CLASSIFYING POLOYGONS

We can make shapes from curves and line segments. A **curve** can be drawn through a set of points using a single continuous motion. Figure 1 contains several different types of curves. Which do you think are simple? Which are closed?

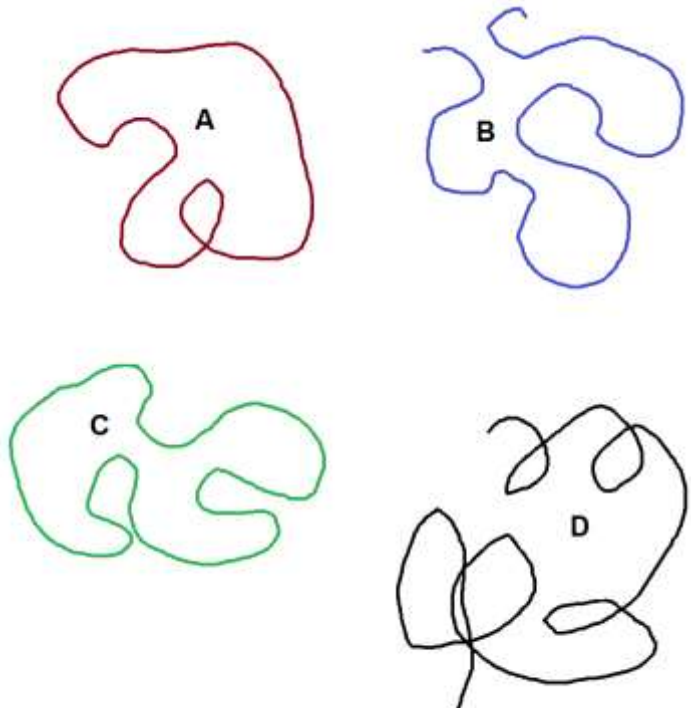

Figure 1: Four curves

A crosses itself and has no visible ends.
B does not cross itself and has two loose ends.
C does not cross itself and has no visible ends.
D crosses itself and has two loose ends.

A **simple curve** does not cross itself. Curves B and C are simple.

A **closed curve** has no visible endpoints. Curves A and C are closed.

Note that a curve can be a combination:
A is a closed curve.
B is a simple curve.
C is a simple closed curve.
D is just a curve.

A simple closed curve and its interior is called a **plane region.** We say a plane region is **concave** if it's "caved in"; technically, if it contains two points that such that a line segment containing the points goes outside the region. If it's not concave, it's **convex.**

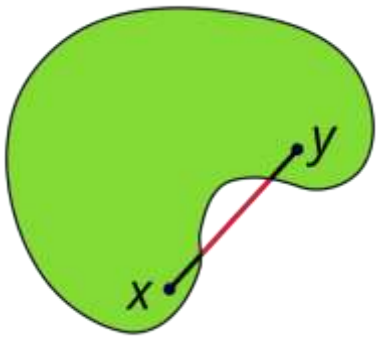

Figure 2: Concave Polygon
https://commons.wikimedia.org/wiki/File:Convex_polygon_illustration2.svg
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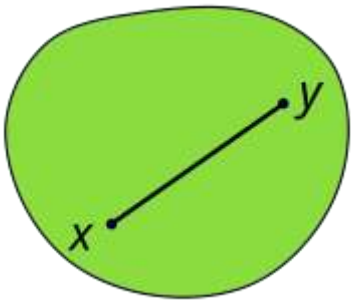

Figure 3: Convex Polygon
https://commons.wikimedia.org/wiki/File:Convex_polygon_illustration1.svg
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Why do we care? What we consider shapes are all simple closed curves. Most are also polygons (we'll define that shortly). One shape that isn't a polygon is a **circle.** Can you define these circle-related terms? Circle, center, radius, diameter, chord, tangent, secant, circumference, arc, sector, major segment, minor segment?

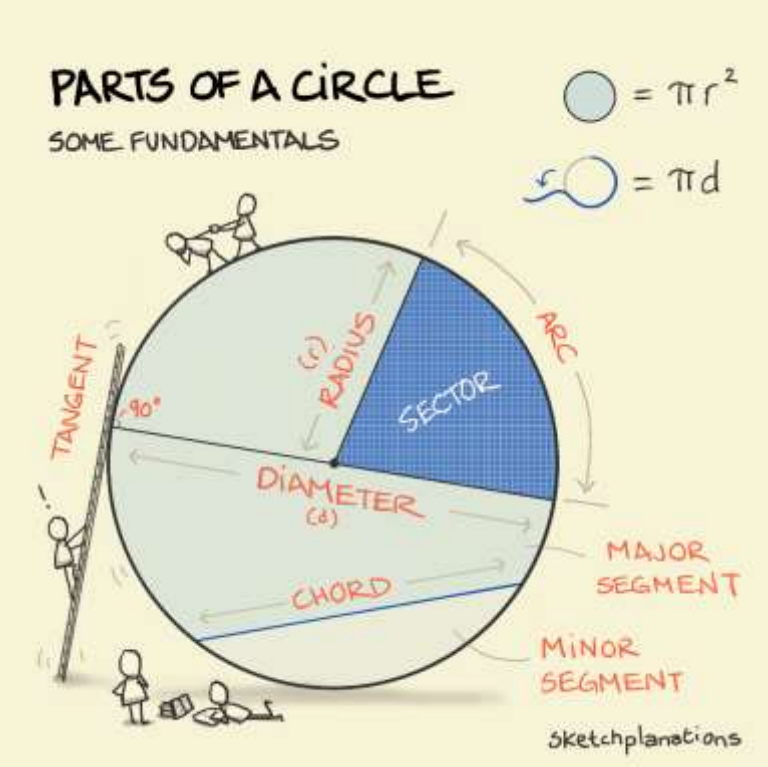

Figure 4: Part of a circle
https://sketchplanations.com/parts-of-a-circle
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A circle is a simple closed curve whose interior is a a convex set. Each point on a circle is the same distance from a from a fixed point we call its **center.** A line segment that goes from the center to an edge point is the **radius.** A line segment that goes from side to side through the center is a **diameter**. A line segment that goes edge to edge without going through the center is a **chord.** A **tangent** is a line that hits the circle at exactly one point. A **secant** (not pictured) is a line that crosses through the circle at two points. (If we extend a chord outside the circle, it becomes a secant.) The **circumference** is the distance around the outside of the circle. If we measure part of the distance around the circle, it's an **arc.** If we cut a "pie" slice out of a circle (anchored at the center), that region is called a **sector.** A **minor segment** is part of the area of a circle that's less than half; a **major segment** is part of the area of a circle that's more than half.

Polygons

A **polygon** is a simple closed curve made up of line segments. Note that a circle, although it's a plane figure (and common shape), is NOT a polygon. "Poly"=many, "gon"=sides. Polygons are classified by the number of sides. Can you classify any of the polygons in figure 5?

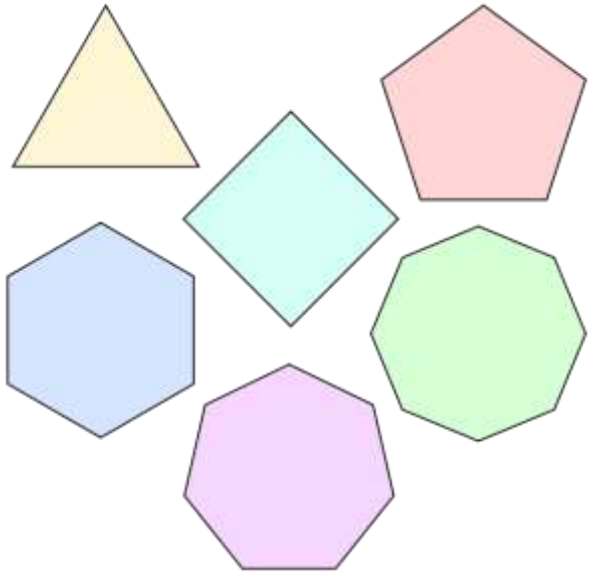

Figure 5: Some polygons
https://commons.wikimedia.org/wiki/File:Regular_polygons_qtl1.svg CC BY-SA 3.0

Number of Sides	Polygon Name
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon
12	Dodecagon
n	n-gon

The more commonly recognized polygon names are listed in the table. There are some names for figures with 11, 13, 14, etc. sides, but they aren't all commonly recognized. For a number not in the table, you can the shape an n-gon, where n is the number of sides. (So a 17-sided polygon would be a 17-gon.) The line segments are the **sides** and the "corners" are the **vertices** of the polygons. We say two sides are **adjacent** if they share a common vertex, and two vertices are adjacent if they share a common side.

Note that the polygons in the picture have all sides and angles congruent (equal). This makes them **regular polygons.** Note that ANY four-sided figure, whether or not it's regular, is a quadrilateral. We have some special names for different triangles and quadrilaterals.

Triangles

Any polygon with 3 sides is a triangle. We classify triangles either by their angles or their sides. Some triangles can be defined both ways. Can you define the triangles in Figure 6?

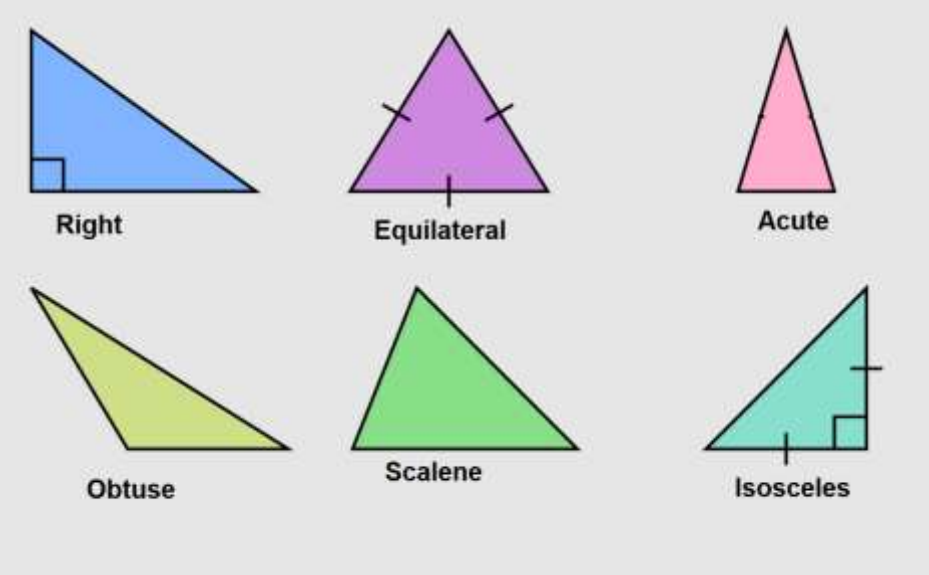

Figure 6: Types of Triangles
https://commons.wikimedia.org/wiki/File:Types_of_triangles_he.svg Labels changed to English
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Classification by Angles: A **right triangle** contains one right angle. An **obtuse triangle** contains one obtuse angle. An **acute triangle** has three acute angles.

Classification by Sides: An **equilateral triangle** has three equal sides. It also has three equal angles, so is sometimes called an equiangular triangle. An **isosceles triangle** has **at least* two equal sides. (Some books say exactly two equal sides, but with our definition an equilateral triangle can be classified as isosceles, too.) A **scalene triangle** has all three sides of different lengths.

Note that there's some overlap—you can have an isosceles right triangle, and an acute equilateral triangle.

Quadrilaterals

Any polygon with 4 sides is a quadrilateral. Sometimes they're called quadrangles, because they also have 4 angles. They're classified by how their sides are related. Again, there's some overlap between the definitions—a square is a rhombus, but a rhombus doesn't have to be a square. See some types of quadrilaterals in Figure 7. One that is omitted is an **isosceles trapezoid.** That's a trapezoid (one pair of non-parallel sides) whose non-parallel sides are of equal length.

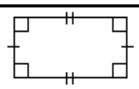
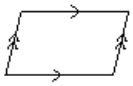
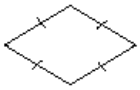
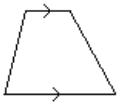
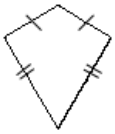
Quadrilateral	*Properties*	
Rectangle	4 right angles and opposite sides equal	
Square	4 right angles and 4 equal sides	
Parallelogram	Two pairs of parallel sides and opposite sides equal	
Rhombus	Parallelogram with 4 equal sides	
Trapezoid	Two sides are parallel	
Kite	Two pairs of adjacent sides of the same length	

Figure 7: Quadrilaterals
https://www.flickr.com/photos/teamvista/5272059630
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There's a lot of overlap between types of quadrilaterals. Note the relationships in the chart; each type is also all the types above it. So, a square is also a rectangle, rhombus, parallelogram, and rhombus. However, a rectangle isn't necessarily a square.

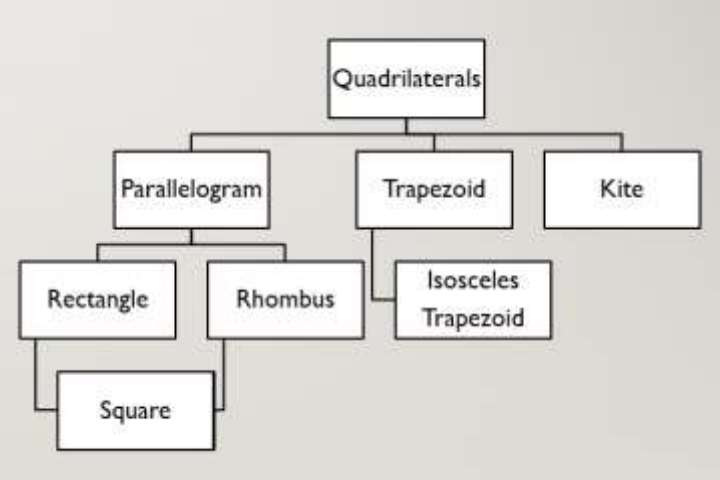

Figure 8: Quadrilateral Chart