Writing about parts of a whole	My writing does not talk about halves or quarters.	My writing talks about either halves of quarters but does not describe them accurately.	My writing talks about either halves or quarters, and describes them accurately.	My writing talks about halves and quarters, and describes them accurately.
Neat and complete	My folding and my writing were messy and not complete.	My folding and writing are not as neat and complete as they could have been.	My folding and my writing are neat and complete.	My folding and my writing are exceptionally neat and exemplary.

Name: _____ Date: _____ Grade: ___/100