

Curriculum topics:

- Patterns & Relationships
- Area and Surface area
- Properties of Circles & Cylinders
- Geometric Shapes
- Native American Culture
- Artistic Exploration

Subject: Math, Art, Social Studies

Grade range: 3 – 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 Hopi Kachina Figures

Combine geometry with Native American Indian culture to create a figure inspired by the Hopi Kachina doll!



Materials required

For each student:

- One cardboard cylindrical tube, approximately 14 cm high by 5 cm wide.
- Geometric shapes, assorted
- Circle, cardboard or cup lid, approximately 10 cm by 10 cm.
- Feathers, 5
- Pony or other type of beads, 6
- String, 1 length approximately 20 cm long.
- Stickers or other decorations
- Fabric square, 1 approximately 15 cm by 15 cm.
- Copy of Mathematical Kachina Chart, 1
- Scissors, ruler, calculator, 1 each
- Colored markers, crayons, and/or colored pens



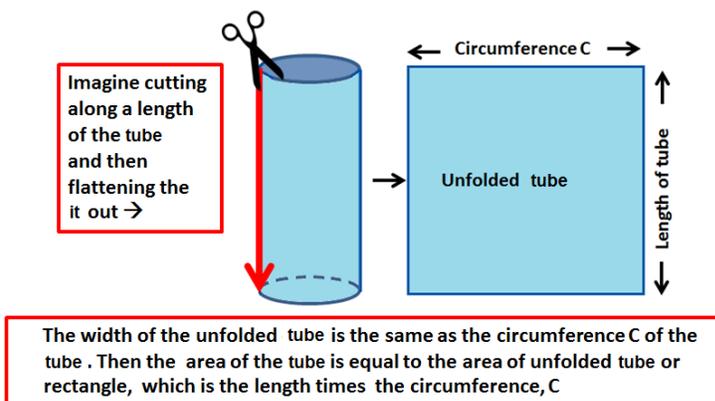
To do and notice

1 Measure and record the **BODY** of the figure on the *Mathematical Kachina Chart*.

- The Diameter, d , of the tube (the widest point across one open end)
- The tube's Circumference, C : wrap string around the circumference of the tube: unwrap and measure the length of the string. Use the Measured Circumference C to find and record the Calculated Diameter of the tube using the formula below (where π is approximately 3.14)

$$C = \pi d \quad \text{Solving for the diameter yields: } d = C \div \pi = C/\pi = \frac{C}{\pi}$$

- The Length, L , of the tube.
- The Surface Area of the tube (equal to the circumference times the tube length).

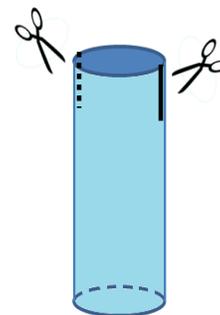


- Compare the measured and calculated diameters. Discuss.

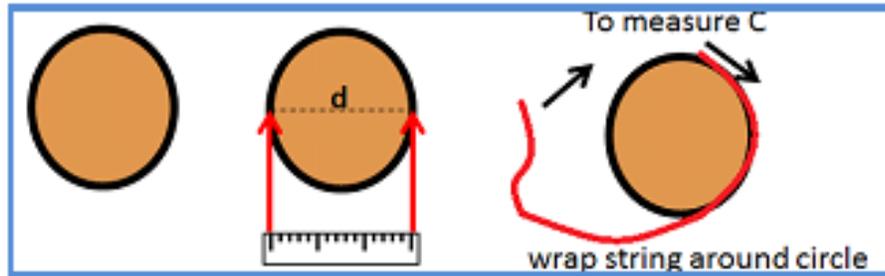
2 Mark a point at both ends of a diameter of one open end of the tube. At each point, cut ~1 cm (1/2 inch) vertical slits down the top sides of the tube →

3 Measure and record the **HEAD** of the Figure on the *Mathematical Kachina Chart*.

- The Diameter D of the circle with a ruler (refer to diagram)
- The Circumference C of the circle with a length of string wrapped around the circle outer edge from start to end.
- Use the formula $C = \pi D$ to calculate the circumference of the circle.

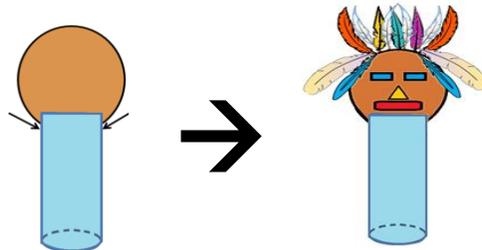


- The Area of any circle = πr^2 , where r is equal to the circle's radius. Notice $D/2 = r$. Use the formula $\pi (D/2)^2$ to record the Area of the circle.
- Compare and discuss the measured and calculated Circumferences.



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Insert the circle head into the slits on the upper end of the tube. Use pens, crayons, or markers to decorate the face and other designs. Optional: glue on geometric shapes to resemble facial features. Add feathers and other decorations as desired.

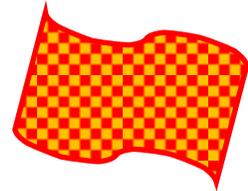


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Create a **BLANKET** for the figure --- cut a piece of fabric with the following dimensions:

Length = tube's circumference, C , plus 13cm (or 5 inches)

Width = $2/3$ times the length of the tube



Measure and record the following on the *Mathematical Hopi Kachina Figures Chart*.

- The Length, width, area, and perimeter of the blanket.
- Compare and discuss the area and perimeter of the blanket.
- Compare the surface area of the tube to the area of the blanket. Discuss.

Wrap the blanket around the body and staple to front through top edge of tube. Optional: Add fringe around the perimeter of the blanket. Create a necklace threading beads onto string. Secure the string ends through the vertical slits on the tube so that the necklace fits around the "neck" of the figure. Tie a knot in the back.

The content behind the activity

The math behind the activity:

Hopi Kachina figures (dolls) are cherished idols of worship that represent the masked spirits of gods who taught the Hopi how to live on earth and they represent the spirit of everything in the world. Kachina dolls are very important to the Hopi cultural traditions and history, and are a main way that stories are told and passed down through generations from clan to clan.

This activity offers students a creative interesting approach for learning the properties of circles, cylindrical tubes, and more. Students compare hand measurements to formula calculations in the body, head, and blanket of the Kachina figure, in diameters, circumferences, surface areas, and other geometric properties.

Curriculum Standards:

Patterns
(Common Core Math Standards: Operations & Algebraic Thinking, Grade 4, 5; Grade 5, 3)

Two-dimensional figures
(Common Core Math Standards: Grade 5, Geometry, 3, 4, & 5)

Problem Solving and Reasoning
(Common Core Math Standards: Mathematical Practices Grades 1-5)

Creative art, materials, and making
(National Visual Arts Standards: Creating: Grades 1-5, 1.1; Grades 1-5, 2.1)

Art, society, and culture (National Visual Arts Standards: Connecting: Grades 1-5, 11.1)

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

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

Learn more

Further thoughts to ponder include:

- What is the surface area of the blanket?
- What is the perimeter of the blanket if it has a surrounding fringe?
- How does the surface area of a cylinder containing a top and bottom differ from the surface area of the tube?
- What other geometric shapes do you see in the Kachina?
- Research the history of the Hopi Kachina and report on your findings.
- Explain how you used math, art, and culture in this activity.

Related Activities:

Explore other RAFT Native American Indian math and art concepts:

Mathematical Dream Catchers –

<http://www.raftbayarea.org/ideas/Mathematical%20Dream%20Catchers.pdf>

Advanced Mathematical Dream Catchers –

<http://www.raftbayarea.org/ideas/Advanced%20Mathematical%20Dream%20Catchers.pdf>

Gaming Sticks –

<http://www.raftbayarea.org/ideas/Gaming%20Sticks.pdf>

File Folder Weaving –

<http://www.raftbayarea.org/ideas/File%20Folder%20Weaving.pdf>

Patterning with Polygons –

<http://www.raftbayarea.org/ideas/Patterning%20with%20Polygons.pdf>

Mathematical Russian Matryoshka Figures –

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

Mathematical African Akuaba Figures –

<http://www.raftbayarea.org/ideas/Mathematical%20African%20Akuaba%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:

- Types of Hopi Kachina Doll ---
<http://www.snowwow.com/naartkachinadescriptions.htm>
- Kachina Doll meanings & Hopi culture ---
<http://www.warpaths2peacepipes.com/native-american-culture/hopi-kachina.htm>