

Activity 7

Go for the Gold

Objective

- ◆ To explore and use ratios

Materials

- ◆ TI-73 calculator
- ◆ Ruler that measures to the nearest millimeter
- ◆ String
- ◆ Student Worksheet

In this activity you will:

- ◆ find ratios that are known to be “golden”
- ◆ take measurements of facial features

You will need to know this math vocabulary:

- ◆ ratio
- ◆ mean

Introduction

The human body is filled with “hidden” ratios that seem to remain constant for most people. Some examples are the arm span/height and the circumference of the fist/foot length.

You know what a ratio is and how to find it. The Greeks knew this, too, and they were in love with a particular ratio called *The Golden Ratio*, whose value is 1.618 to three decimal places.

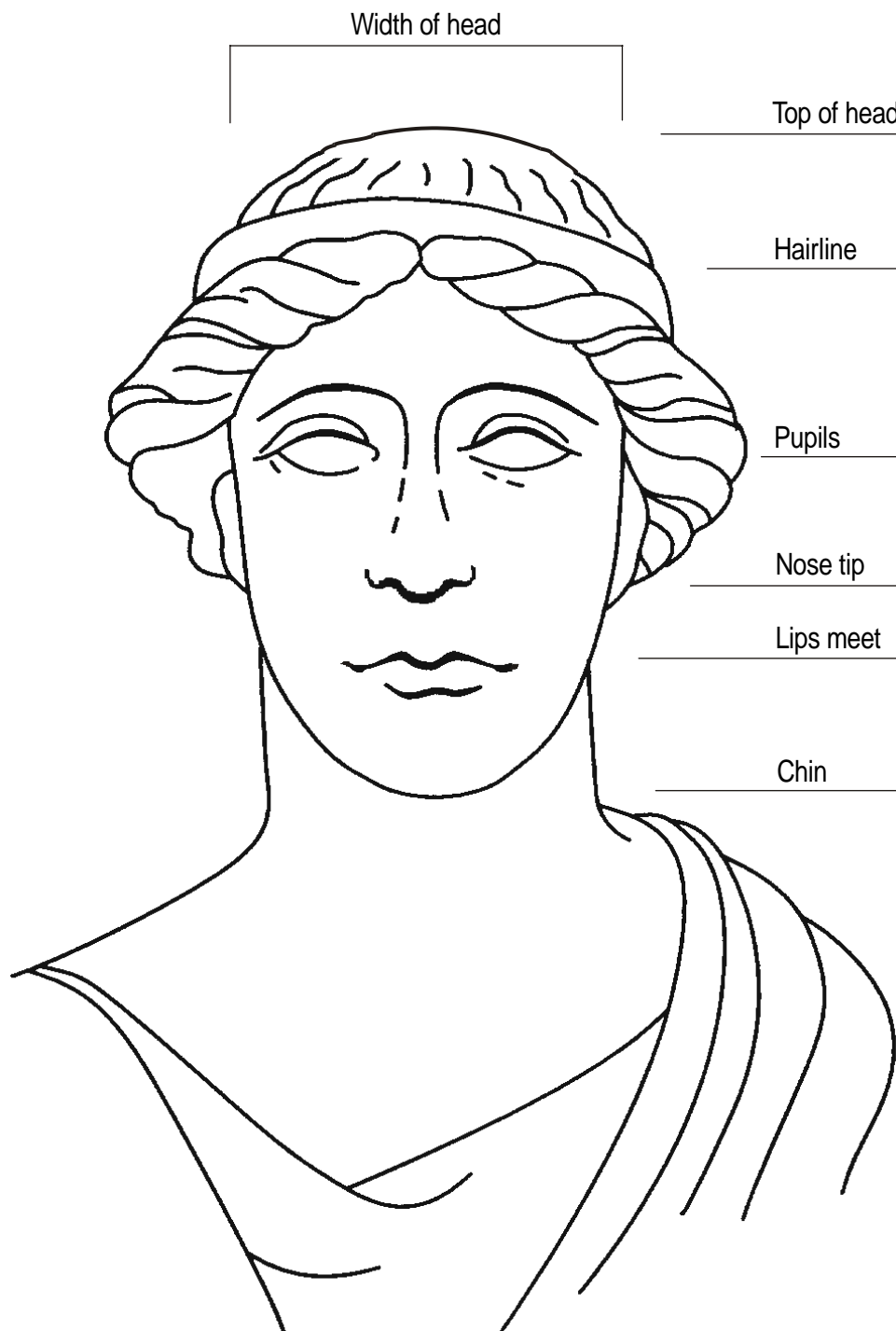
Activity

You will be rounding your results to three decimal places. Before you begin, set the **[MODE]** to 3 places.

```
Normal Sci
Float 0123456789
Degree Radian
Fix/d b/c
AutoSIMF Mansimp
```

Part 1 - Individual Activity

- The Greeks liked to make their statues with Golden Ratios twinkling in them. To see how they did this, measure the distances between features on the statue picture as accurately as you can *to the nearest millimeter*, writing the answer as a decimal number of centimeters.
 - Record each measurement on the Student Worksheet.



Use your ruler to find each measurement to the nearest millimeter (____.____ cm). If something is 7mm marks past 3 cm, call it 3.7 cm.

Part 2 - Group Project

Have a team member measure lengths on your face while recording the information in #3 on the Student Worksheet.

Note to Measurer: It is best to hold the ruler as far away from your eyes as possible when measuring these distances on the other's face. Otherwise you will get distorted measurements. Another way to measure is to use string.

Part 3

- ✎ Record your mean average ratios, your group's mean average ratios, and your class' mean average ratio in the table on the Student Worksheet.

Going Further

1. Draw a strange face, but make sure it has lots of Golden Ratios in it.
2. Redraw the Greek face so that it has none of the Golden Ratios in it.
3. Make up a new ratio and give it an interesting name. You can even make up some history and lore about it in a write-up. Draw a face that has lots of this ratio. Compare and contrast it with the Golden Ratio Face.
4. Find photographs in magazines and books. Check them for the Golden Ratios you measured in the Greek face. Find faces of other nationalities and see if they have more or fewer Golden Ratios than the ideal Greek one.
5. Purchase or borrow from the library a copy of *Jim and the Beanstalk* by Ray Briggs. In this story, Jim wakes up one day to find a great plant growing outside his window. He decides to climb up into the clouds, where he finds a castle with an old, unhappy giant. Unlike the original *Jack in the Beanstalk* tale, in this story, Jim helps the aging giant. When the giant complains about not being able to see to read, Jim measures his huge head and returns to his town to have giant eyeglasses made. Later, he measures the giant for false teeth and a wig. The proportional illustrations help students as they work to figure out the size of the giant's hands and then his height.



Name _____

Date _____

Activity 7

Go for the Gold

1. Record your measurements from the illustration on page 60.
 - A. Top of Head to Chin = ____ . ____ cm
 - B. Top of Head to Pupil = ____ . ____ cm
 - C. Pupil to Tip of Nose = ____ . ____ cm
 - D. Pupil to Lips = ____ . ____ cm
 - E. Width of Nose = ____ . ____ cm
 - F. Distance Between Outside Edges of Eyes = ____ . ____ cm
 - G. Width of Head = ____ . ____ cm
 - H. Hairline to Pupil = ____ . ____ cm
 - I. Tip of Nose to Chin = ____ . ____ cm
 - J. Lips to Chin = ____ . ____ cm
 - K. Length of Lips = ____ . ____ cm
 - L. Tip of Nose to Lips = ____ . ____ cm.
2. After you have measured these lengths, calculate the ratios indicated. (Remember A/B means A divided by B on your calculator.)
 - A. $A/G =$ ____
 - B. $B/D =$ ____
 - C. $I/J =$ ____
 - D. $I/C =$ ____
 - E. $E/L =$ ____
 - F. $F/H =$ ____
 - G. $K/E =$ ____

Your answers to the above ratios should be near the Golden Ratio, 1.618. If you are very far off on any one of them, recheck both your measurements and your calculations.

3. Record the measurements of your face and then calculate each of the ratios for your face.

- | | |
|--|----------------|
| A. Top of Head to Chin = ____ cm | A. A/G = _____ |
| B. Top of Head to Pupil = ____ cm | B. B/D = _____ |
| C. Pupil to Tip of Nose = ____ cm | C. I/J = _____ |
| D. Pupil to Lips = ____ cm | D. I/C = _____ |
| E. Width of Nose = ____ cm | E. E/L = _____ |
| F. Distance Between Outside Edges of Eyes = ____ cm | F. F/H = _____ |
| G. Width of Head = ____ cm | G. K/E = _____ |
| H. Hairline to Pupil = ____ cm | |
| I. Tip of Nose to Chin = ____ cm | |
| J. Lips to Chin = ____ cm | |
| K. Length of Lips = ____ cm | |
| L. Tip of Nose to Lips = ____ cm | |

4. Would you say that your face is “classically Greek” (since classical Greek statues show all of these Golden Ratios)?

5. Record your mean average ratios, your group’s mean average ratios, and your class’ mean average ratio in the table below.

| Ratio | Student Ratio | Your Groups’ Average | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | Your Class’ Average |
|----------------|---------------|----------------------|----|----|----|----|----|----|----|----|---------------------|
| A/G | | | | | | | | | | | |
| B/D | | | | | | | | | | | |
| I/J | | | | | | | | | | | |
| I/C | | | | | | | | | | | |
| E/L | | | | | | | | | | | |
| F/H | | | | | | | | | | | |
| K/E | | | | | | | | | | | |
| Column Average | | | | | | | | | | | |

Teacher Notes



Activity 7

Go for the Gold

Math Strand

- ◆ Geometry and measurement
- ◆ Number sense
- ◆ Patterns and functions

Materials

- ◆ TI- 73 calculator
- ◆ Ruler that measures to the nearest millimeter
- ◆ Transparency of Student, Group and Class Ratios Table (page 68)

The students will explore and use the concept of ratio in a real-world situation. They will make judgments regarding accuracy and precision of measurement.

Vocabulary

| | |
|-------|--|
| ratio | the comparison of two numbers by division |
| mean | a measure of central tendency (an average) that is calculated by taking the sum of the data set and dividing by the number of elements in the data set |

Classroom management

1. Students should work in teams of four. Assign each group a number that will correspond to the G1, G2 (and so forth) names on the Student, Group, and Class Ratios Table.
2. This Class Project is a great example of statistics in action and of how scientific reports are created. Two scientific methods are used:
 - a. First, a poll of statistics of each individual is taken. A group of individuals with a majority of statistics meeting a certain size criterion is searched for. This is a search for individuals of a certain *profile of characteristics*.
 - b. A certain ratio (calculated body statistic) known throughout the group is averaged. Other ratios of the group are similarly averaged. Finally, these averages are evaluated to check for a maximum number that fall within a certain criterion. If a large majority do, we have a *trend*.
3. Another aspect of statistical thinking is the notion of a *sample*. It is known that in a *random* sample of about 30, if we take a characteristic and average it among the 30, there is a very high chance that this characteristic would average about the same in the same population from which the sample came. So, if the sample is large enough, you can make a statement about the “Classic Greekness,” on the average, of all “typical students of that age.”

Activity**Part 1**

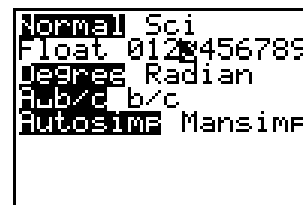
All measurements are done vertically or horizontally. Sample measurements are shown below. If students have difficulty determining where to measure, encourage them to use the lines at the side of the picture as guidelines.

- A. Top of Head to Chin = 9.3 cm
- B. Top of Head to Pupil = 4.6 cm
- C. Pupil to Tip of Nose = 1.8 cm
- D. Pupil to Lips = 2.8 cm
- E. Width of Nose = 1.6 cm
- F. Distance Between Outside Edges of Eyes = 4.4 cm
- G. Width of Head = 5.6 cm
- H. Hairline to Pupil = 2.7 cm
- I. Tip of Nose to Chin = 2.9 cm
- J. Lips to Chin = 1.9 cm
- K. Length of Lips = 2.6 cm
- L. Tip of Nose to Lips = 1.0 cm

Students will simply use the Home screen to calculate the ratios. First, set the **MODE** to 3 places (see screen at right).

Then, to calculate **A/G**, for example, press

2nd [QUIT] [CLEAR] **9** **.** **3** **÷** **5** **.** **6** [ENTER].



- A. $A/G = 1.661$
- B. $B/D = 1.643$
- C. $I/J = 1.526$
- D. $I/C = 1.611$
- E. $E/L = 1.600$
- F. $F/H = 1.630$
- G. $K/E = 1.625$

Part 2

Again, students will use the Home screen to calculate the ratios.

Part 3

1. In column 2 (student ratio) of the table, students should record their ratios to three decimal places (to the nearest thousand).
2. In column 3 (your groups' average) of the table, students should record their group average ratios to three decimal places.
3. Students will provide you with their groups' average of each ratio. The results will be recorded on the Teacher transparency table. Students should record the group data on their table.
4. Name lists appropriately and enter the data as elements in the respective list. Use the table on the transparency (page 68) as a guide. To access lists, name lists, and use formulas in lists see Appendix A, B, and C, respectively. **RAT** will be a categorical list. Sample screens are shown below.

| L5 | L6 | RAT | 7 |
|--------------|-------|-------|---|
| ----- | ----- | ----- | |
| RATC()="A/G" | | | |

| RAT | c | G1 | G2 | 7 |
|------------|---|-------|-------|---|
| A/G | | 1.503 | 1.412 | |
| B/D | | 1.489 | 1.489 | |
| I/J | | 1.689 | 1.658 | |
| I/C | | 1.666 | 1.45 | |
| E/L | | 1.523 | 1.981 | |
| F/H | | 1.656 | 1.613 | |
| K/E | | 1.554 | 1.615 | |
| RATC()=A/G | | | | |

| G3 | G4 | G5 | 10 |
|-------------|-------|-------|----|
| 1.542 | 1.569 | 1.669 | |
| 1.659 | 1.235 | 1.787 | |
| 1.235 | 1.865 | 1.995 | |
| 1.525 | 1.651 | 1.321 | |
| 1.326 | 1.258 | 1.568 | |
| 1.615 | 1.878 | 1.85 | |
| 1.619 | 1.614 | 1.6 | |
| G3C()=1.542 | | | |

| G5 | G6 | AVE | 14 |
|-----------------------|-------|-------|----|
| 1.669 | 1.358 | ----- | |
| 1.787 | 1.858 | | |
| 1.995 | 1.626 | | |
| 1.321 | 1.931 | | |
| 1.568 | 1.369 | | |
| 1.85 | 1.568 | | |
| 1.6 | 1.715 | | |
| AVE = (G5 + G6 + L... | | | |

5. To find the average of the 8 different ratios, use the formula (where N = number of groups): $AVE = (G1 + G2 + G3 + G4 \dots GN)/N$.

Sample screen shots are shown below.

| G5 | G6 | AVE | 14 |
|--------------------------|-------|-------|----|
| 1.669 | 1.358 | ----- | |
| 1.787 | 1.858 | | |
| 1.995 | 1.626 | | |
| 1.321 | 1.931 | | |
| 1.568 | 1.369 | | |
| 1.85 | 1.568 | | |
| 1.6 | 1.715 | | |
| AVE = ... LG5 + LG6) / 6 | | | |

| G5 | G6 | AVE | 14 |
|----------------------|-------|------------|----|
| 1.669 | 1.358 | 1.52216666 | |
| 1.787 | 1.858 | 1.5862 | |
| 1.995 | 1.626 | 1.678 | |
| 1.321 | 1.931 | 1.5907 | |
| 1.568 | 1.369 | 1.5042 | |
| 1.85 | 1.568 | 1.6967 | |
| 1.6 | 1.715 | 1.6195 | |
| AVEC()=1.52216666... | | | |

6. Find the mean average of each list and record on the table. Press **2nd**[QUIT] **[CLEAR]** to clear the Home screen and then press **2nd** [STAT] **[>]** **[>]** **[>]** **[>]** (to select **mean**) **[ENTER]** (pastes command on the home screen) then **2nd** [STAT] and select the lists named **G1**, **G2** through **AVE**.

| | | |
|-------------|-------------|-------------|
| 1.599619048 | mean(LG1) | 1.581428571 |
| mean(LG2) | 1.594285714 | mean(LG5) |
| mean(LG3) | 1.602571429 | 1.684285714 |
| mean(LG4) | 1.503 | mean(LG6) |
| | | 1.632142857 |
| | | mean(LAVE) |
| | | 1.599619048 |

Wrap-Up/Assessments

1. Have students compare the averages if you average the last column and the last row on the teacher transparency.
2. Ask the students:
 - ◆ *Are the averages the same?*
 - ◆ *How “Greek” are the faces in your room?*
3. Have students write a paragraph answering the following question after thinking about it a few minutes or discussing it with others who have done the same work.
 - ◆ *Why do you think the Greeks wanted to use the Golden Ratio to design the bodies and faces of statues for their gods and heroes?*

Teacher Transparency

| RATIO | G1 | G2 | G3 | G4 | G5 | G6 | G7 | G8 | G9 | AVE |
|--------------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|------------|
| A/G | | | | | | | | | | |
| B/D | | | | | | | | | | |
| I/J | | | | | | | | | | |
| I/C | | | | | | | | | | |
| E/L | | | | | | | | | | |
| F/H | | | | | | | | | | |
| K/E | | | | | | | | | | |
| Avg | | | | | | | | | | |