

## DECIMAL/PERCENT FOLDS

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Students have problems with decimals and percent in large part because:

1. students really do not understand the concept of place value.
2. the nature of the operations is confusing.
3. students view mathematics simply as discrete sets of rules to memorize.

Specific problems which are manifested include:

### **The relationship between 10 hundredths and 1 tenth**

Students, when presented with a model of hundredths and asked to count and record, will say "one-hundredth" and write .01, say "two-hundredths" and write .02, say "three-hundredths" and write .03, say "four-hundredths" and write .04, say "five-hundredths" and write .05, say "six-hundredths" and write .06, say "seven-hundredths" and write .07, say "eight-hundredths" and write .08, say "nine-hundredths" and write .09, say "ten-hundredths" and write .010. They have no conception of the relationship between hundredths and tenths or tenths and ones.

### **Operational Problems**

Addition and subtraction of decimals pose no difficulty unless the decimals are "ragged" and written in horizontal forms, (e.g.  $3.17 + 4.2$ ) in which case students are apt to add from the right, neglecting the decimal. If the numbers are written in vertical order and with the same number of decimal positions, students add and subtract proficiently, whether or not they understand the decimal system.

Multiplication and division, on the other hand, pose significant and understandable problems for students. Very few people do "decimal" multiplication or division. Instead, they multiply and/or divide whole numbers and have memorized a rule for inserting the decimal. None of the intermediate steps contain decimals. When confronted with this situation, students memorize:

- the correct rule.
- a partial rule.
- or something of their own creation.

Significant numbers of students seem to pick one of the last two alternatives. A similar situation occurs with percents. However, in the case of percent conversion to decimals the "rule" frequently depends upon the size of the number.

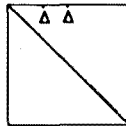
### Decimals

The following activity is designed to help students understand the decimal concept and the conversion of percents to decimals.

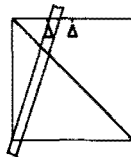
#### **ACTIVITY:**

1. Begin with a square (8x8 is a convenient size).
2. Fold the NW to SE diagonal.
3. Across the top pinch a crease at the half mark.

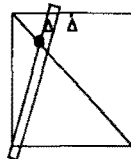
4. Now pinch at the left quarter mark.



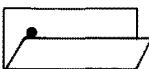
5. Place a straight-edge from the quarter mark to the SW vertex of the square.



6. Mark the intersection (This mark is  $1/5$  the length from the left and  $1/5$  the height from the top).

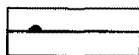


7. Fold the bottom to the dot.



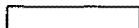
How many thicknesses on the bottom? (2)

8. Fold the crease to the dot.



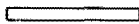
How many thicknesses on the bottom? (4)

9. Fold the top back.



How many thicknesses? (5)

10. Fold in half lengthwise



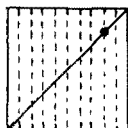
How many thicknesses? (10)

11. When it is opened, how many parts? (10)

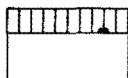
What is the decimal name of one of them? (.1)

- two of them? (.2) Show two of the parts.
- three of them? (.3) Show three of the parts.
- four of them? (.4) Show four of the parts.
- five of them? (.5) Show five of the parts.
- six of them? (.6) Show six of the parts.
- seven of them? (.7) Show seven of the parts.
- eight of them? (.8) Show eight of the parts.
- nine of them? (.9) Show nine of the parts.
- ten of them? (1.0 or 1 whole) Show all ten of the parts.

12. Rotate the paper so the dot is in the NE.

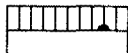


13. Fold the bottom of the sheet to the dot.



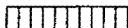
How many thickness in the bottom portion? (2)

14. Fold the crease to the dot.



How many thicknesses in the bottom portion? (4)

15. Fold the top back.



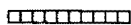
How many thicknesses? (5)

How many horizontal strips? (5)

Each strip contains how many rectangles? (10)

How many rectangles on the entire sheet? (50)

16. Fold in half lengthwise.

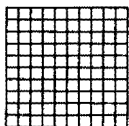


How many thicknesses? (10)

How many horizontal strips? (10)

What is the decimal name of one strip? (.1)

17. Each strip contains how many squares? (10)



How many strips? (10)

How many squares in each strip? (10)

How many squares in the whole sheet? (100)

Cover all but:

one of the squares



What is the decimal name? (.01)

two of the squares



What is the decimal name? (.02)

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three of the squares



What is the decimal name? (.03)

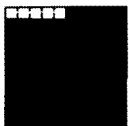
four of the squares



What is the decimal name? (.04)

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five of the squares



What is the decimal name? (.05)

six of the squares



What is the decimal name? (.06)

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seven of the squares



What is the decimal name? (.07)

eight of the squares



What is the decimal name? (.08)

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nine of the squares



What is the decimal name? (.09)

10 of the squares



What is the decimal name? (.10  
or .1)

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### Percent

Another "rule" which students frequently "forget" involves the conversion of percents to their decimal equivalents. If the percent is greater than 10, students generally make the conversion correctly. If the percent is between one and ten they frequently move the decimal one place to the left (i.e. 7.9% is changed to .79). Or, if the percent is less than one with two non-zero digits, the decimal either is moved two places to the right (i.e. .46% is changed to 46) or is not moved at all (i.e. .46% is changed to .46). The previous folding activity leads to a method which seems to eliminate the percent to decimal difficulty. It also lends itself to an inductive process with which the three cases of percent problems can be solved. The first case will be illustrated.

### **ACTIVITY:**

Use the previously folded square.

1. The square has two sides, one with a dot and the other with only folds. The side with the dot will be used for decimals and the other side for percents.
2. Turn the Percent Side up.
3. What percent of the large square can you see? (100%)
4. How many small squares in the large square? (100)
5. So, one small square is what percent of the large square? (1%)

6. What is it on the Decimal Side? (.01)

7. Show 6% on the Percent Side.



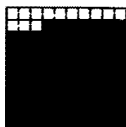
8. What is it on the Decimal Side? (.06)

9. Show 10% on the Percent Side.



10. What is it on the Decimal Side? (.10)

11. Show 13% on the Percent Side.

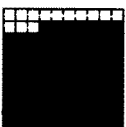


12. What is it on the Decimal Side? (.13)

#### ACTIVITY: FINDING 13% OF 23.

1. Use the Percent Side of the large square.

2. Show 13% of the large square



3. What is on the Decimal Side? (.13)

4. Let's build a table.

If 13% of	1 square is	.13	
13% of	2 squares is	_____	(.26)
	3 squares is	_____	(.39)
	4 squares is	_____	(.52)
	.	.	
	.	.	
	10	_____	(1.3)
	.	.	
	.	.	
	20	_____	(2.6)
	.	.	
	.	.	
	23	_____	(2.99 by addition if necessary)

The other cases of percent also can be done inductively.

A suggestion from John Van Beynen, Northern Michigan University, Marquette, MI, who was one of the referees for "Decimal/Percent Folds": A nice junior or senior high math problem is to prove the paper folding does divide the paper into five equal horizontal (and vertical) strips. One approach uses coordinate geometry, slope, and solving a simple system of linear equations. (A different method, involving a synthetic approach, is to use properties of similar triangles. —the Editors.) What proofs can your students find?

### MATH SCRAMBLER

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Unscramble these twelve mixed-up math terms, one letter to each blank:

G I T R H      \_\_\_\_\_  \_\_\_\_\_  \_\_\_\_\_

W T I D H      \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

N S E C I O      \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_   \_\_\_\_\_

W S E K      \_\_\_\_\_  \_\_\_\_\_ \_\_\_\_\_

R O H M T E E        \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

M Y E T O G E R      \_\_\_\_\_  \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_  \_\_\_\_\_

E T R E C N      \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_  \_\_\_\_\_

L U F A S R O M        \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

V E P O R      \_\_\_\_\_  \_\_\_\_\_ \_\_\_\_\_

S A R D U I      \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_  \_\_\_\_\_ \_\_\_\_\_

X Y S I A       -  \_\_\_\_\_ \_\_\_\_\_ \_\_\_\_\_

M I I T L      \_\_\_\_\_ \_\_\_\_\_  \_\_\_\_\_ \_\_\_\_\_

Now, write the letters in the boxes in the same order below and you'll have the answer to the riddle:

WHAT DID DESCARTES SAY WHEN HIS WIFE GAVE HIM A PLATE OF SWEET POTATOES?

Answer: \_\_\_\_\_ ; \_\_\_\_\_  
\_\_\_\_\_ !

Answers are on page 26.