# The Golden Ratios

## Objective for Student Activity:

Write ratios to express part-to-part or part-to-whole comparisons.

Develop an understanding of the Golden Ratio and how it applies to advertising and packaging of products.

Develop an understanding of the many applications of the Golden Ratio to Science, Art, and Nature.

Develop an understanding of the definition of "pi".

Apply understanding of the Golden Ratio and "pi" to create a label for a soft-drink can.

## Introduction

In this lesson, you will learn how designers use ratio to produce attractive shapes that influence the shopper to buy the product. Designers know that some shapes are more pleasing to look at than others. They find that if the lengths of the sides of a rectangle are related in a certain numerical way, a "beautiful" rectangle results. The Greeks knew this ratio as the "Golden Ratio".

Another important ratio used in design is the ratio of the circumference of a circle to its diameter. Both of these ratios are explored in the activity.

**Websites**:
http://www.mathworld.wolfram.com/
http://www.geom.uiuc.edu/
http://www.geocities.com/
http://www.markwahl.com/

## Materials

Rulers (millimeter reading)
Paper
Many examples of boxes that products come packaged in
Random examples of rectangles (books, index cards, credit card, stamp, newspaper, textbook, index card,……)
Many examples of items that are circular
Soft-Drink can for each student
Cloth measuring tape

**Instructional Concepts**

The students will develop an understanding of the golden ratio and pi.

The students will develop an understanding of how the golden ratio is used in a "real-world setting" and how they are influenced to purchase some products by their appearance.

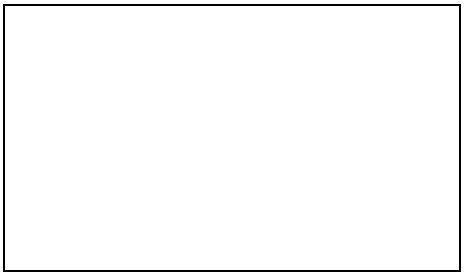
**Project Development**

Designers carefully plan the shapes of the packages which they create. They know that some rectangular shapes are more attractive than others. Maybe you never thought that a shape of a package could influence you. Try the following experiment. A discussion will follow.

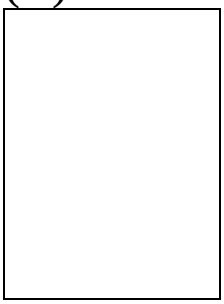
Look at the following rectangles. Choose the one that is the most attractive. Choose the one that you think is the least attractive. Write down your choices.

(A)

(B)



(C)



(D)

Measure each rectangle with a metric ruler. For each rectangle write:

(1) the length in millimeters
(2) the width in millimeters
(3) the ratio of width to length (length: width)
(4) the ratio as a fraction
(5) the decimal name for the ratio (rounded to the hundred-thousandth place)

Questions for Discussion:

(1) Which rectangle did you choose as most attractive?
(2) Which rectangle did most of the people in your class choose?
(3) What is the ratio of width to length of rectangle C? Write this ratio as a decimal?
(4) Which rectangle did you choose as the least attractive?
(5) Which rectangle did most of the people in your class choose as the least attractive?
(6) What is the ratio, width to length of rectangle D? Write this ratio as a decimal.
(7) What is the ratio, width to length of rectangle B? Write the ratio as a decimal.

Below is a list of everyday items that are designed to be pleasing to the eye. For each item below write the ratio of width to length and express as a decimal rounded to the hundred-thousandth.

| **Item** | **Width** | **Length** | **Ratio** |
|---|---|---|---|
| Textbook | 17.2 cm | 26.2 cm | _____ |
| Magazine | 19.5cm | 30.5 cm | _____ |
| Credit Card | 5.4 cm | 8.6 cm | _____ |
| Index card | 10.1 cm | 15.3 cm | _____ |
| Newspaper | 36 cm | 56 cm | _____ |

Write a conclusion from the results of your calculations. Discuss the width/length ratios and how they compare.

Early Greek artist and architects understood the "pleasing" aspect of certain ratios. One ratio, the "Golden Ratio" was used extensively in paintings and buildings.

Golden Ratio:

Width to Length = .618

Or

Length to Width = 1.618

Now you try it!!!!  Choose 5 items from the table and complete the following table.

| Item | Width (mm) | Length (mm) | Ratio (decimal) |
|---|---|---|---|
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |

Are the items that you measured very close the “Golden Ratio”

Let’s try one more application of the “Golden Ratio” that has nothing to do with advertising.

Make a sequence of counting numbers by choosing two numbers to start with, and obtaining the next number by adding the previous two.

Example: 1, 2, 3, 5, 8 ,13, ……

(1) Form ratios using the numbers in this sequence and write the decimal approximation for each ratio to 3 decimal places.

(a) ½ _____

(b) 2/3 _____

(c) 3/5 _____

(d) 5/8 _____

(e) ?/? _____

(f) ?/? _____

(g) ?/? _____

(h) ?/? _____

(i) ?/? _____

(j) ?/? _____

(2) The decimal value of these ratios seems to approach what number?
(3) If you think this sequence is “fixed”, try your own sequence.Remember, get the third number by adding the previous two numbers. Continue until you have nine numbers in your sequence.
(4) Write the ratios as before and change to a decimal. Round to the thousandths place.
(5) The decimal value of the ratios for your sequence seems to approach what number?

Circles

Circles are used by designers to show things which are related or connected. No matter how large the circle, a certain ratio exists when comparing the “distance around”, the circumference, to the “distance across”, the diameter, of a circle.
The earliest Greek geometry was a geometry of measurement. The decimal approximation 3.1416….. (defined as a ratio of circumference of circle / diameter of circle) is the decimal approximation for what we refer to in mathematics as “pi”.This magical number appears anytime your form the ratio of circumference/diameter for a circle.

Activity:

Design a Label for a soft drink can

To design your label:
(1) Draw a sketch of the soft drink can as it would look if the can was cut open and flattened out.
(2) Calculate the dimensions of the rectangular piece. What is the width? What is the length?
(3) Cut out a piece of paper with these measurements for your label.
(4) Design a label for your soft drink can
(5) Check to see if your label fits by wrapping it around an empty soft drink can.

**Assessment**

This project can be evaluated in a variety of ways. An example of a rubric follows:
(1) correctness of measurements
(2) Correctness of ratios for examples given
(3) Correctness of table of information
(4) Correctness of ratios for sequence
(5) Design of label
(6) Checking for overlap of label on soft drink can
(7) Creativity
(8) If you chose to place in groups during any part of the activity……. How well did they work within the group
(9) Neatness

**Application in the Workplace**

(1) Students will develop measuring skills
(2) Students will develop knowledge of ratios
(3) Students will practice decimal and/or fractional skills
(4) Students will develop understanding of advertising products and the importance of creating a product that is pleasing to eye.
(5) Students will develop group-working skills
(6) Students will further develop internet skills
(7) Students will develop and implement communication skills