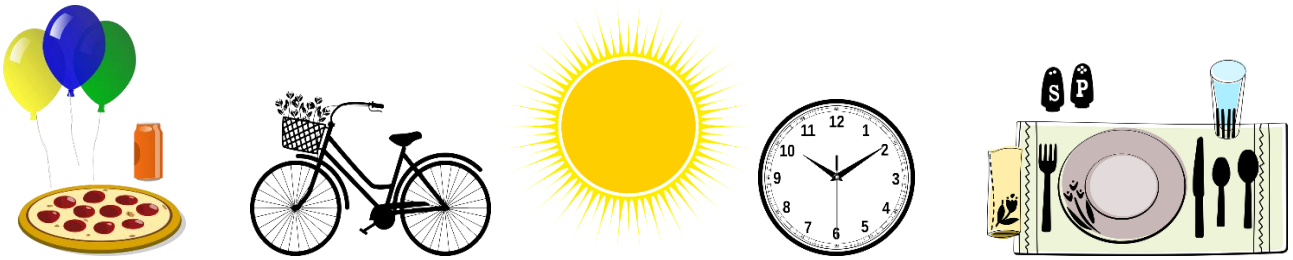
CIRCLES IN GEOMETRY



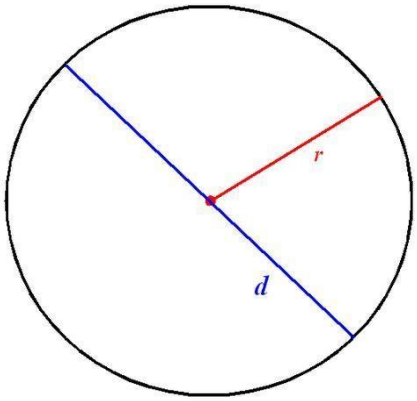
Look around and you will see circles everywhere! Circles are one of the most basic figures in the branch of mathematics called **geometry**, the study of shapes and figures. **Plane geometry** is the study of flat shapes that can be drawn on a piece of paper, like lines, circles, triangles, squares, and rectangles. These are called 2D or 2-dimensional shapes. **Solid geometry** studies 3D or 3-dimensional shapes, like cones, cubes, and spheres.

The word *geometry* comes from the Greek words "geo" and "metron" which mean Earth and measurement. The origin of geometry dates back to 500 BCE when the Greek mathematician **Euclid**, known as the "Father of Geometry", wrote one of the most important mathematical books of all time: a 13-volume set called the *Elements*.

Geometry provides valuable tools that people use every day in all walks of life. Architects, engineers and contractors use geometric formulas to design and construct buildings, monuments, and bridges. Astronomers use it to map the distances between stars and planets. Geometry is also used in various types of technology including medical imaging, robotics, computers, and video games. Even sports coaches use geometry to improve athletic performance by studying angles and circular arcs.

Basic mathematical definitions that describe circles

In geometry, a **circle** is defined as a shape on a plane or flat surface made up of all the points that are the same distance from the center point.



circumference: the distance around a circle.

diameter: (line segment **d** above) the straight line that goes through the center to each edge, touching both sides of the circumference. It is the longest distance from one edge of the circle to the other.

diameter = 2 x radius.

origin: the center of the circle

radius: (line segment **r** above) the distance from the center point of the circle to the edge or circumference of the circle.

π: the Greek symbol, **pi**, pronounced "pie", is defined as the circumference divided by the diameter of a circle.

The circumference divided by the diameter is always π, no matter how small or large the circle is!

The value of **π** is approximately 3.14159265. To help you remember all of these numbers, you can count the letters of the words in the following sentence:

May I have a large container of butter today?

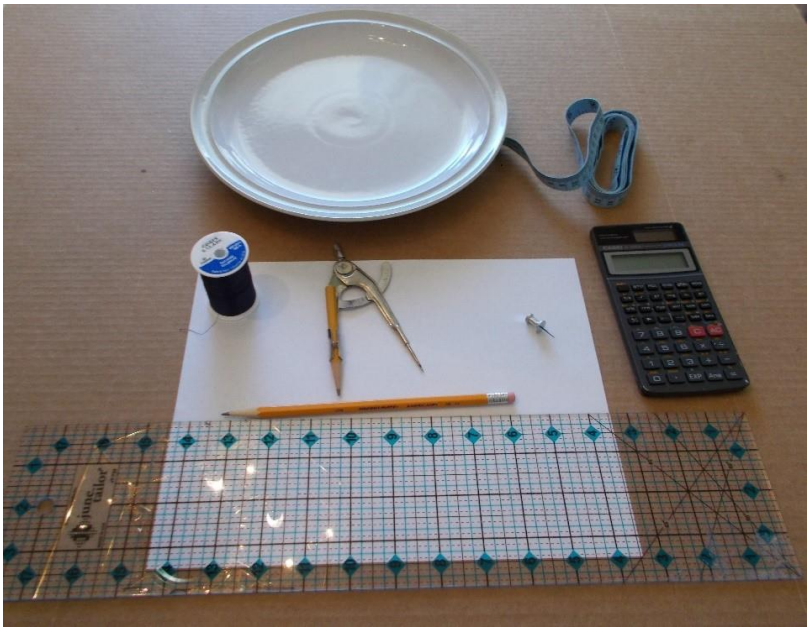
Circumference/Diameter = π

Pi Day is celebrated on March 14th. Since March is the 3rd month, it looks like 3/14!

ACTIVITY: A series of exercises to explore circles

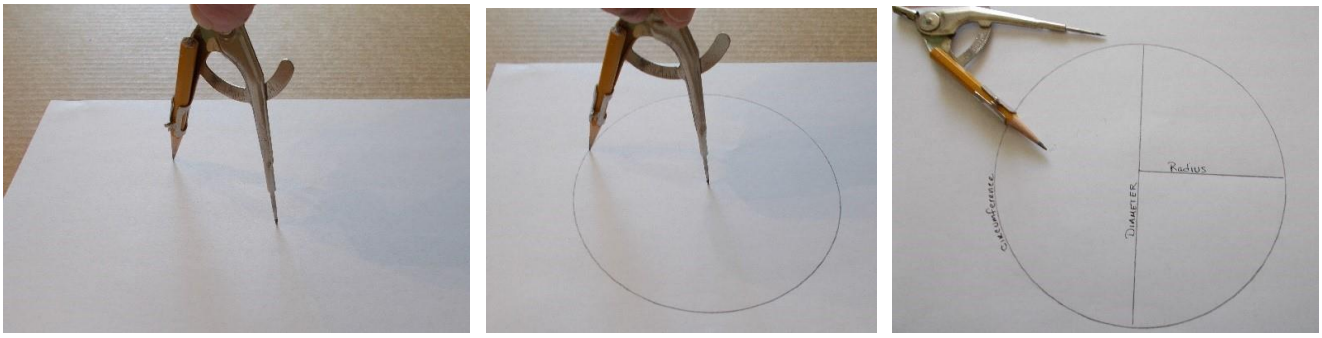
Materials**:**

- Piece of cardboard
- Paper
- Push pin or thumb tack
- String or twine (twine or kite string will be easier to work with than sewing thread)
- Pencil
- Ruler
- Measuring tape
- Calculator
- Plate
- Compass (optional)
- Scotch tape



Exercise # 1: Drawing a circle with a compass

One way to draw a circle is by using an instrument called a **compass**. This simple tool makes drawing a perfect circle very easy. A compass has two arms. One arm is sharp, and one is designed to hold a pencil for drawing the circle or arcs. If you don't have a compass, you can learn to make your own in Exercise #2.



1. Place the sharp point of the compass on the paper and press down.
2. Apply light pressure to the pencil and swing it around without moving the center point until you have drawn a perfect circle.

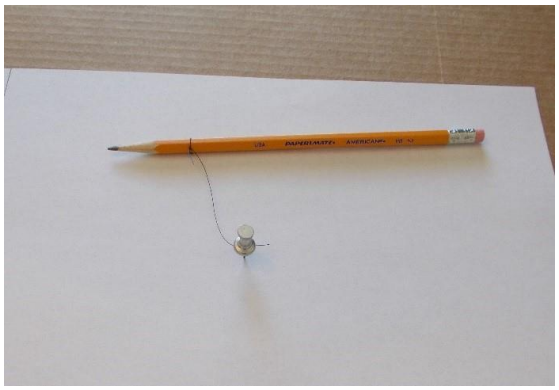
Exercise #2: How to draw a circle with a homemade compass

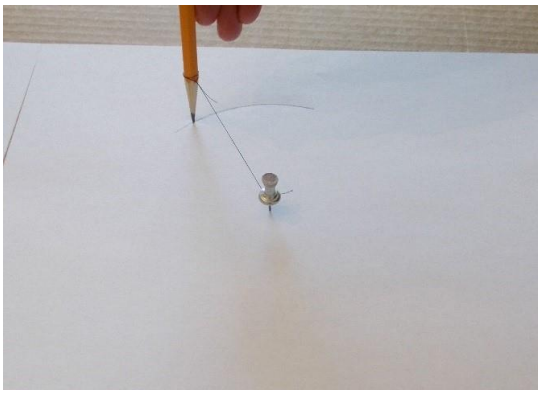
1. Tape a sheet of paper to a piece of cardboard.
2. Place the push pin or tack through the middle of the paper and cardboard. The pin hole marks the center of the circle that you will draw with your homemade compass.

3. Loop a string around the push pin and around your penci, no more than 4 inches long so that it will fit on the paper. You can experiment with making the string different lengths to see different **radii** (plural for radius).
4. Keep the string stretched as you draw your circles, and keep the pencil point down and eraser end up.
5. After you have drawn your circle:

- Measure the distance from the center of the circle to the circumference to determine the radius.
- Multiply the radius x 2 to calculate the diameter.
- Take another piece of string and loop it all the way around the circles that you drew.
- Measure that string with your ruler to find the circumference.

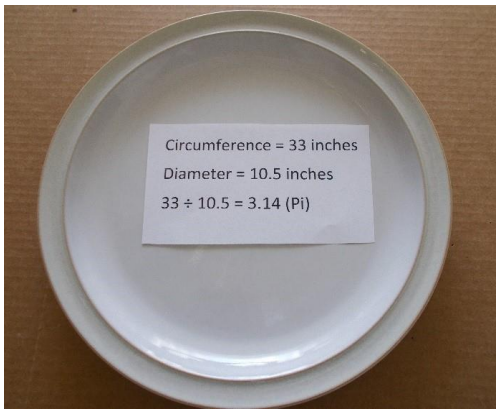
6. If you divide the circumference by the diameter (2 x the radius), you will get [Equation], or pi (3.141592654). You can use a calculator for this.





Exercise #3: Looking for pi

1. Using a tape measure, measure around the edge (circumference) of a plate. It is helpful to use some adhesive tape to hold the tape measure in place. Make a note of your measurement.
2. With a ruler, measure across the plate (diameter). Again, make a note of your measurement.
3. Divide the circumference by the diameter using your calculator.
4. Did you discover **π**?



The circumference of this plate is 33". The diameter is approximately 10.5".

33 ÷10.5 = 3.14 (Pi)

REMEMBER: The circumference divided by the diameter will always be π, no matter how small or large the circle is!

Exercise #4: Calculations

1. If you know the diameter of a circle, you can calculate the circumference like this:

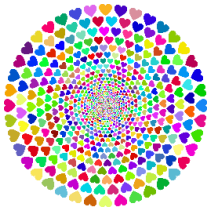
circumference = π x diameter

2. Measure the diameter of the plate and multiply by **π.**
3. Now check to see if that equals the circumference of your plate.
4. In the above example, 3.14159265 X 10.5 = 32.98 (round up to 33). Pretty close!

Something to think about: If you walk around a circle and only know the diameter of the circle, you can figure out how far you have walked. If you walk around a circle that has a diameter of 20 ft, how far have you walked?

circumference = π X 20 ft. **circumference = 3.141592654 X 20** **answer: 62.83 ft.**

Circles surround us! They are used in many situations in science to model different physical concepts. They describe the movement of electrons in atoms, the motion of a car around a curve in a road, and the orbits of the planets. In manufactured objects, circles can be found in the shape of wires and pipes, ball bearings, wheels and dinnerware. Look around your house and community to see how many circular objects you can find!

ADDITIONAL RESOURCES

Books available from the Washoe County Library

Circles by David Adler

Figuring Out Geometry by Rebecca Wingard-Nelson

Geometry Smarts! by Lucille Caron and Philip M. St. Jacques

Kathy Ross Crafts Triangle, Rectangles, Circles, and Squares by Kathy Ross

Let's Draw a Butterfly with Circles = Vamos a Dibujar una Mariposa Usando Circulos by Joanne Randolph and Emily Muschinske

The Librarian who Measured the Earth by Kathryn Lasky

Pi by Kevin Cunningham

Shapes In Math, Science and Nature; Squares, Triangles and Circles by Catherine Sheldrick Ross

Sir Cumference and the Dragon of Pi; A Math Adventure by Cindy Neuschwander

Sir Cumference and the First Round Table; A Math Adventure by Cindy Neuschwander

Why Pi? by Johnny Ball

Videos:

Idea, "3 Life Hacks Ways to Drawing a Circle without a Compass" https://youtu.be/_yqmqESN_Oo

Math Antics, "Circles, What is Pi?" https://youtu.be/cC0fZ_lkFpQ

Sesame Street, Bert and Ernie's Circle Song https://youtu.be/g4fq3l5-TsA

Smile and Learn, Circle and Circumference – Geometric Figures for Kids https://youtu.be/o4we1rigywc

Sunshine22854, "How to Use a Compass by Lorri" https://youtu.be/02XRad7s1Io

Websites:

Khan Academy, Math: Pre-K - 8th grade (includes geometry lessons for different age groups)
https://www.khanacademy.org/math/k-8-grades

National Association for the Education of Young Children, Discovering Shapes and Space in Preschool
https://www.naeyc.org/resources/pubs/tyc/apr2014/discovering-shapes-and-space-preschool

University of Illinois at Chicago College of Education, Early Math Counts, Silly Circles
https://earlymathcounts.org/lessons/silly-circles/