Grade 1

Partitioning Wholes Into Equal Areas

Geometry	CCSSM 1.G
Reason with shapes and their attributes.	
3. Partition circles and rectangles into two and four equal shares, describe the shares using the words *halves, fourths,* and *quarters,* and use the phrases *half of, fourth of,* and *quarter of.* Describe the whole as two of, or four of the shares. Understand for these examples that decomposing into more equal shares creates smaller shares.	

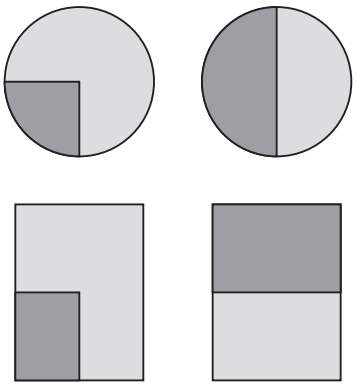
IMPORTANT UNDERLYING IDEAS

➢ ***Notions of partitioning.*** The concept of partitioning (sharing) is fundamental to the notion of fraction as part of a whole. Often students understand partitioning best when presented as a set of objects that is shared, rather than a single object—for example, when 2 children share 6 cookies. Later, students will be able to model a process whereby 2 children share 5 cookies (and need to split one cookie in half). Or students might share 8 cookies among 4 students and later 10 cookies among 4 students (Siegler et al., 2010).

Before long, students might share a single object, for example a circle model representing a pizza, among initially 2 and then 4 students. Notice that the shapes suggested for partitioning in the standard, circles and rectangles, are symmetrical. It is only later that students would be expected to partition nonsymmetrical shapes.

There is research (Petit, Laird, & Marsden, 2010) that suggests that students find it easiest to partition into halves, so partitions of 2, 4, and, later, 8 make sense to start with. At some point students will become comfortable with partitions of, for example, 3 or 5, but not initially. Even later they can use partitions of 3 and 5 to create partitions of 6 and 10.

Early work with partitioning might be set up using plastic fraction pieces where half and quarter pieces are available to place on top of a full circle or rectangle. This allows students to be a bit more precise than they could be with drawings.



Later students might be provided with images where they draw or fold to estimate equal shares. When partitioning rectangles or circles into 4 equal pieces, it might make sense to initially provide an image of the shape divided into 2 equal parts and ask students to think about how to get from 2 shares to 4 shares. This supports the mathematical practice standards of constructing viable arguments and reasoning abstractly and quantitatively.

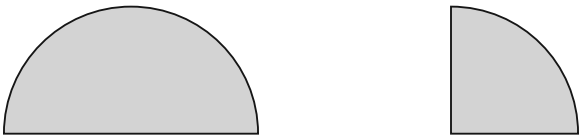
An important concept that needs to emerge is that more sharers of the same whole leads to a smaller share for each. This is fundamental not only to an understanding of fractions (e.g., why $\frac{1}{4}$ is less than $\frac{1}{2}$), but also for mastery of other mathematical ideas related to division. For example, more advanced students should realize why $20 \div 5$ must be less than $20 \div 4$, since there are more sharers.

➢ ***Using fraction words.*** Notice that the standard does not require the use of fraction notation. I would advise starting work with fractions using words and not symbols. This avoids students potentially drawing inappropriate conclusions based on the numbers that they see. For example, we do not want to encourage students to think that $\frac{1}{4} > \frac{1}{2}$ since $4 > 2$. This is less likely to occur if we use the words "*fourth*" (or "*quarter*") and "*half*" than if the symbols are written.

This approach of using words rather than symbols emphasizes that *one half* or *one fourth* is one number. This is an important foundation for ensuring that subsequent work in fractions is well grounded.

➢ ***Recognizing halves and fourths.*** Students are apt to recognize halves and fourths of circles even without seeing the wholes, but quick identification is less likely if rectangles are used.

For example, it is obvious that the picture on the left represents half of a circle and the picture on the right a quarter of a circle.



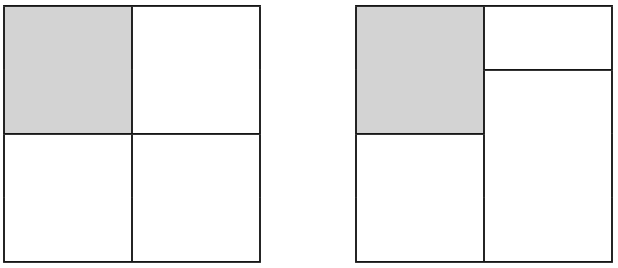
It is much less clear whether the picture below represents half or a quarter of a given rectangle unless the whole rectangle is shown.

However, this should not lead to using circles most of the time. It should instead mean that rectangles are often used in order to help students become aware of the need to know the whole in order to describe a part.

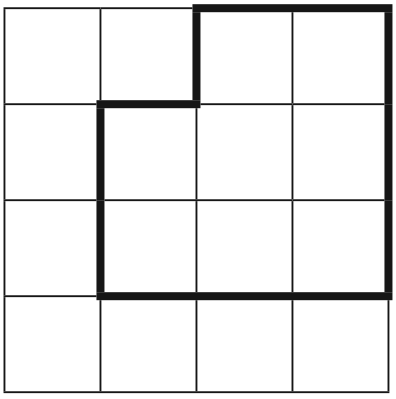
➢ ***Alternate approaches to introducing fractions.*** Although the Common Core State Standards for Mathematics suggest introducing fractions through an area model, in other jurisdictions, fractions are introduced first through other measures, such as length or volume (Watanabe, 2006) or through sharing sets (e.g., taking half of a set of candies) (Empson, 1995). For some students, these alternate approaches might make more sense.

Good Questions to Ask

- *Provide two identical circles. Ask students to fold one circle into halves and the other into quarters. Ask students: Which pieces are bigger? Why?*
- *Ask students to describe what the word* "half" *means.*
- *Ask students if each of the gray sections is one fourth or not.* [Some students will be (and should be) disturbed that the right-hand shape is not properly divided, but may still recognize that the gray is still one fourth of the whole since 4 of them would make a whole.]



- *Provide geoboards that are 5 pin × 5 pin (16 unit squares) or else a 4 × 4 grid of squares. Ask students to divide the board or grid in half in as many ways as they can.* [Not only can the boards be divided vertically, horizontally and diagonally, but some students may find other ways to split the 16 squares on the board into 2 sections of 8 squares. One is shown below. This is an example of the practice standard: Use appropriate tools strategically.]



- *Ask students: Draw a picture to show why someone might say that one fourth can be more than one half.* [The idea is to draw two different-sized wholes. The whole for the fourths is much bigger than the whole for the halves.]
- *Ask students: Why is creating 2 equal parts a good first step if you want to create 4 equal parts?*

Summary

By the end of Grade 1, student comfort with partitioning shapes into smaller shapes should support further development in fraction work in Grade 2, but also in work with number in general. Thinking about and performing compositions and decompositions to describe parts of shapes and numbers is a critical element of mathematics learning.