week 2

Will It Go Round in Circles?

Make the closest estimate of the area and circumference of the circle created by the team members sitting cross-legged.

Subjects and Skills

- Geometry
- Estimating measurement, converting units of measurement
- Circles (circumference, diameter, area, pi)

Materials

- String or yarn
- Metersticks/yardsticks (use only after team challenge has been completed)
- Calculators

Vocabulary

- Cubits
- Digit
- Span
- Fathom
- Circumference
- Diameter
- Pi
- Radius
- Area

Purpose

The concepts associated with circles are based on fundamental geometric principles. Students will create their own circles and will understand what the circumference and area look like, as well as how they are related to circles.

Objectives

Students will:

- estimate the area and circumference of a circle;
- check estimation by finding the exact measurements;

- relate area and circumference to real life as they physically form a circle with their group;
- define diameter, radius, pi, area, and circumference; and
- understand how measurements have changed over time.

Activity Preparation

1. Run off activity sheets.
2. Gather materials and place them in two different areas in the room.
3. Bookmark websites to be used in class.
   a. http://www.touregypt.net/featurestories/measures.htm
   b. http://boatsafe.com/tools/meter.htm

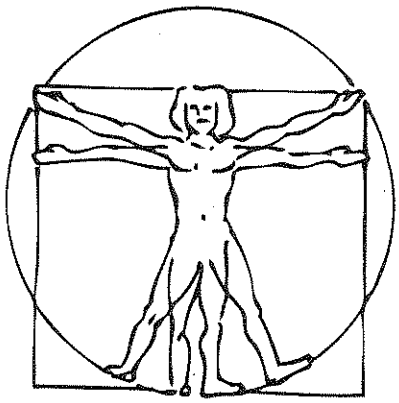
Activity Procedure

1. Ask students to think about how specific measurements originated. Why did people develop measurements? What did they use for measuring? What purpose did people have for specifically defining measurements?
2. Share information from Link a. about the weights and measures of Ancient Egypt.
3. Write and discuss the vocabulary related to measurement, specifically area and circumference of circles.
4. Have students read and complete Questions 1–9 on the activity sheet. In this series of questions, students estimate measurements of lengths in the classroom. They can do this individually, or you can conduct the activity as a whole class. It is up to you whether or not to provide actual measurements (or allow students to measure the actual lengths themselves), although it is not necessary. When teaching fathom conversion, you might go to Link b. for helpful information.
5. While students are working independently on the practice problems (Question 10), put students into groups of four or five, and assign group numbers.
6. Review the answers to Question 10 (a. 9.42 cm; b. 8.4 in.; c. 12.56 yd; d. 3 m).
7. Review the team challenge, answer any questions students may have, and start the clock for the team challenge.
8. After the challenge has been completed, have students complete the rest of the activity sheet. Teams will check each other's calculations (based on estimations), and then students will measure and calculate the actual dimensions and area of their circles.
9. If you wish, assign one of the activities suggested in Extend the Learning With Circles: Websites and Activities.

Name: _____ Date: _____

Will It Go Round in Circles?

GOAL



- Make the closest estimate of the area and circumference of the circle created by the team members sitting cross-legged.

MATERIALS

- String or yarn
- Metersticks/yardsticks (use only after team challenge has been completed)
- Calculators

TIME FOR ACTIVITY

- 12 minutes

INDIVIDUAL ACTIVITY

1. Before technology had been designed to help gauge accurate measurements, people used handy instruments—literally. For example, the width of an index finger became a *digit*. How many digits wide is your desk? _____
2. The length of the arm from the tip of the middle finger to the elbow became a *cubit*. From your seat, estimate how many cubits tall you think the class doorway might be: _____
3. The Romans used the length of a grown man's foot as a measurement tool. What do you think that unit of measurement was named? _____ How many inches long do you think your foot is? _____
4. What besides a ruler might be used to measure an inch? _____
5. The width of the outstretched hand from the thumb to the little finger was called a *span*. Approximately how many spans wide is your desk? _____
6. The length from fingertip to fingertip with arms outstretched is a *fathom*. Using fathoms, what do you think your classroom's length and width are? _____
7. Leonardo da Vinci used a *braccio*, or arm's length, when planning his work. A braccio was equal to two *palmi*, or outstretched palms. Approximately how many braccio in height are you? _____
8. Around 250 B.C., the Greek mathematician Archimedes figured out the ratio of a circle's circumference to its diameter. What is the formula for measuring circumference? _____ What is the formula for measuring area? _____
9. What is the value of pi? _____

10. Practice on your own with these problems:
    a. The diameter of a nickel is 3 cm. What is the circumference? _____
    b. The radius of a plate is 4.2 in. What is the diameter? _____
    c. The radius of a circular rug is 2 yd. What is the area? _____
    d. The circumference of a wheel is 18.84 m. What is the radius? _____

TEAM CHALLENGE

Participants will work in teams of four or five to form a circle and make estimates and calculations based on that circle's measurements. Once teams have been selected, the teacher will record the start time. You will have exactly 12 minutes to get your supplies and make your team's circle. Your goal is make a circle and be the closest with your estimations/calculations of the diameter, circumference, and area. You will record your estimates in the box provided.

Start Time _____:_____ + 12 Minutes = _____:_____ End Time

Sit cross-legged as closely together as possible in a circle, and use the yarn or string provided to outline the group circle. Estimate what the circle's diameter might be. Calculate the circumference and the area based on this estimate. Don't forget to include the units on all measurements. Leave the yarn outline of your circle in place until the end of the challenge.

ESTIMATIONS OF MEASUREMENTS

1. Our estimate of the diameter: _____
2. Our estimate of the circumference: _____
3. Our estimate of the area: _____

When the time period is up, pass your paper to another team to check the accuracy of your group's calculations. Use a calculator and pen and write neatly when checking another team's work.

The team that is checking the measurements recorded in the box should complete the following:

Based on the estimated measurement of the team's diameter equaling _____, the circumference equals _____ and the area equals _____. The team's calculations were (circle one) correct/ incorrect.

If one or more of the team's calculations was incorrect, write in the space provided where you think the team's error took place.

Each team should now get its checked calculations back from the team that checked them. It is now time to check for accuracy of estimation by using a yard- or meterstick.

1. Measure the diameter of your group's circle and record the information below.

   Diameter = _____ Circumference = _____ Area = _____

2. What was the difference between your estimation and the actual measurement?

   Diameter = _____ Circumference = _____ Area = _____

3. Were you successful in estimating the diameter? _____

4. Were you successful calculating the circumference? _____ The area? _____

5. How could your team have been more accurate? _____

6. Sometimes estimating measurements is sufficient, and sometimes we need to be precise.

   Give two examples of when estimation is sufficient. _____

   Give two examples of when measurements must be precise. _____

7. Why is it important to understand measurement? _____

EXTEND THE LEARNING WITH CIRCLES: WEBSITES AND ACTIVITIES

1. **Interactive circle.** Learn the concepts of chords, tangents, and circular sectors. Visit http://www.misterteacher.com/everything_geometry/interactivecircle.html.
2. **Circle tool.** Investigate the relationships of area and circumference of a circle compared to its radius and diameter. Visit http://illuminations.nctm.org/ActivityDetail.aspx?ID=116.
3. **Computing pi.** Explore how Archimedes approximated pi by using polygons and calculating perimeters. Visit http://illuminations.nctm.org/ActivityDetail.aspx?ID=161.
4. **Linking circles to cylinders.** The volume of a cylinder is calculated by multiplying the area of the circle base of a cylinder by the height of the cylinder: $V = \pi r^2 h$. Gather various cylindrical objects, such as cans, and record the diameter of the top of each cylindrical object. Use this information to find, for each object, the radius of the circular base, the area of the circular base, the height of the cylinder, and the volume of the cylinder. Make a table containing this information.