

Curriculum topics:

- Patterns & Relationships
- Proportions & Ratios
- The Golden Ratio
- Symmetry
- Geometric Shapes
- African Culture
- Artistic Exploration

Subject: Math, Art, Social Studies

Grade range: 5 – 8

Who we are:

Resource Area for Teaching (RAFT) helps educators transform the learning experience through affordable “hands-on” activities that engage students and inspire the joy and discovery of learning.

For more ideas and to see RAFT Locations

www.raft.net/visit-raft-location

Mathematical African Akuaba Figures

Integrate African culture with concepts of mathematical ratios and proportions in creating figures inspired by the ceremonial Akuaba figures.



Materials required

For each student:

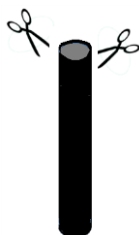
- Copy of Mathematical African Akuaba Figures Chart, 1
- Cardboard cylindrical tube, color black, approximately 18 cm high by 2 cm wide, 1
- Geometric shapes, 8 assorted
- Circle, cardboard or other material, color black, approximately 15 cm in diameter, 1
- Pony or other type of beads, 10
- Black or Gray color corks or other material for arms, approx. 2cm by 6cm, 2
- String, 3 lengths, each approximately 15 cm long.
- Stickers or other decorations, 8
- Feathers, 5 assorted colors.
- Square base, approx. 13 cm by 13 cm, 1
- Scissors, ruler, calculator, 1 each
- Colored markers, crayons, and/or colored pens

To do and notice

1

Measure the diameter along one end of the tube. Mark a point at both ends of the diameter along the circumference of one of the tube's ends. At each point, use scissors to cut 1.5 cm vertical slits down the tube. Set the tube aside. Measure and record the following on the *Mathematical African Akuaba Figures Chart*:

- The diameter of the tube
- The length of the tube

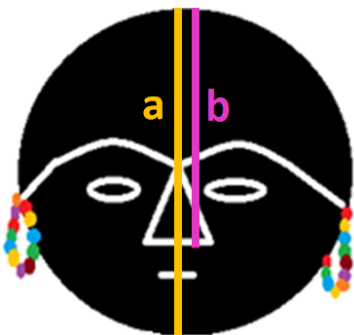


2

Measure and record the diameter of the circle on the *Mathematical African Akuaba Figures Chart*. (Optional: use a compass to draw a circle on black cardstock having a 11.5cm diameter, then cut out the circle).

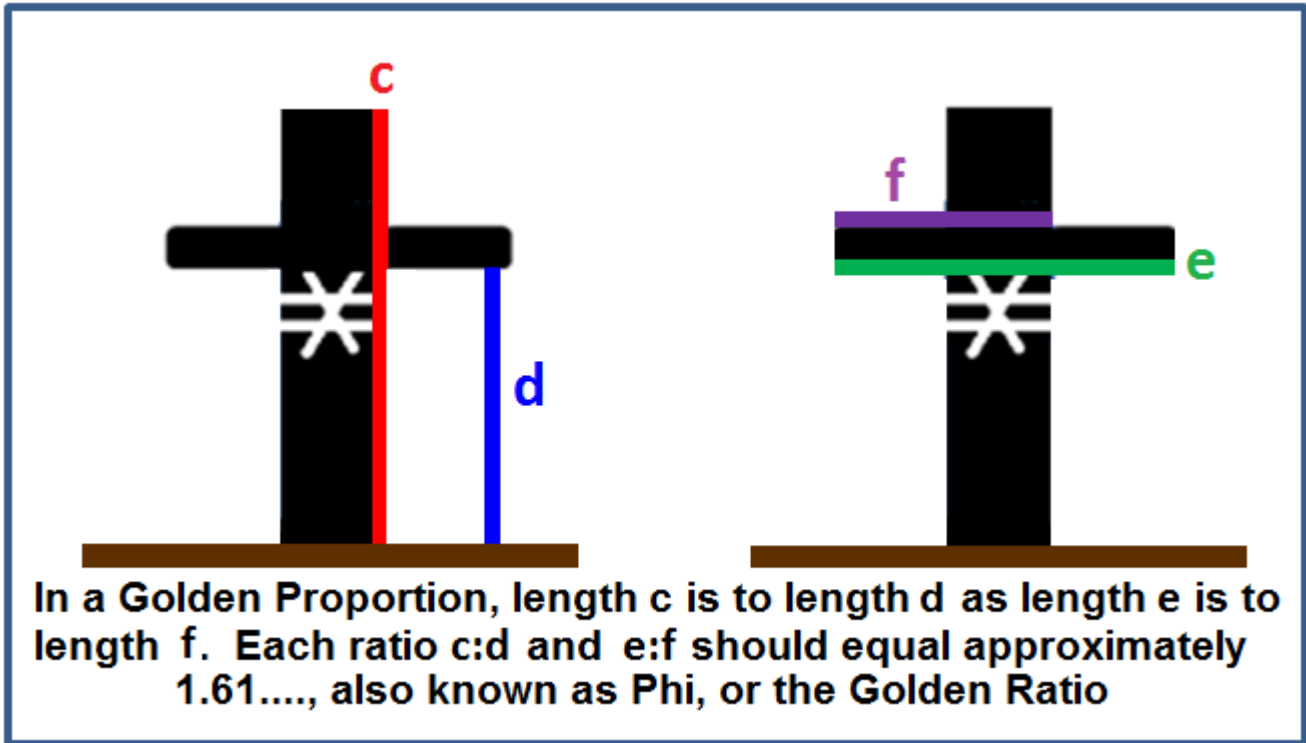
3

Determine where to draw or glue symmetrical facial features so that the positions make “golden ratios” and record measurements on the *Mathematical African Akuaba Figures Chart*. For example in the figure below, the distance from the top of the head to the bottom of the chin (length a) divided by the distance b (top of head to bottom of nose) should equal approximately 1.618 = the Golden Ratio, an irrational number, symbolized by the Greek letter phi (φ or ϕ).



Optional: string beads to make earrings. Punch holes on either side of the face and slip beaded strings through for earrings to hang (or use glue to attach the earrings to the sides of the face).

- 4 Glue the bottom of the tube to the middle of the square base. Locate the placement then attach the arms so they form golden ratios as shown below:



- 5 Measure and record the following on the *Mathematical African Akuaba Figures Chart*:

- The length of the tube (length c above)
- The distance from the bottom of the arm to the base (length d above)
- The length from the tip of one arm to the tip of the other arm (length e above)
- The length from end of one arm to the outer edge of the tube (length f above).
- The ratio of c to d
- The ratio of e to f

- 6 Insert the circle into the slits on the upper end of the tube. Optional: Add feathers, lines under the chin (see background information below) and other decorations as desired.



The content behind the activity

The math behind the activity:

This activity helps students understand golden ratios and proportions while creating a model of the Akuaba figure. Students problem solvers use the Common Core Math practices throughout their investigations making measurements that form golden ratios and proportions: paying attention to detail, being persistent in their investigations, being precise with numbers, looking for efficient strategies in their constructions, using number sense and math to describe a real situation, and using tools strategically.

Historical Background Information:

Akuaba are wooden ceremonial “good luck” fertility dolls from Ghana and nearby areas of Africa. The best known are from the Ashanti people, with large, disc-like heads. The flat forehead of the Akuaba is a sign of royalty among the Ashanti and rings on the neck are meant to suggest the creased flesh of a chubby baby. The black color, beaded necklaces, and earrings represent feminine beauty. Today Akuaba are sold as souvenirs and general symbols of good luck.

Curriculum Standards:

Ratios & Proportional Relationships (Common Core State Standards: Grades 6 – 8)

Traditions & culture (National Curriculum for Social Studies: Theme 1, Culture)

Geometry 5G.3; 6T.1; 7G.2, 3, 4, 6; 8G.4, 9

Learn more

Further questions:

- Describe what it means to be symmetrical.
- What is an irrational number?
- What is the difference between a ratio and a proportion?
- Where else can you find golden ratios and proportions on the Akuaba figure?
- If a ratio isn't "golden", how could you make it "golden"?
- Can you find golden ratios in your own face and body?
- Who discovered the golden ratio and where is it found and used in real life?

Related Activities:

Mancala -- <http://www.raftsac.org/ideas/Mancala.pdf>

Nine Men's Morris (including African version Morabaraba) -- <http://www.raftsac.org/ideas/Nine%20Mens%20Morris.pdf>

Mathematical Russian Matryoshka Figures – <http://www.raftbayarea.org/ideas/Mathematical%20Russian%20Matryoshka%20Figures.pdf>

Mathematical Hopi Kachina Figures – <http://www.raftbayarea.org/ideas/Mathematical%20Hopi%20Kachina%20Figures.pdf>

Mathematical Japanese Kokeshi Figures – <http://www.raftbayarea.org/ideas/Mathematical%20Japanese%20Kokeshi%20Figures.pdf>

Resources

Visit www.raft.net/more for "how-to" video demos and more ideas!

See these websites for more information on the following topics:

- More on the Golden Ratio – <https://www.mathsisfun.com/numbers/golden-ratio.html>
- Example problems on Proportions and Ratios --- <http://www.mathsisfun.com/algebra/proportions.html>
- More information on the African Akuaba Doll --- <http://smafathers.org/museum/ghana-birth-and-death-akua-ba-dolls/>
- Information on the Ashanti African Culture --- <http://jared007.blogspot.com/>