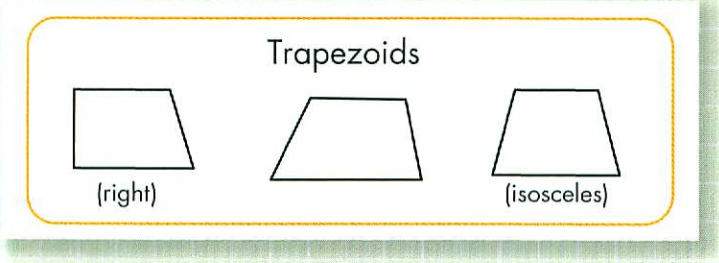
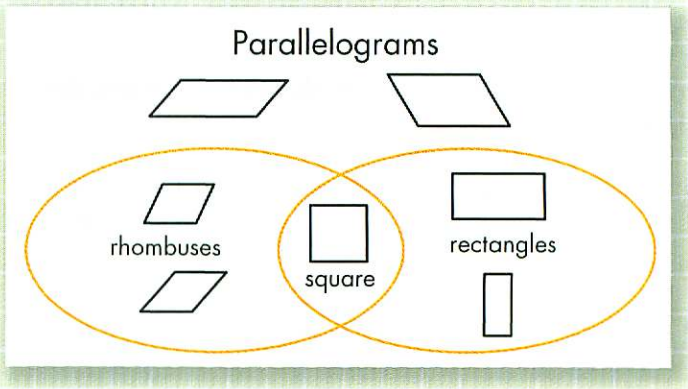
Classification of Quadrilaterals

Classification systems help us organize the world into categories that are often hierarchical and overlapping. For example, a person might live in the city of Cleveland, which is in the state of Ohio, which is in the United States, which is in North America. If you know someone who lives in Cleveland, you also know that that person lives in Ohio, and in the United States, and in North America.

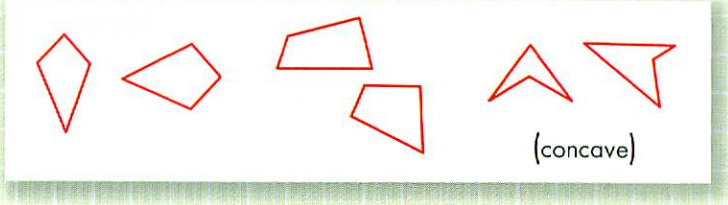
Mathematicians use a hierarchical classification system to sort geometric figures. In this unit, students consider this as it applies to what they know about the general category of shapes that have four sides, called quadrilaterals. Quadrilaterals are classified by looking at their sides and their angles. When sides are being considered, the characteristics to pay attention to are the length of the sides and whether or not pairs of sides are parallel. For example, *trapezoids* have exactly one pair of parallel sides that are not equal in length, and opposite nonparallel sides that may or may not be equal in length. If one pair of opposite sides in a trapezoid is equal in length, this is called an *isosceles trapezoid,* which is the trapezoid that fourth graders are most familiar with. A trapezoid can also be further classified by whether it contains a right angle.



Parallelograms have two pairs of parallel sides, and opposite sides are equal in length. *Rhombuses* (or rhombi) are members of the parallelogram family that have all four sides equal. Rectangles are also members of the parallelogram family. The angles are what make rectangles special; all four angles are equal, and measure 90 degrees. Squares, then, are in many families, including rectangle (because the angles are all the same size), rhombus (because the sides are all the same length), and parallelogram (because there are two pairs of parallel sides).



Other kinds of quadrilaterals do not fit into the categories of either trapezoids or parallelograms, because they do not have any parallel sides. These quadrilaterals may, however, have some sides that are equal in length, such as the first two examples in the figure below. Quadrilaterals may have angles that are four different sizes, as in the second two examples below. They may also have an angle that is greater than 180 degrees which makes a *concave* quadrilateral, as in the last two examples.



Such traditional classifications are just one useful way to sort geometric figures. One could just as well declare that rectangles *cannot* have all equal sides, and then squares would not be in the family of rectangles. Students often initially prefer this partitioning way of classifying. Only with time will they come to see the advantages of hierarchical classification—for example, if you know that a square is a rectangle, you then know that it has all the properties of rectangles.

At this age, students will benefit from thinking and communicating about the properties of polygons, but they need not have the whole classification system in mind.