2023 NCTM ANNUAL MEETING & EXPOSITION
Oct. 25-28, Washington, DC

ORIGAMI MATH: EXPLORING PARALLELOGRAMS & SPECIAL RIGHT TRIANGLES THROUGH THE ART OF PAPER FOLDING

Tracy Conte

D.C. Convention Center 143 AB

Friday, 10/27 1-2:15 p.m.

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- Knightdale High School, Knightdale, NC
- TikTok: @YourTikTokMathTeacher

NATIONAL GEOGRAPHIC, FEBRUARY 2023

MAGAZINE

Origami is revolutionizing technology, from medicine to space

The centuries-old art of folding paper is yielding new applications in spacecraft, architecture, and even the human body.

ORIGAMI IN MATH: MATHIGON

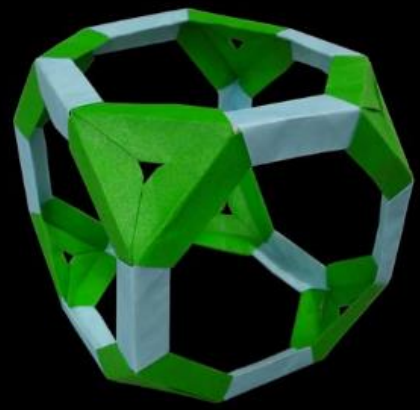
Mathigon | Polypad | Courses | Activities | Lessons

Archimedean Solids

Archimedean Solids, like the Platonic ones, consist of regular Polygons and look the same at every vertex. However the faces are multiple different regular polygons. There are 13 Archimedean Solids, two of which are reflections of each other. Explore 3D models on Polypad…

Truncated Tetrahedron

Cuboctahedron



Truncated Hexahedron

Truncated Octahedron

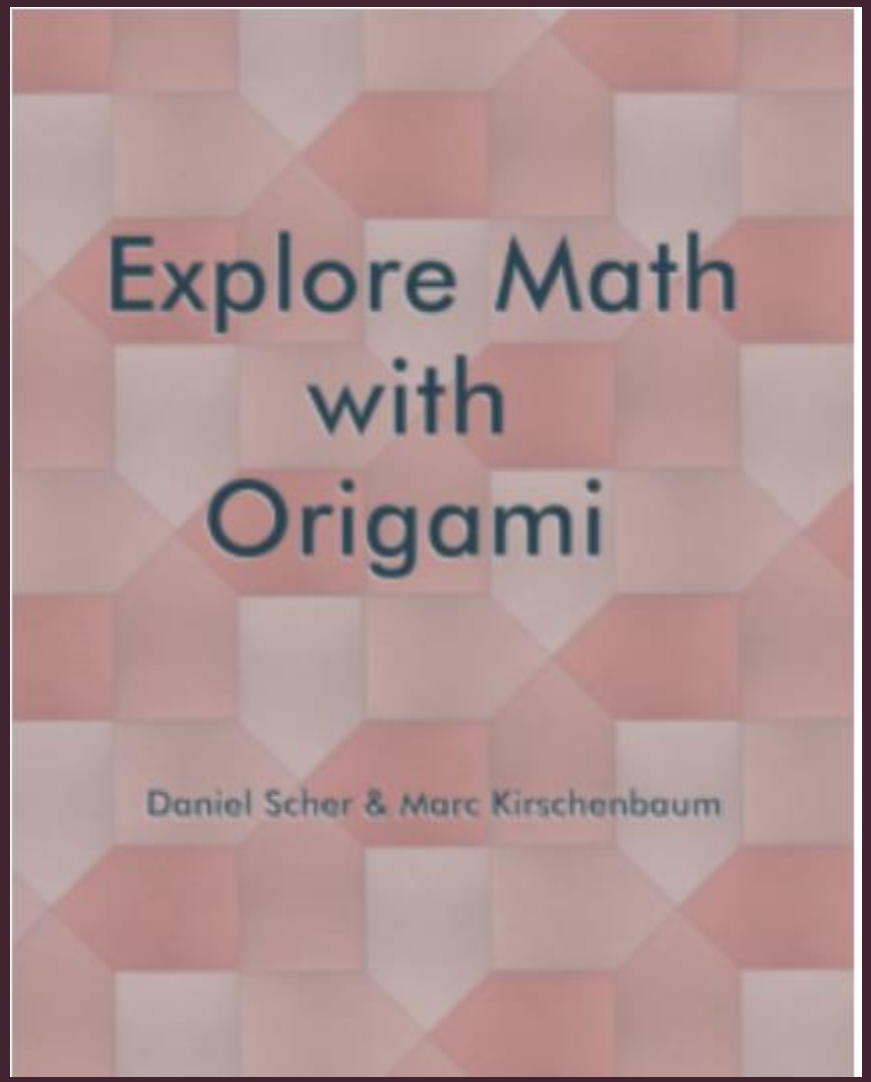
ORIGAMI IN MATH: ORIGAMETRIA BY MIRI GOLAN

ORIGAMETRIA

A digital environment for teaching Geometry using paper folding.

Experiential activities lead to the development of the student's ability to investigate geometric shapes, polyhedra, and their attributes.

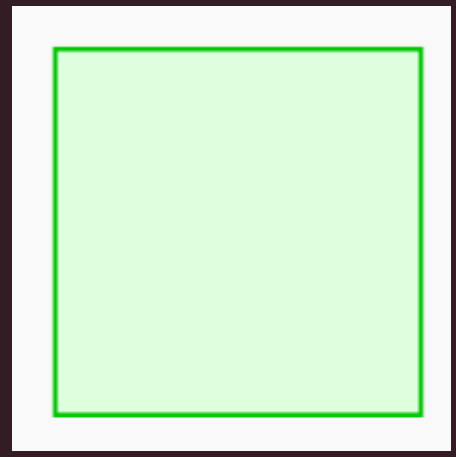
Origametria is a program approved by the Ministry of Education in Israel.

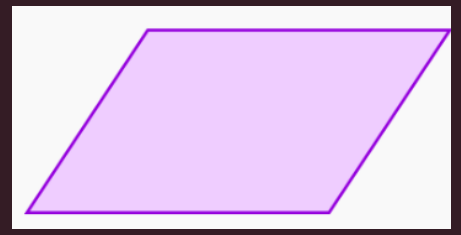

Explore Math
with
Origami
Daniel Scher & Marc Kirschenbaum

PARALLELOGRAMS TASK

Pre-Requisite Knowledge:

- Rotations
- Reflections
- Triangle Congruence Rules





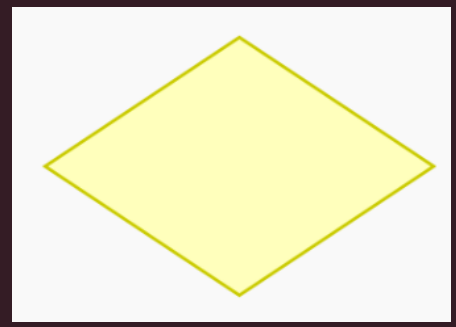
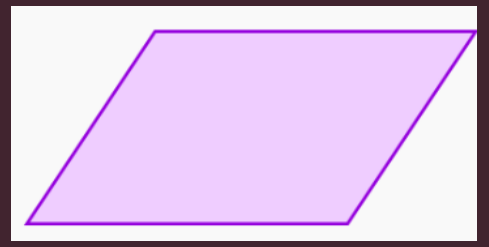
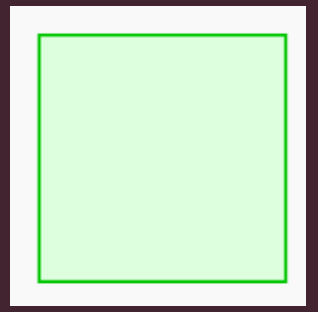


Image: Wikipedia

PARALLELOGRAM TASKS

1. Construct each parallelogram
2. Fold along the diagonals
3. What can we notice about the shape's…
   - *Lengths?*
   - *Angles?*
4. How can we use rotations or reflections to prove or disprove features?





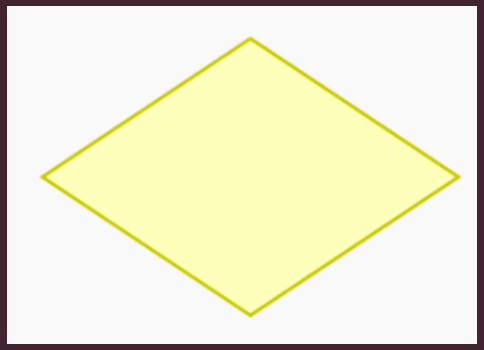
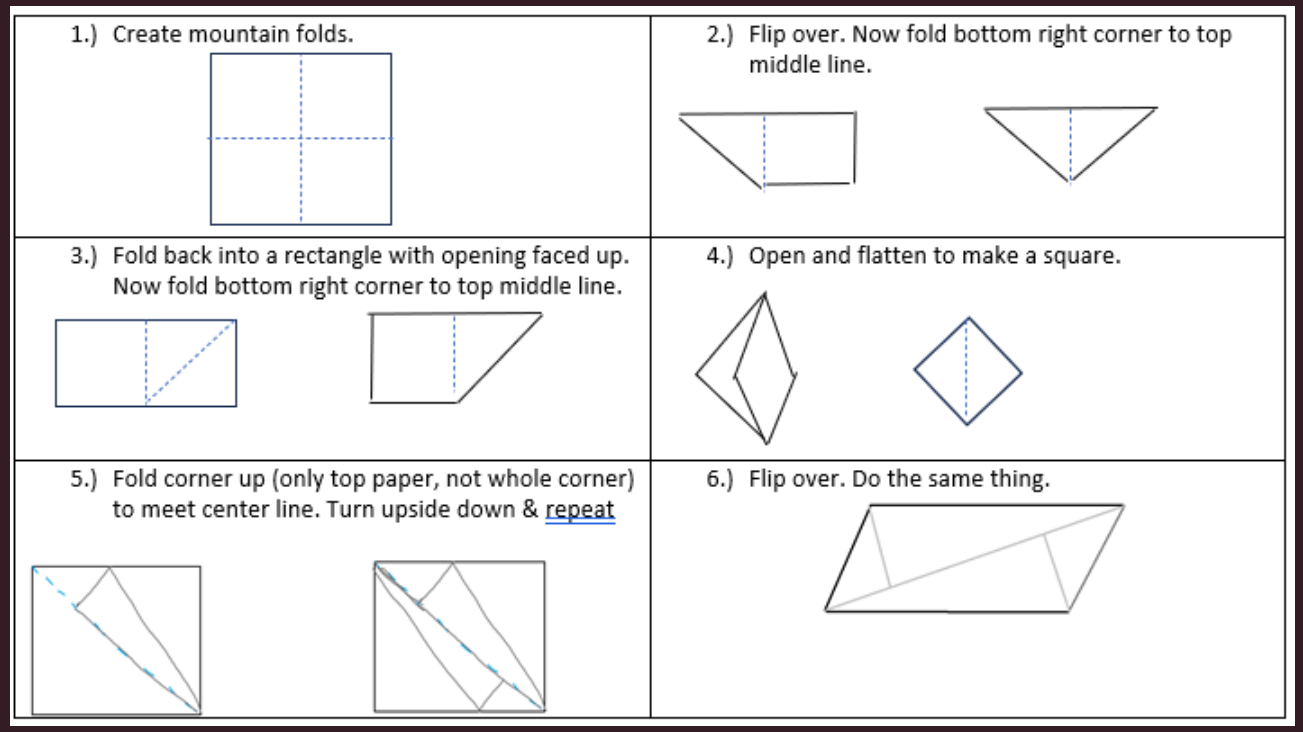


Image: Wikipedia

PARALLELOGRAM PROPERTIES

- Definition: quadrilateral with 2 pairs of opposite parallel sides

1. What can we notice about the shape's…
   - *Lengths?*
   - *Angles?*
2. How can we use rotations or reflections to prove or disprove features?

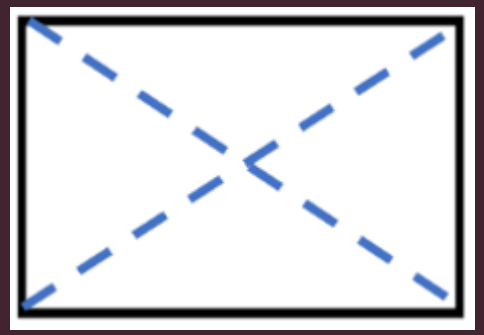


SQUARE PROPERTIES

- Definition: quad w/4 congruent sides & 4 right angles

1. What can we notice about the shape's…
   - *Lengths?*
   - *Angles?*
2. How can we use rotations or reflections to prove or disprove features?

RECTANGLE PROPERTIES



- Definition: quadrilateral with 4 right angles

1. What can we notice about the shape's…
   - *Lengths?*
   - *Angles?*
2. How can we use rotations or reflections to prove or disprove features?

RHOMBUS PROPERTIES

- Definition: …4 congruent sides

1. What can we notice about the shape's…
   - *Lengths?*
   - *Angles?*
2. How can we use rotations or reflections to prove or disprove features?

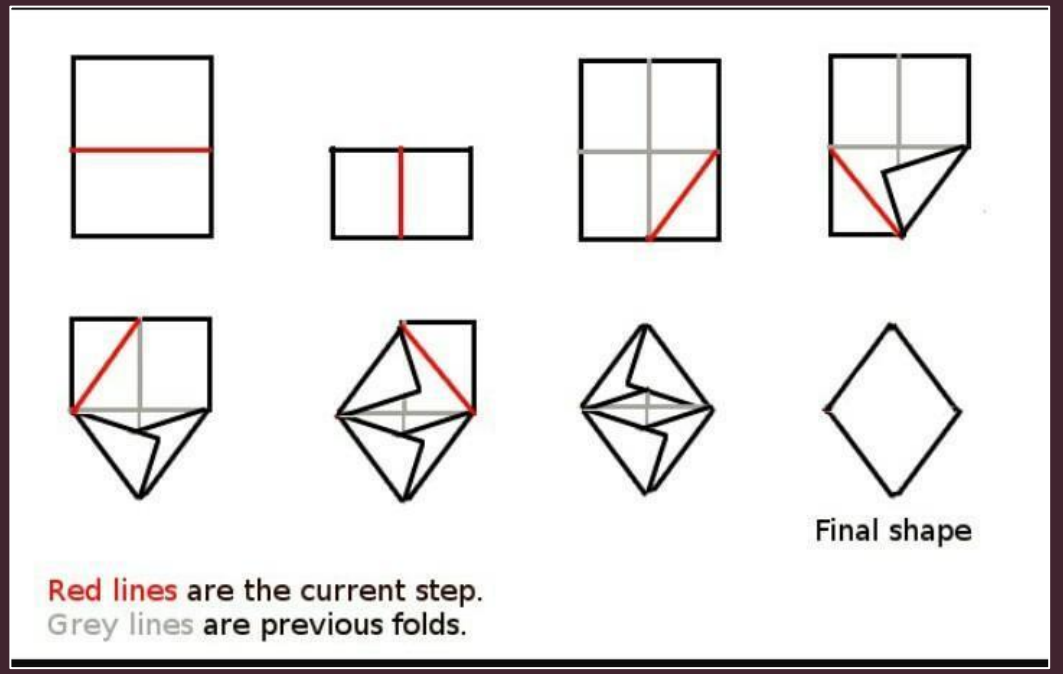
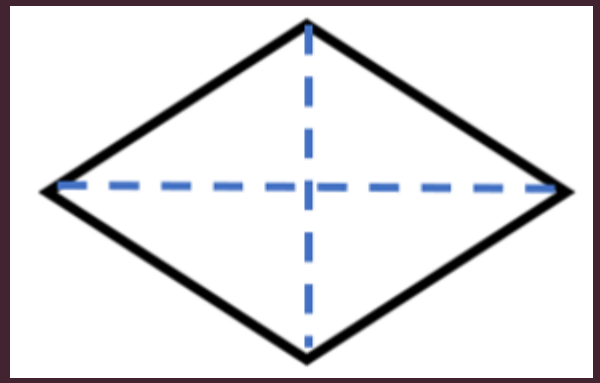
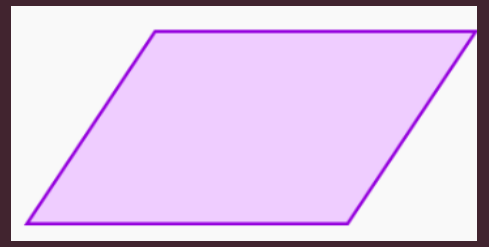


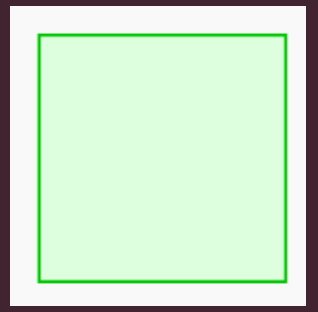
Image: Brainly



PARALLELOGRAM TASKS

- What knowledge was acquired by students in this task?
- What advantages could paper folding have over using dynamic software?





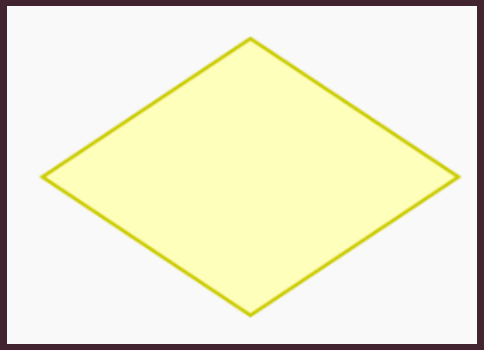
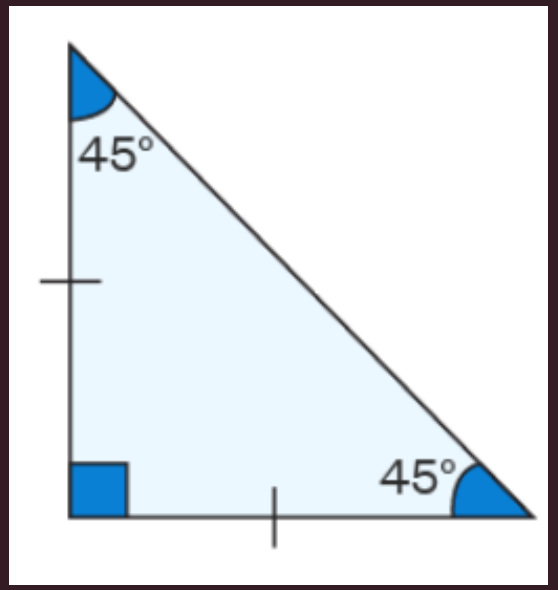


Image: Wikipedia

SPECIAL RIGHT TRIANGLE TASKS

Prerequisite Knowledge:

- Squares Theorem $a^2 + b^2 = c^2$



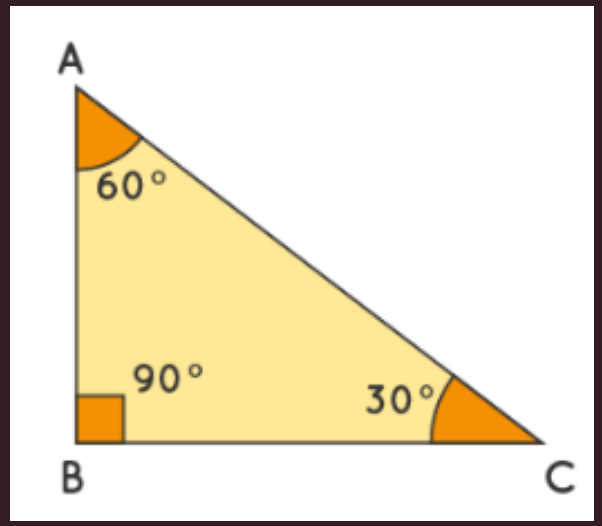
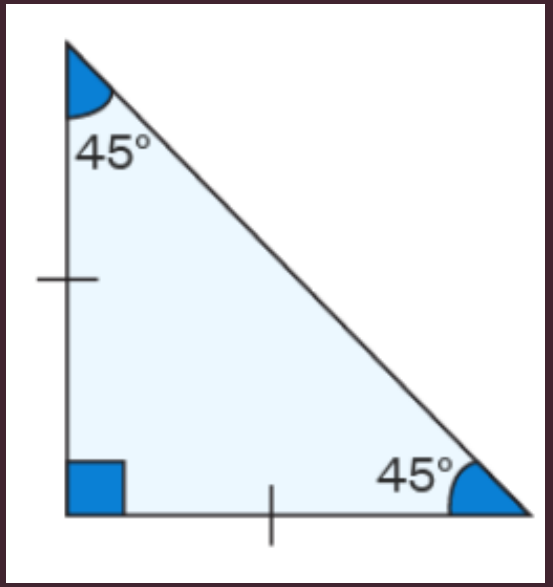


Image: CueMath

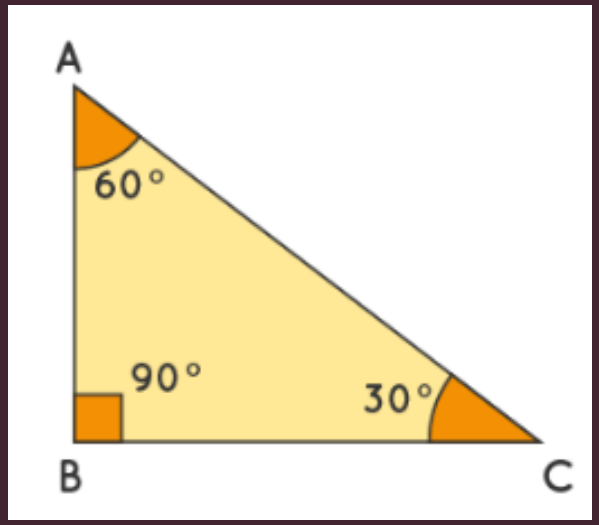
SPECIAL RIGHT TRIANGLE TASKS



Directions: Fold the origami paper so that you make a 45-45-90 triangle where the hypotenuse is the edge of the square.

Image: CueMath

SPECIAL RIGHT TRIANGLE TASKS



Directions: Fold the origami paper so that you make a 30-60-90 triangle where the hypotenuse is the edge of the square.

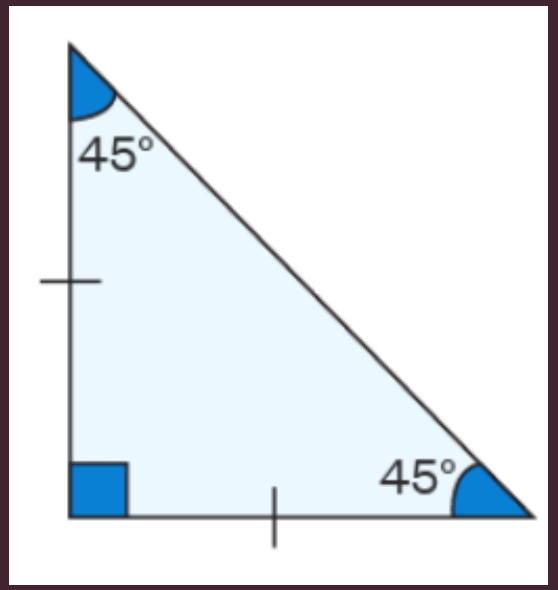
(need a hint?)

Image: CueMath

SPECIAL RIGHT TRIANGLE TASKS

Assuming the lengths of each side of your paper squares are 2 units, what are the lengths of each side of your triangles?

How do the dimensions change if the length is now 1 unit?



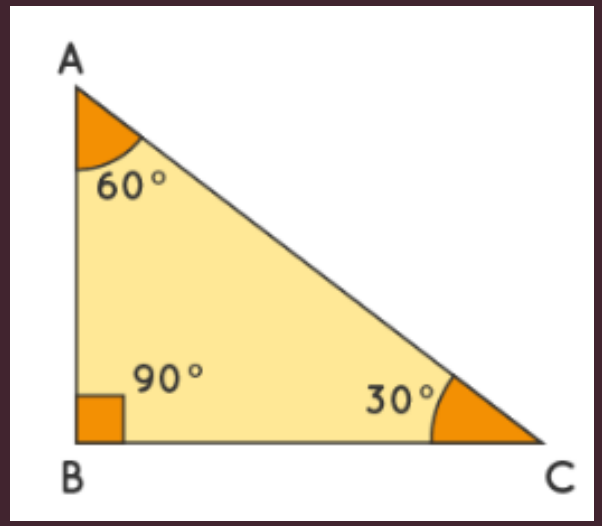
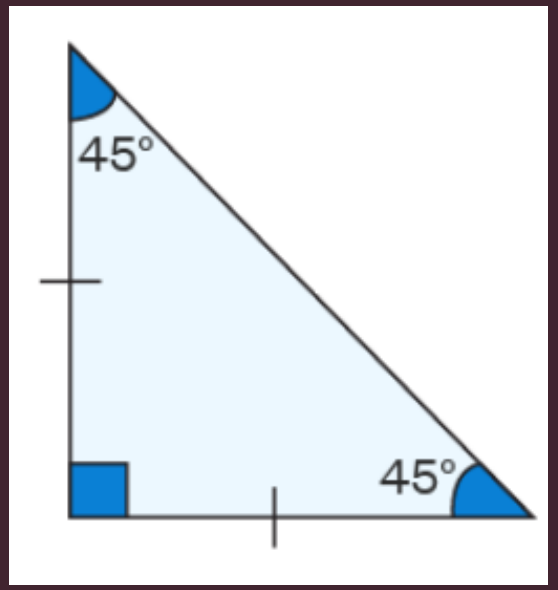
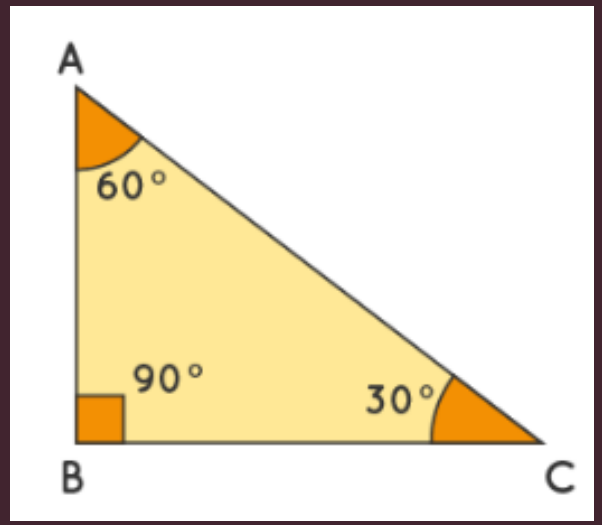


Image: CueMath

SPECIAL RIGHT TRIANGLE TASKS

- What knowledge was acquired by students in this task?
- What advantages could paper folding have over using dynamic software or by simply drawing the triangles?





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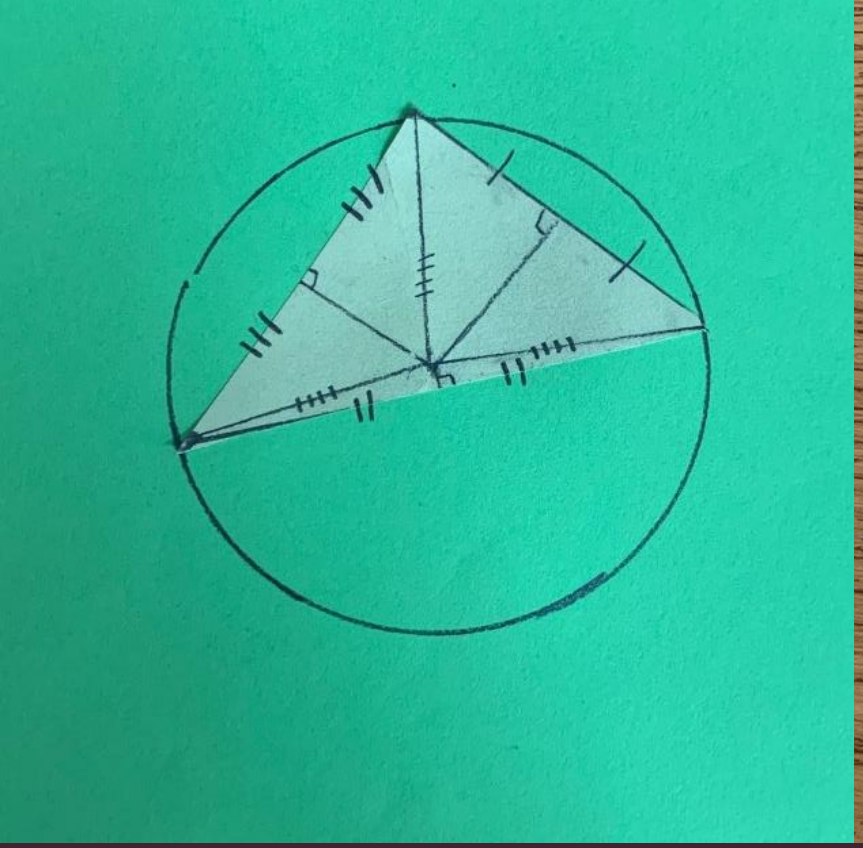
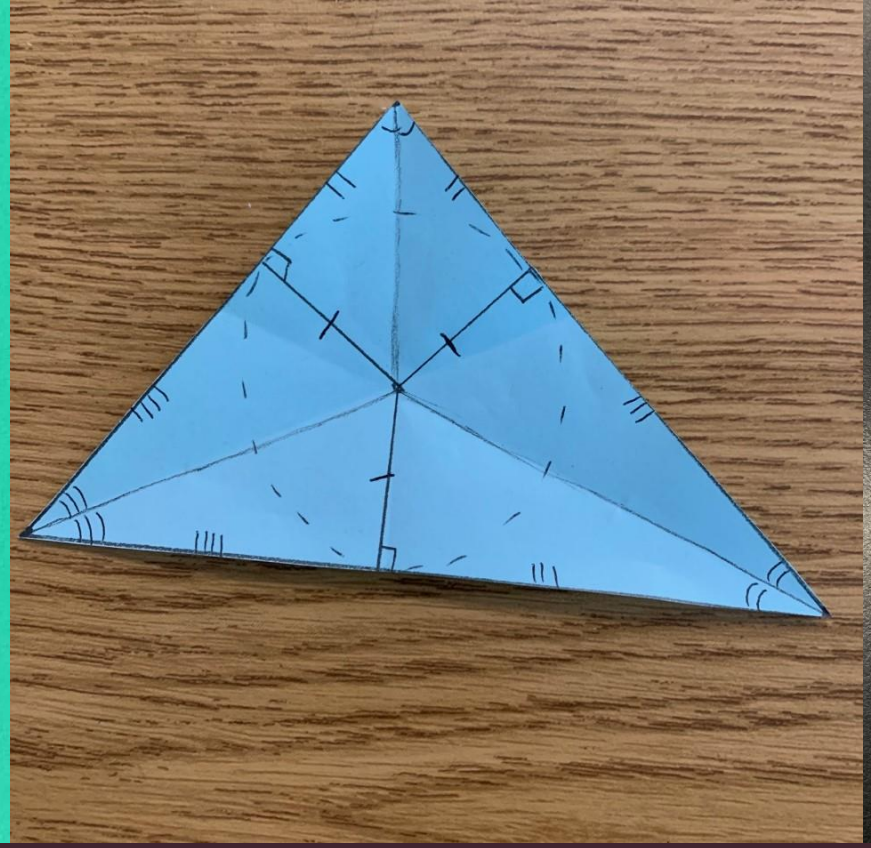
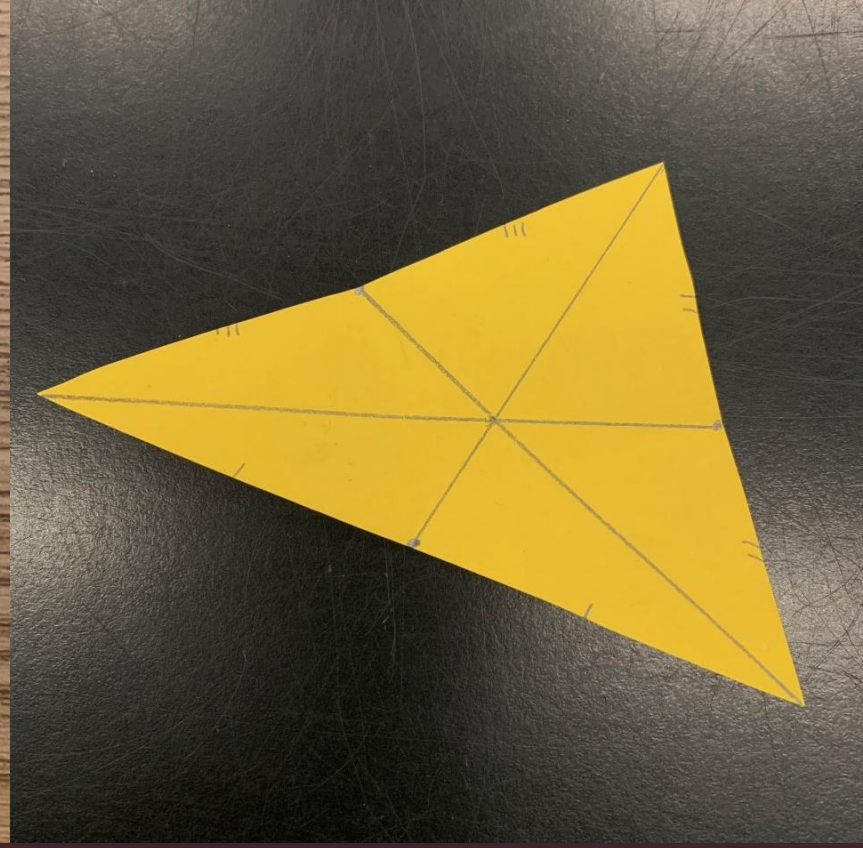


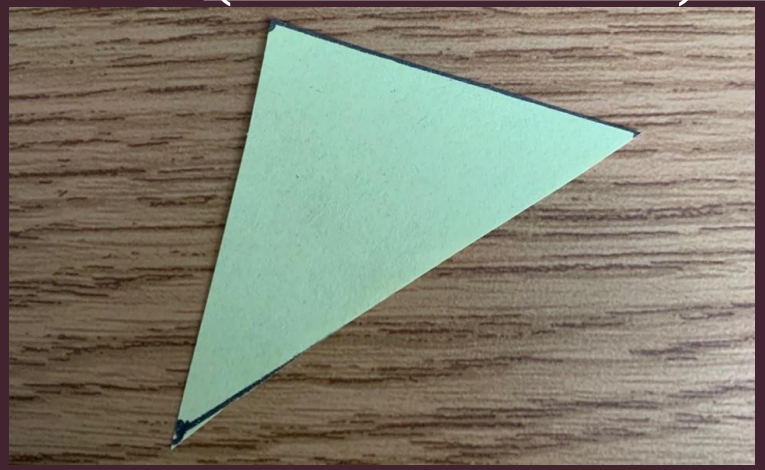




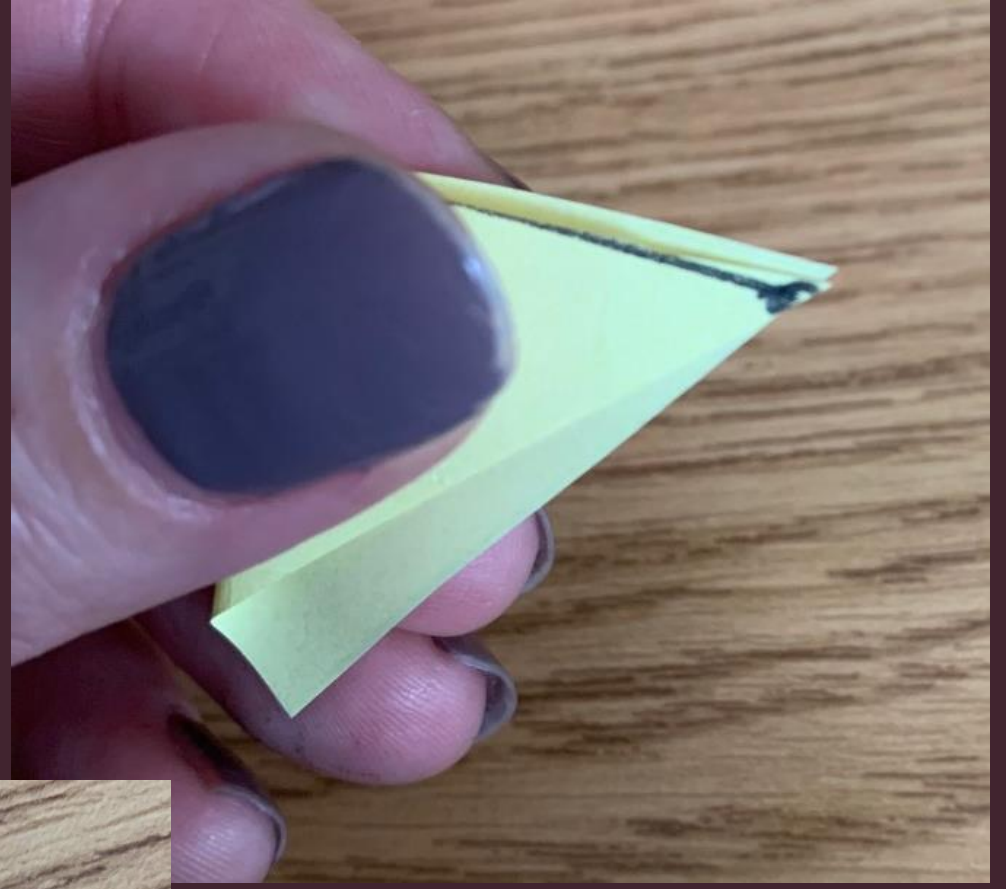
EXTENSIONS

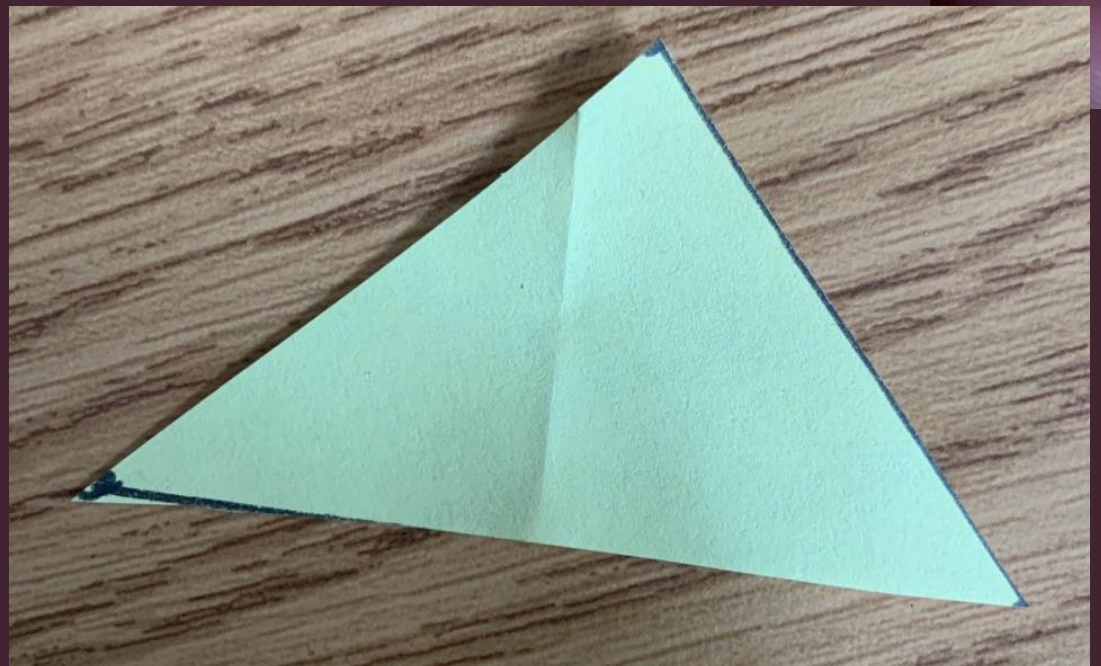
Triangle Centers

(KIRIGAMI) CIRCUMCENTER



- Fold a pair of vertices on top of one another
- This creates a midpoint for that side of the triangle.

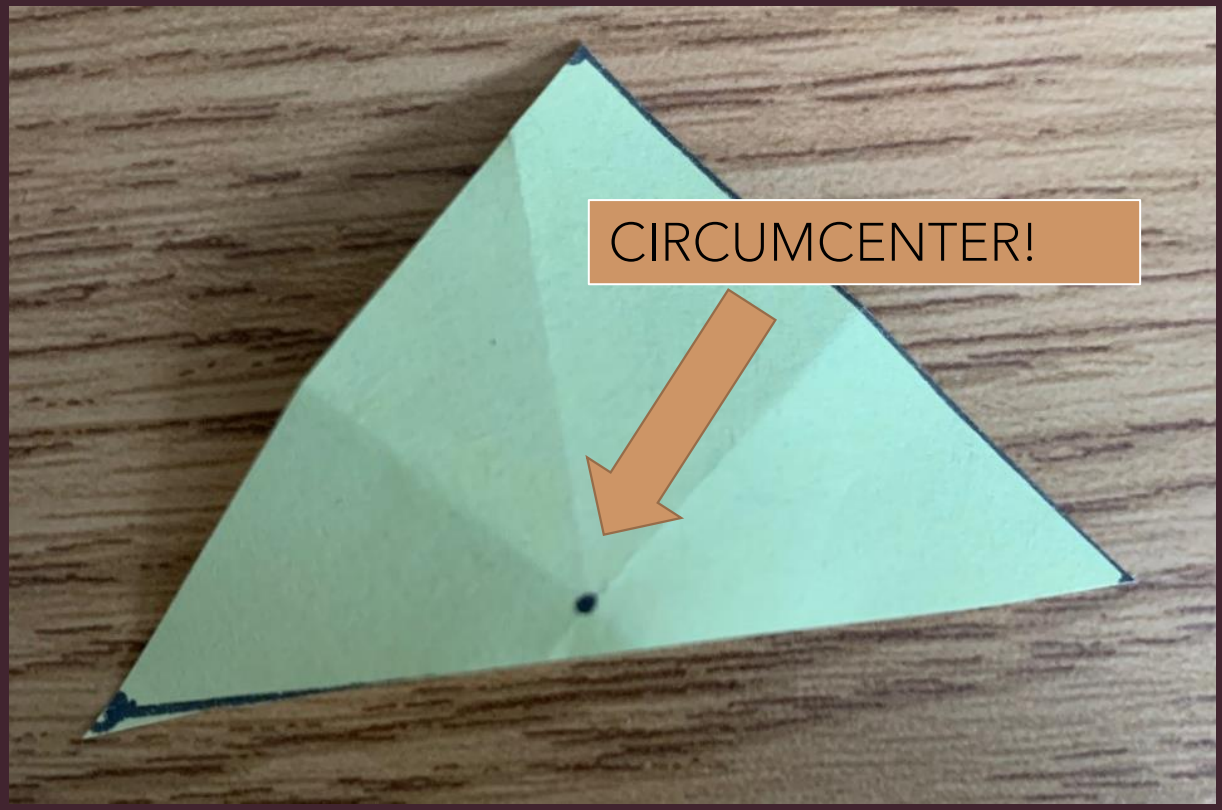




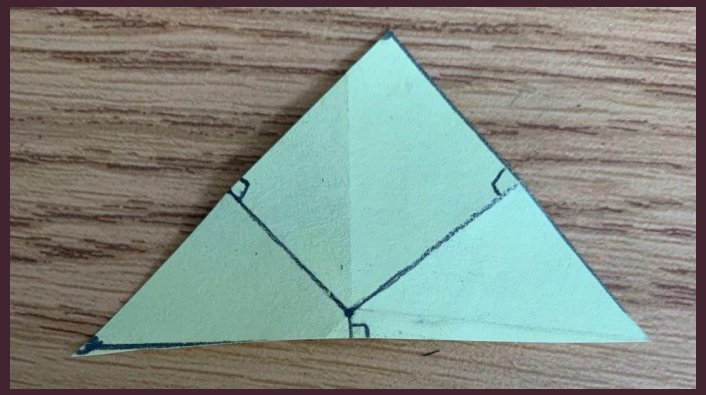
- Perpendicular Bisector!

CIRCUMCENTER

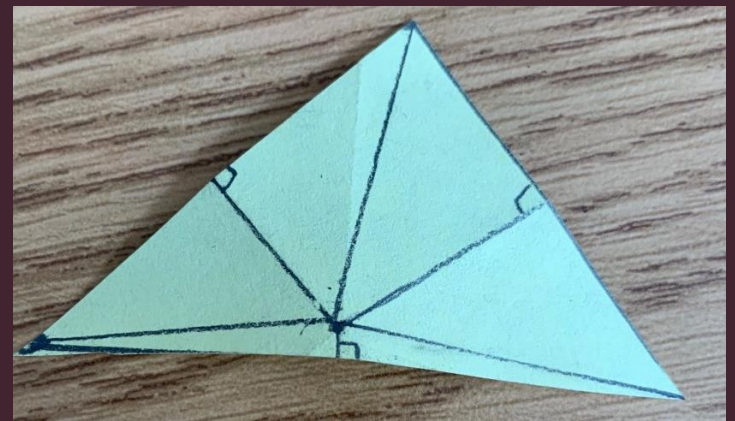
- Fold for all 3 pairs of vertices



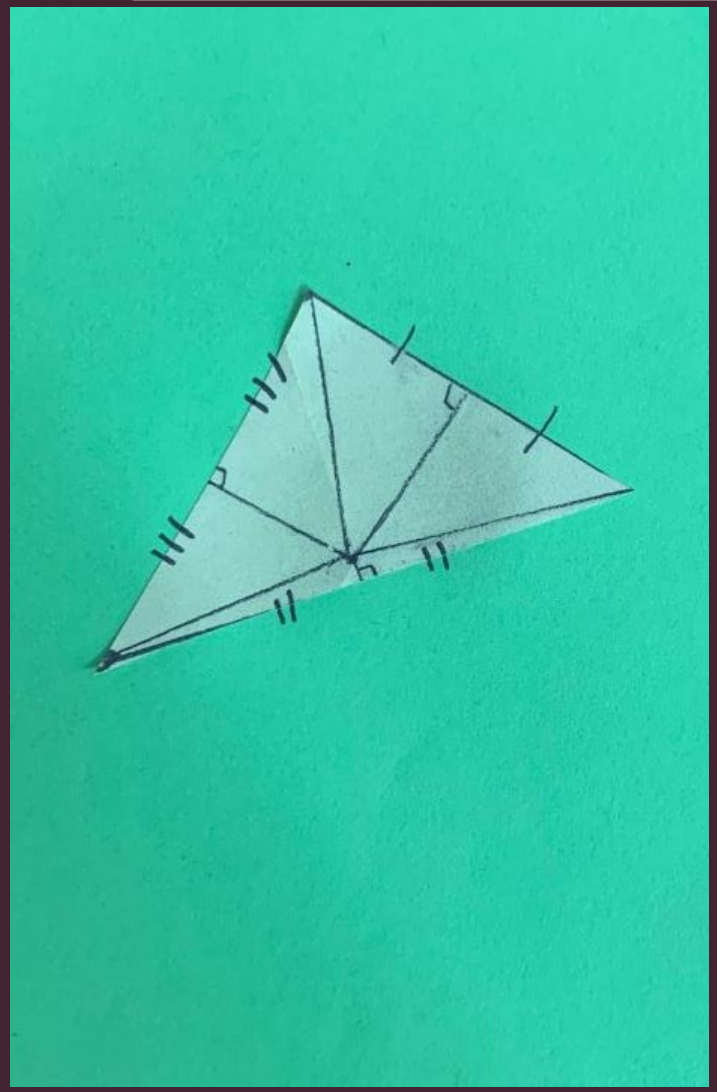
Draw perpendicular lines from circumcenter to sides

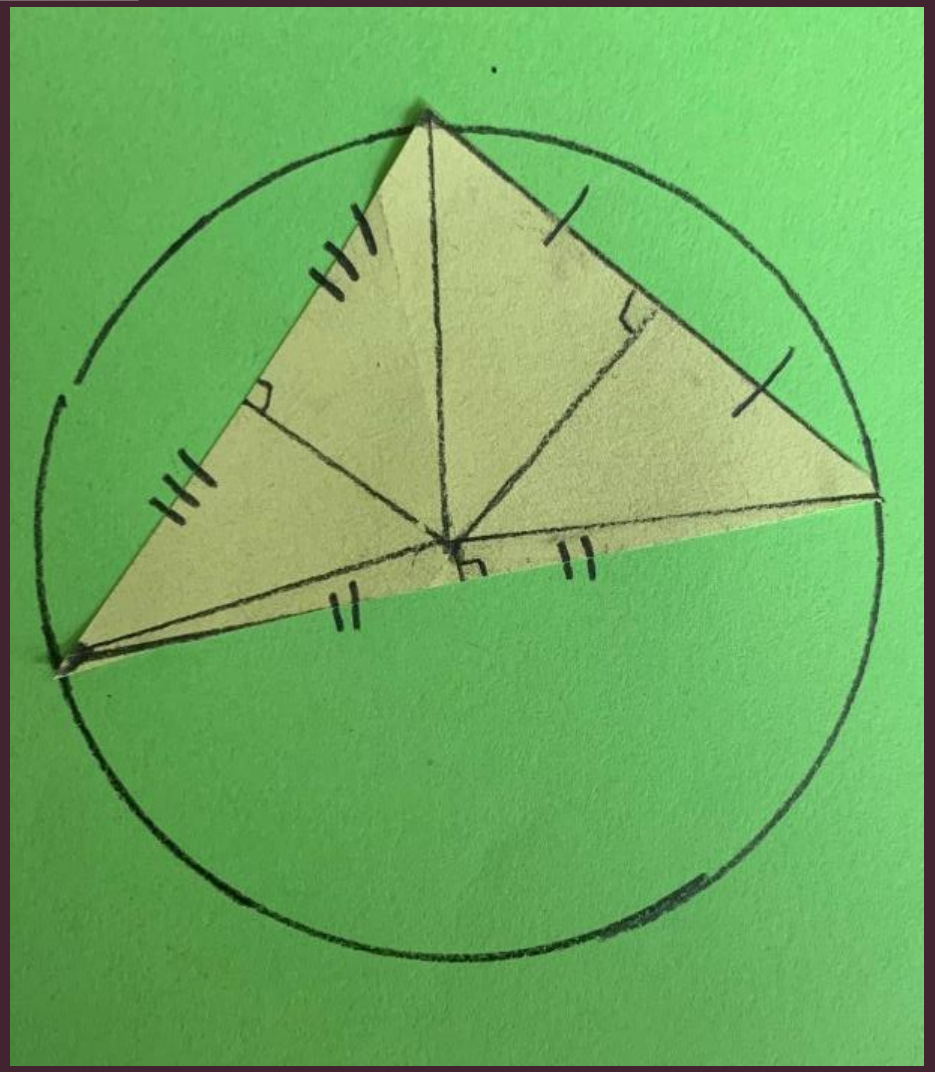


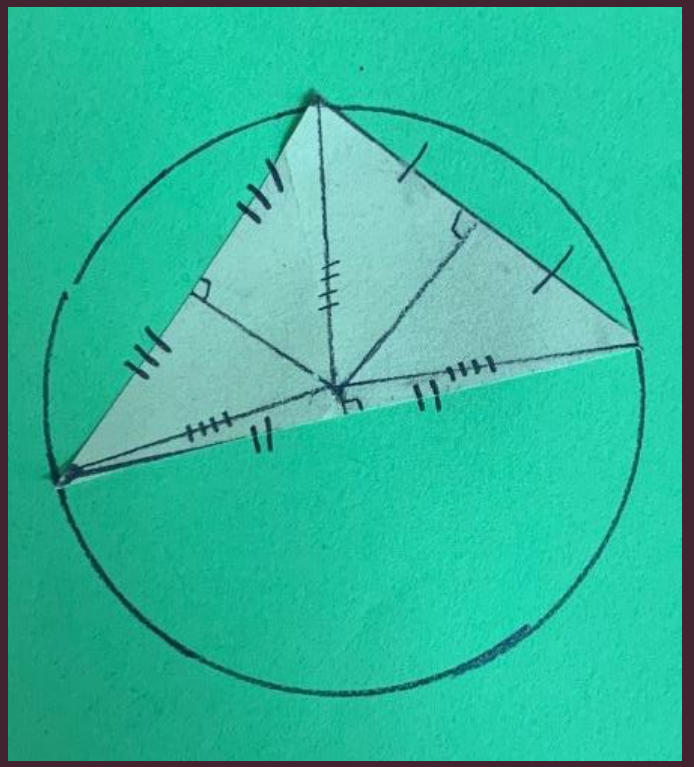
Draw lines from circumcenter to each vertex



CIRCUMCENTER

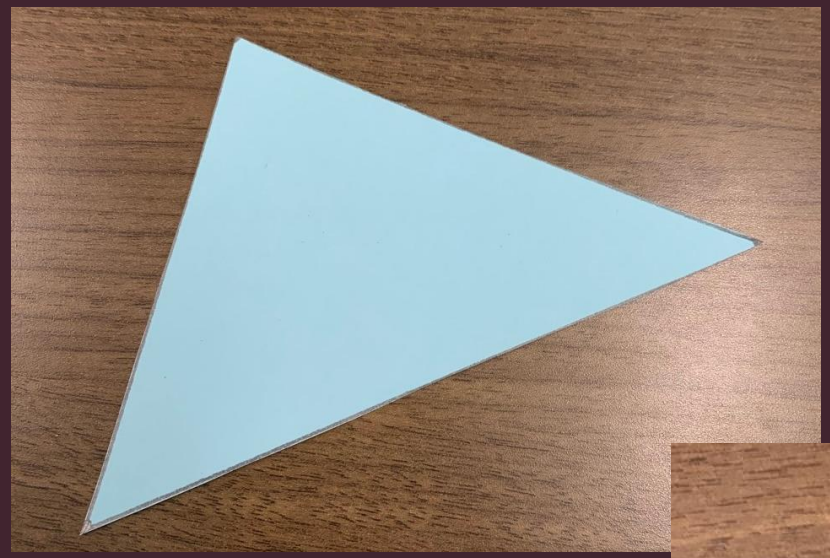




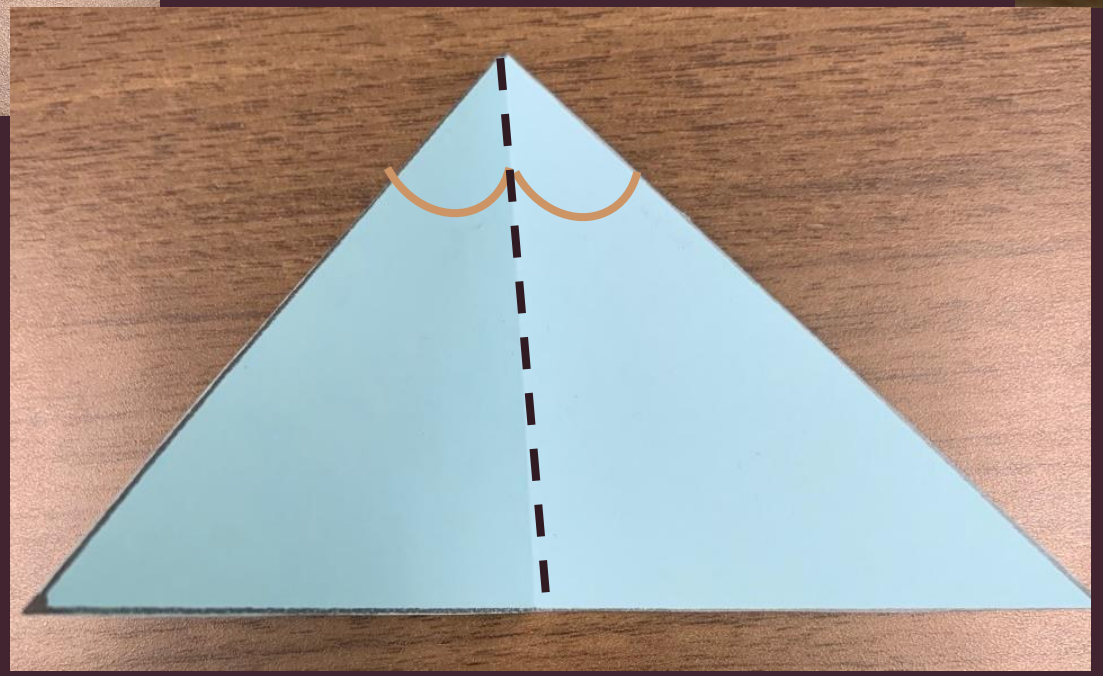


- Lines from circumcenter to each vertex is a radius (they're all ≅)

KIRIGAMI INCENTER

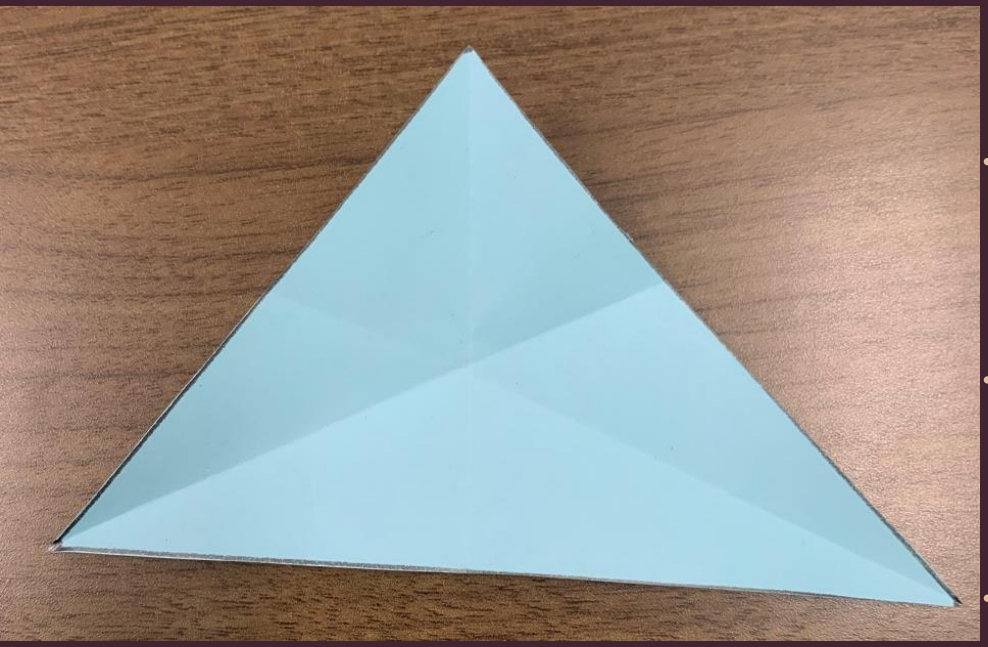


- Fold a vertex in half
- This creates 2 congruent angles at the vertex.

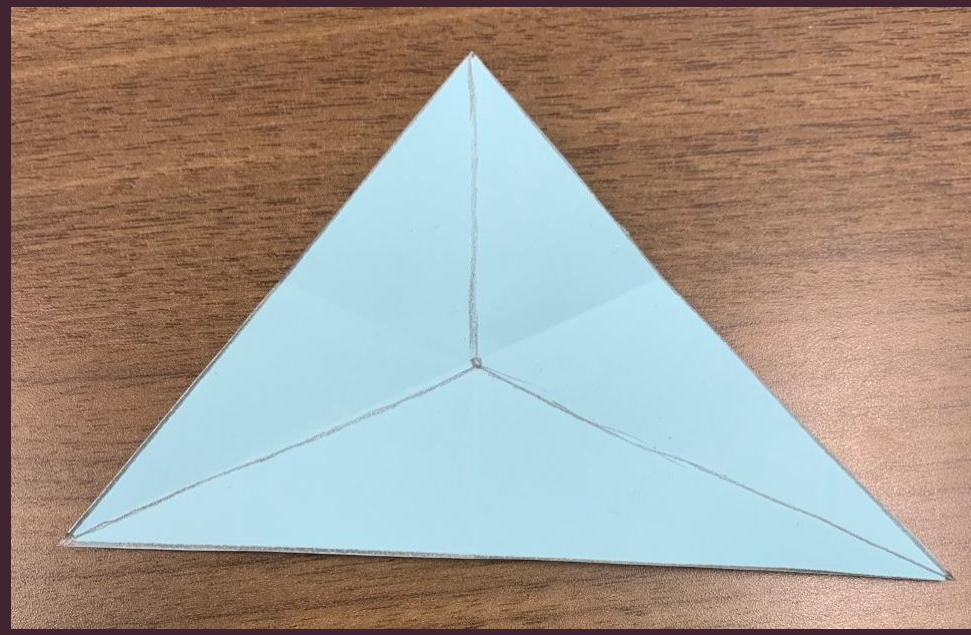


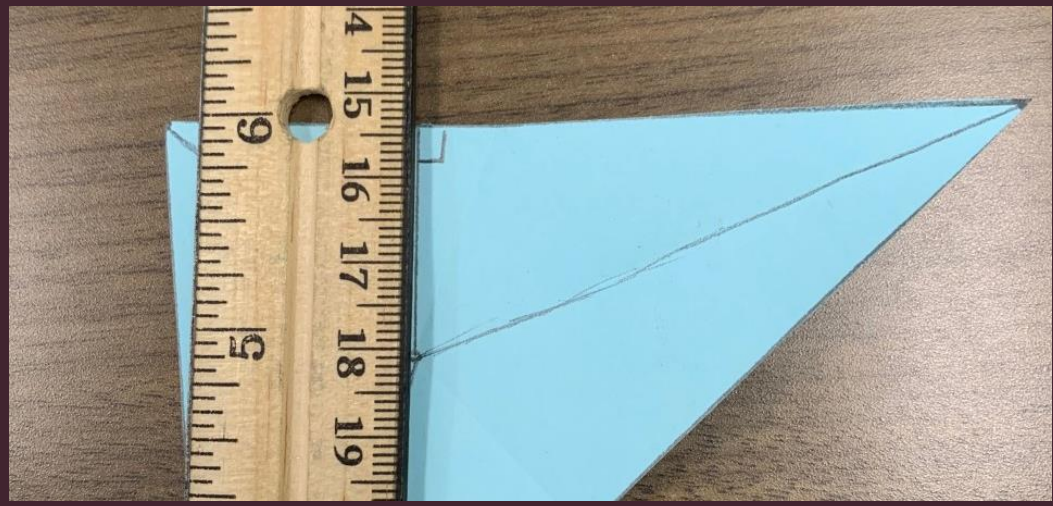
- Angle Bisector!

INCENTER

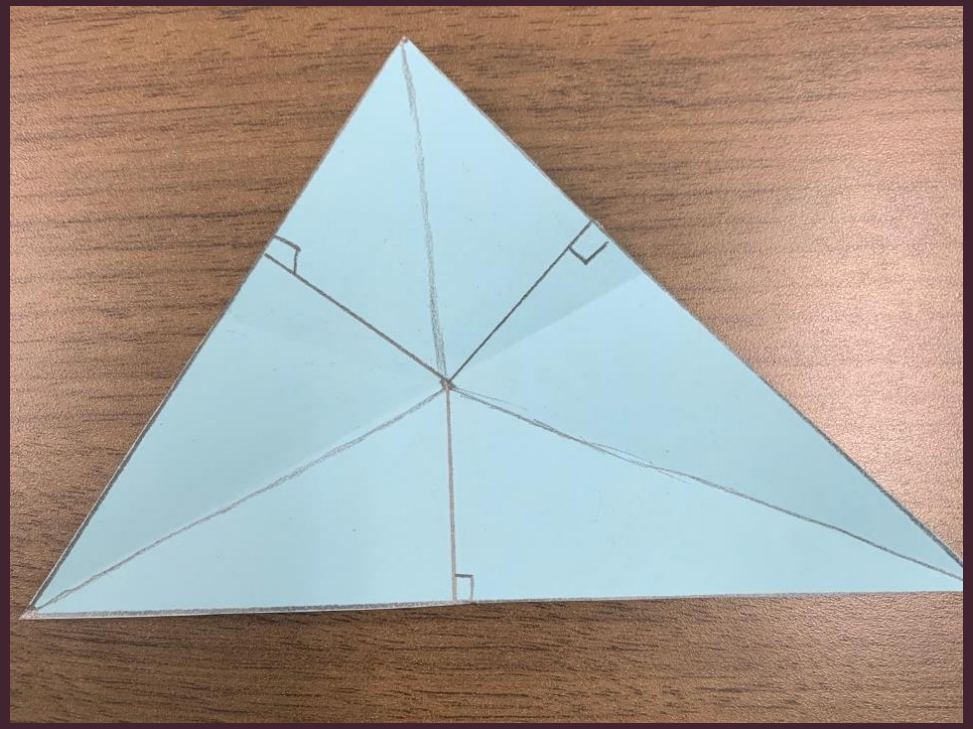


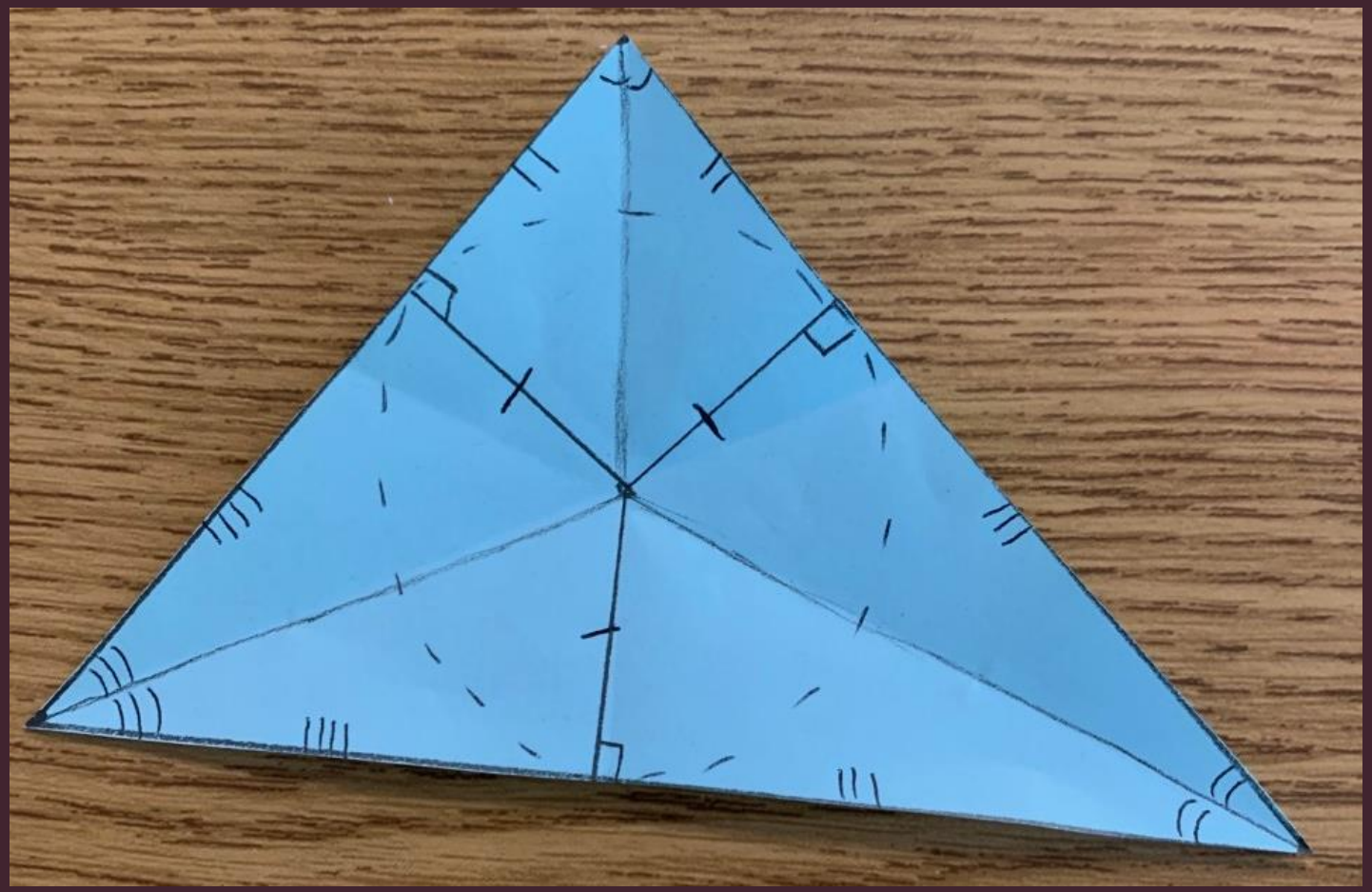
- Fold each vertex in half to create all 3 angle bisectors
- The point where the 3 lines meet is the incenter!
- Trace lines from the incenter to each vertex
- Then draw perpendicular lines from the incenter to each side (use a ruler to see the 90^0 angle)





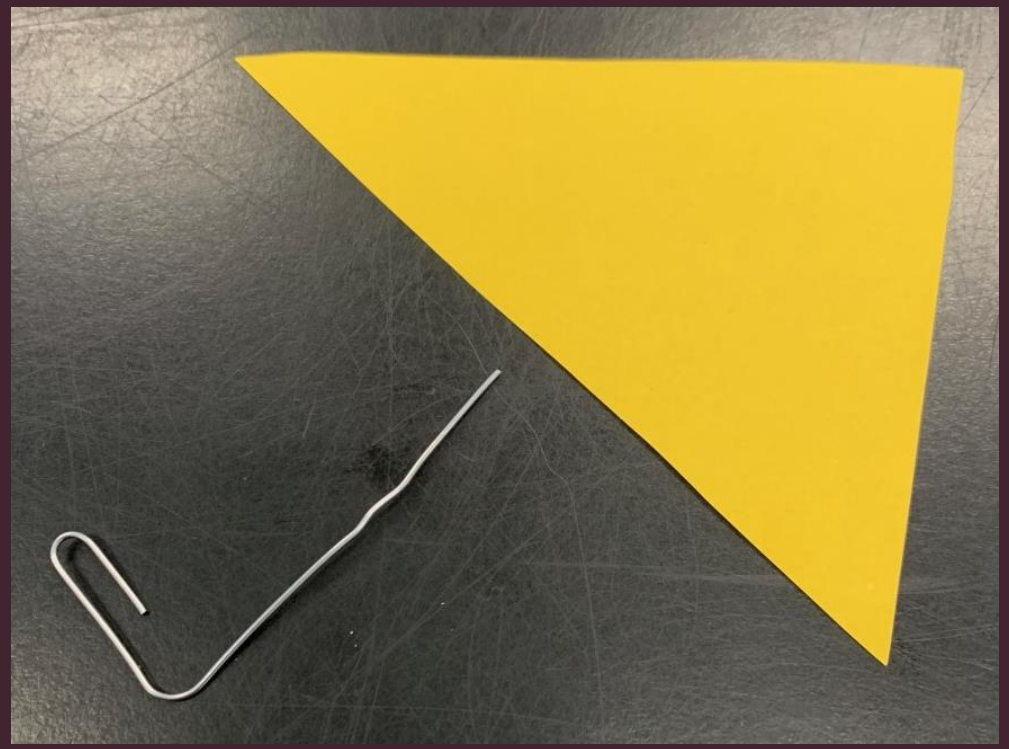
INCENTER

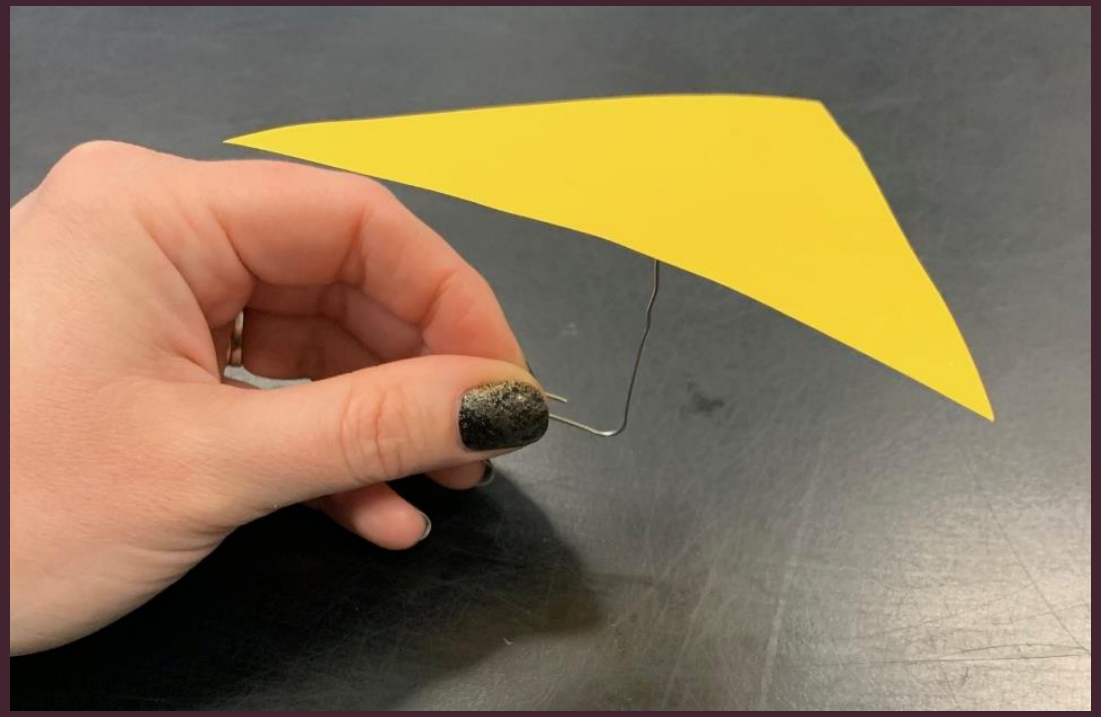


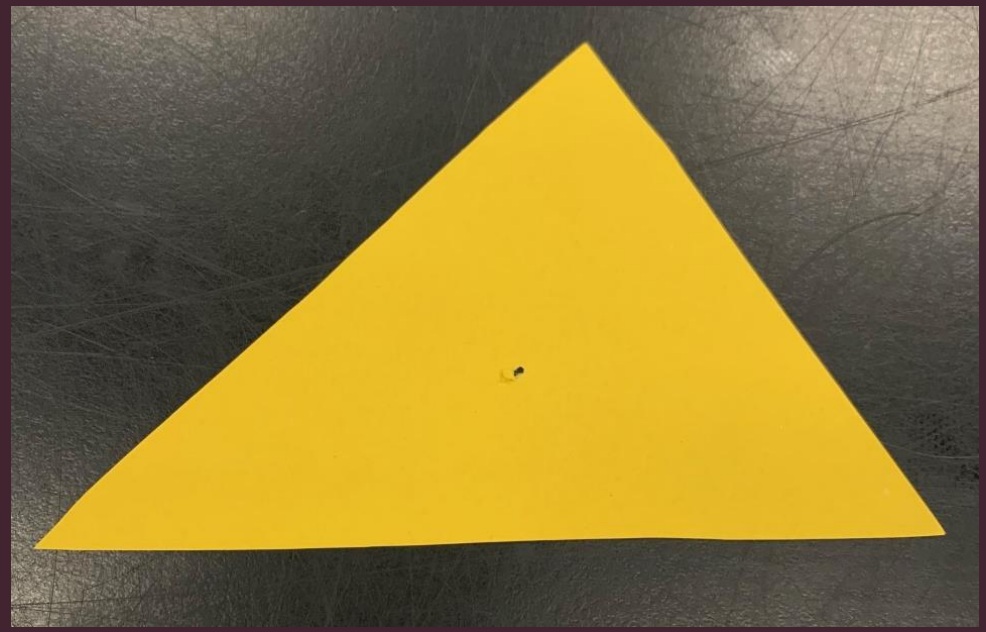


- These 3 perpendicular lines are congruent!
- A circle is inscribed within the triangle, making these lines radii

KIRIGAMI CENTROID



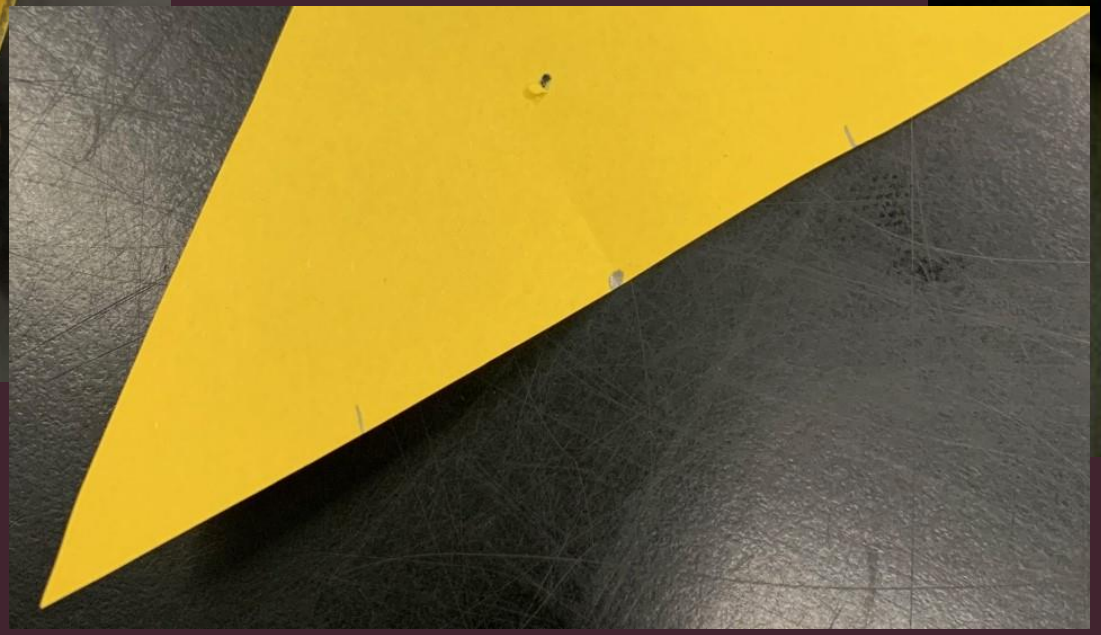


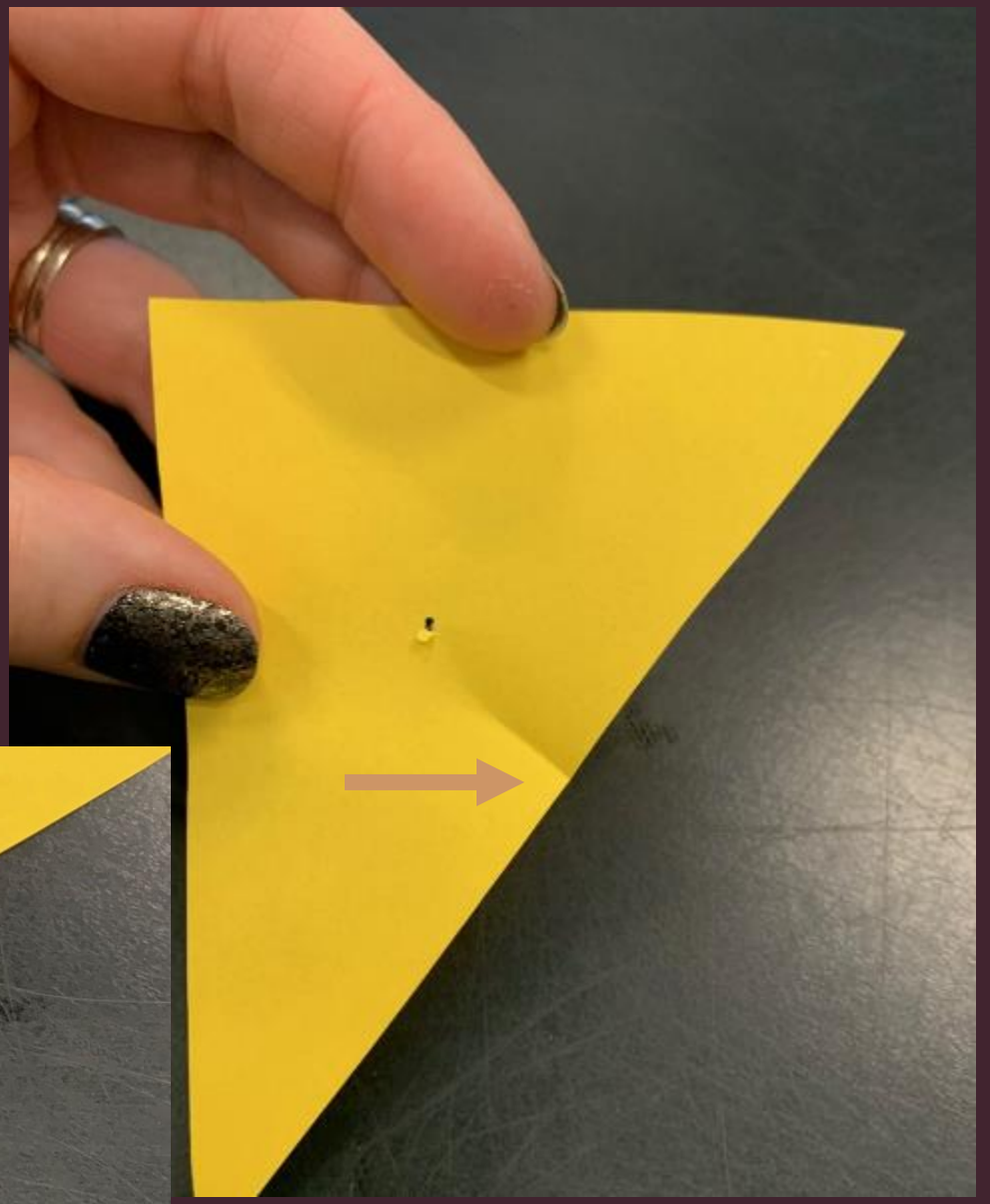


- Draw & cut out a triangle (use a ruler!)
- Bend the paper clip
- Balance the triangle on the paper clip
- Gently punch a hole- you have a centroid!

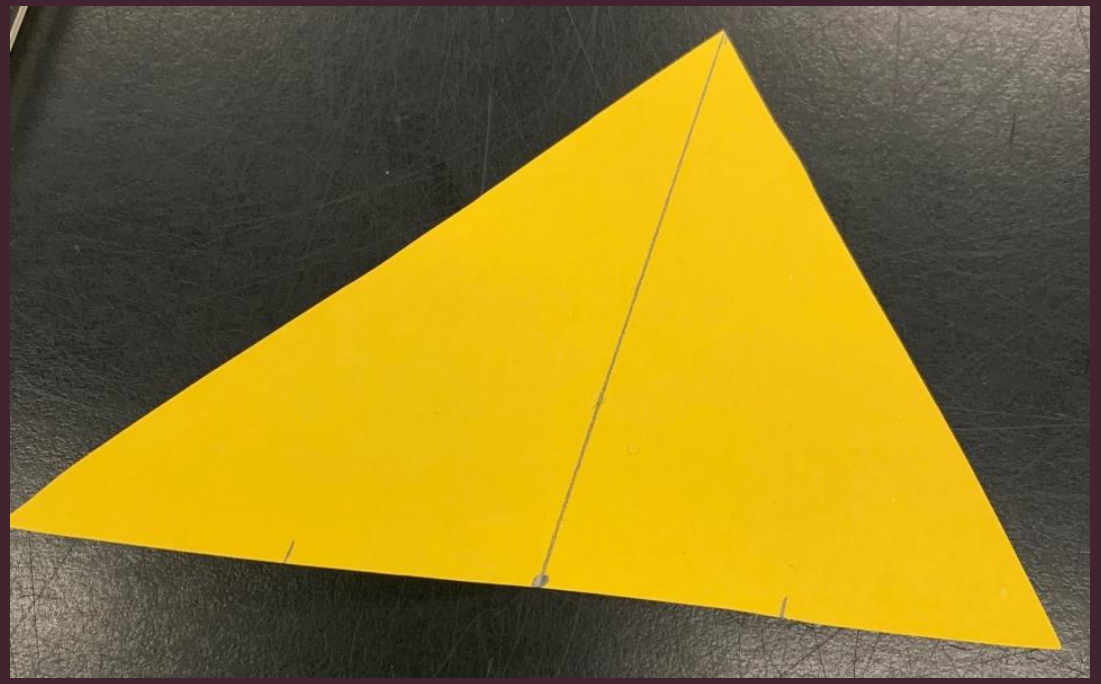
CENTROID

- Line up 2 vertices to create a midpoint- PINCH but DON'T crease!
- You just created a midpoint!



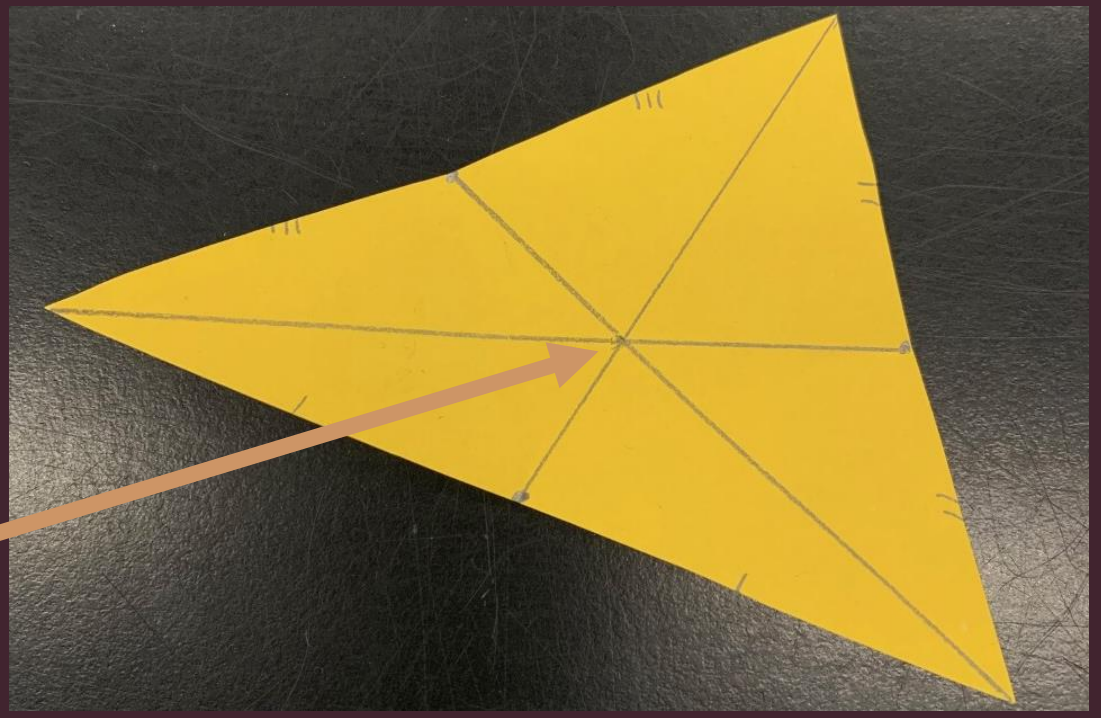


CENTROID



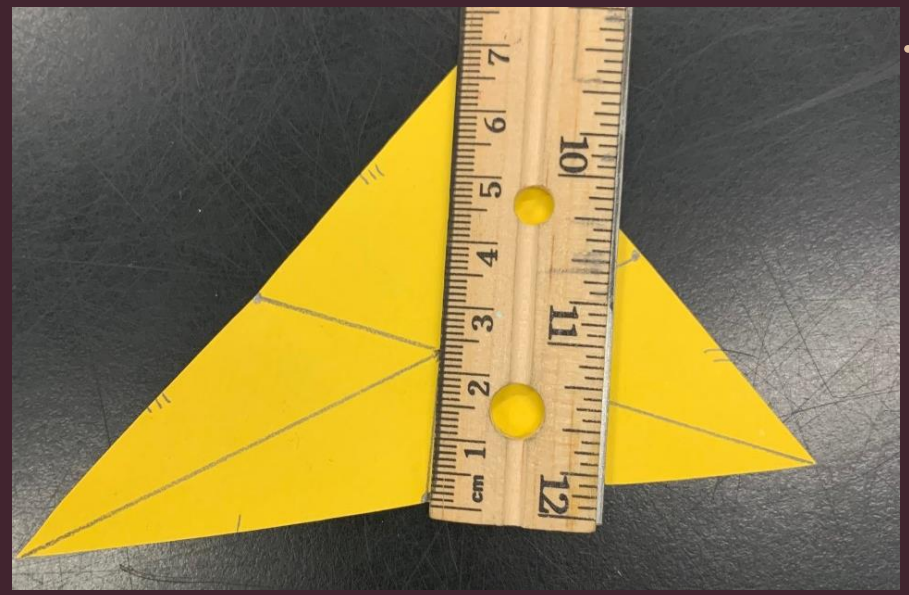
Draw a line from your midpoint to the opposite vertex

- PINCH each pair of vertices to create midpoints. Draw lines to opposite vertices.

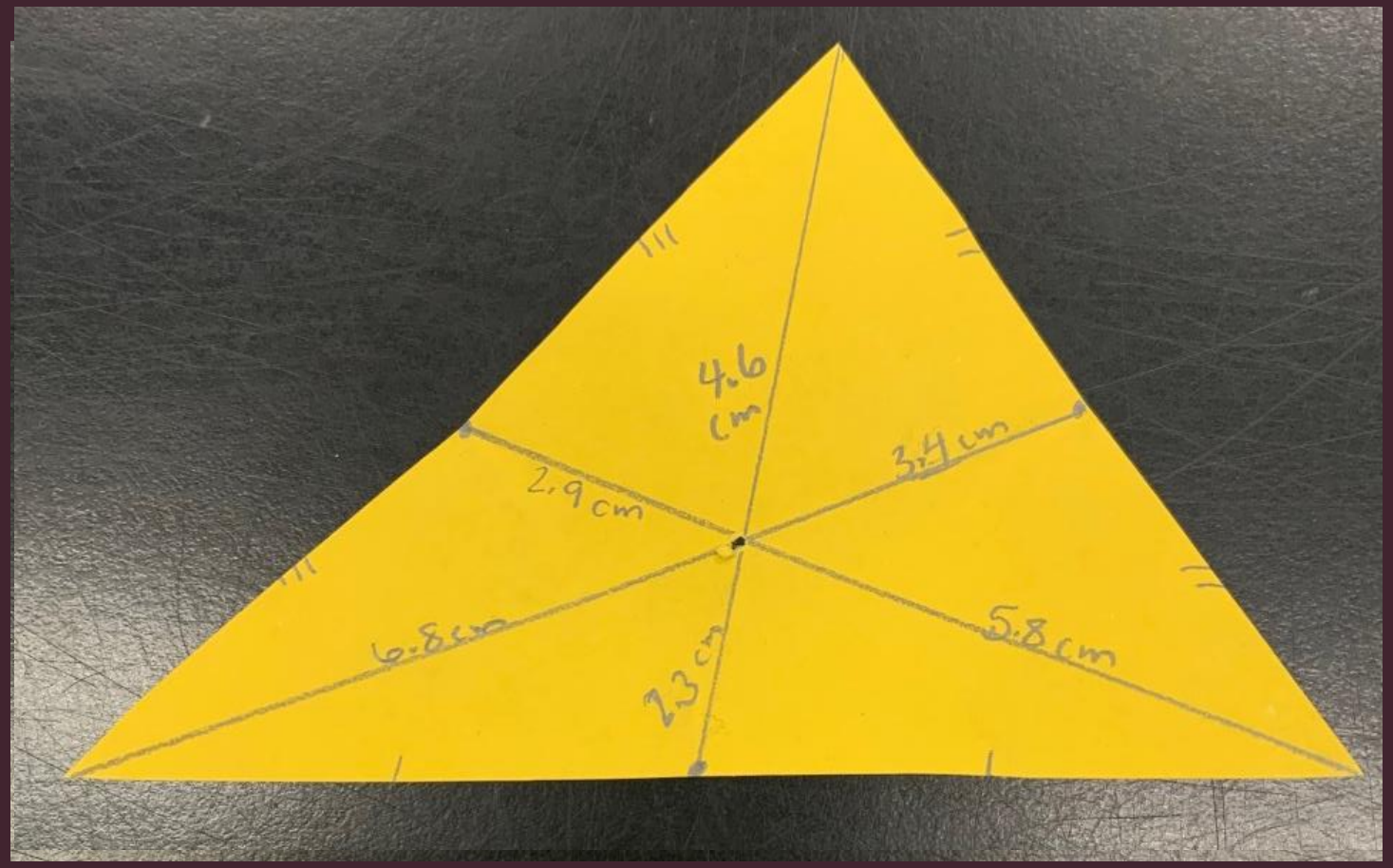


- You created a MEDIAN!
- Where the 3 medians meet is the CENTROID

CENTROID



- Measure the length from each midpoint to the centroid



- What do you NOTICE?
- The median lengths are cut into 2:1 ratio