Measuring Up

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Lesson 2

The Golden Ratio

Students learn about ratios, including the "Golden Ratio", a ratio of length to width that can be found in art, architecture, and nature. Students examine different ratios to determine whether the Golden Ratio can be found in the human body.

⊞ Learning Objectives

Students will:

- understand the concept of ratio
- explore ratios dealing with the human body by taking measurements and calculating the ratios
- explore the Golden Ratio

⊞ Materials

Chart paper
Markers
Measuring tape

6 – 8

1 period

NCTM Resources

Principles and Standards for School Mathematics

Yardstick
String

Instructional Plan

To assess students' prior knowledge, ask students to recall where they have heard of or used ratios before. Their answers may include the following:

- Ratios compare the relative sizes of two numbers.
- Ratios compare wins to losses in the World Series; for example, the Braves are ahead in the series three games to one.
- Ratios can describe the number of students to a teacher in a classroom or the number of boys to girls in a classroom.

Record student answers on chart paper for future reference.

Discuss the meaning of ratio in each of the examples from the class list. Explain that a fraction expresses a ratio when it is written as a quotient of one number divided by the other number, and that there are several ways to write ratios. Note the ways in which students have used fractions to express such relationships.

Organize the class into groups of three or four. Provide a measuring tape or yardstick and some string (about two yards or so) to each group. Encourage students to assist one another in measuring their total body heights with the string, as well as their heights from their feet to their navels. Have them record their measurements on a chart.

Have students write their two measurements as a ratio. Explain the history of the Golden Ratio (The Golden Ratio is a ratio of the length to width and is approximately 1.618. This ratio not only appears in art and architecture, but also in natural structures including the human body). Then describe that the Golden Ratio is the ratio of a person's total height to height from their feet to their navels. The students may have heard of this as well as other ratios said to exist in the human body.

$$60'' \div 37'' \approx 1.62$$
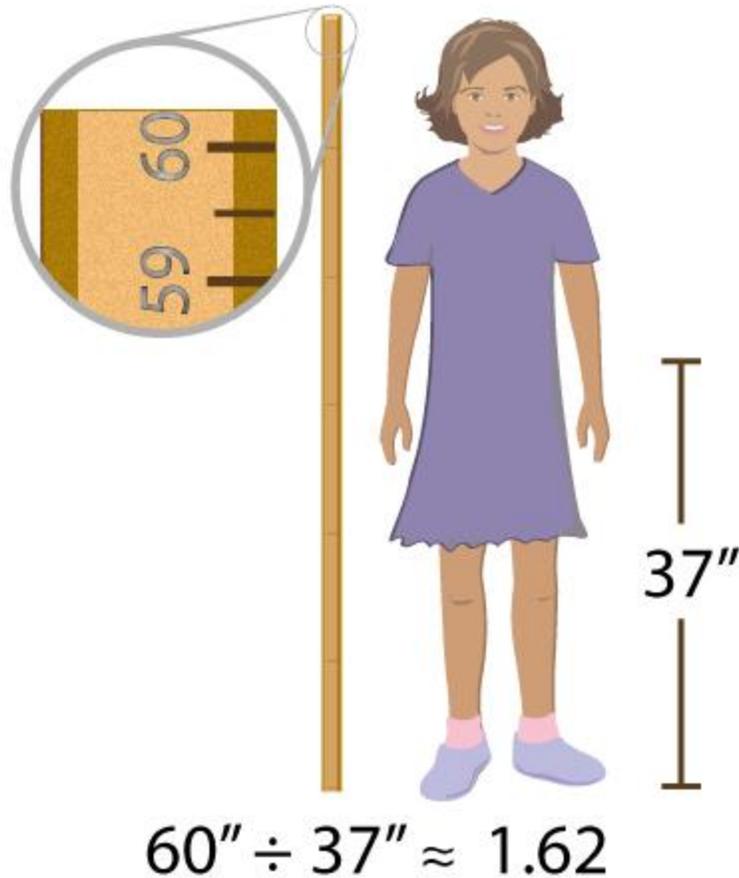
See how the students "measure up" to the Golden Ratio.

As an independent assignment, invite the students to measure other lengths, such as the distance from their waist to the floor and from the top of their head to their waist, to see whether a similar ratio exists between those measurements. This activity provides extra practice in writing ratios and in developing a better understanding of how ratios are used.

Enter the class data on a chart. Graph the ratios by individual student and compare the different groups of students, such as girls to boys or students of one age to students of another.

⊞ Questions for Students

What are three ways in which ratios may be expressed?

[Fractions, the word "to", or a colon (:).]

How does total body height compare to the height of your navel? Is it

close to the Golden Ratio?

> [Student responses may vary depending upon their own individual measurements.]

⊞ Assessment Options

1. At this stage of the unit, students should be able to do the following:
   - o Define ratio
   - o Express ratios in more than one form
   - o Identify ratios that are found in everyday life

⊞ Teacher Reflection

1. Were there any similarities between the real-world examples of ratio that students gave (e.g., gender, cultural, or employment rates)?
2. Could any of these concepts be used in later lessons to connect with the students' prior knowledge and make the concepts real for them?
3. Did the students see that ratios are ways of expressing fractional relationships that compare two quantities? Did students relate ratios to the simple division problems they have seen since the early grades?
4. Were there any concepts that needed to be reviewed before introducing ratio (e.g., fractions)? If so, how could those reviews be incorporated into the lesson?
5. Are the students ready to investigate unit rates, or should they practice more with ratios before moving on?

⊞ NCTM Standards and Expectations

Measurement 6-8

1. Understand both metric and customary systems of measurement.
2. Solve problems involving scale factors, using ratio and proportion.

This lesson was developed by Katie Carbone.

More and Better Mathematics for All Students