Models for Teaching Fractions and Percent

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Today the study of fractional numbers in the form of common fractions begins in the primary grades of the elementary school. In the intermediate grades, pupils learn that decimal fractions and percents are other ways to express fractional numbers. Although most textbooks and teachers delay the introduction of decimal fractions and percent to Grades V and VI, recent research has indicated that some of these concepts can be taught earlier. Furthermore, the anticipated future adoption of the metric system may in time expedite this matter. In fact, in 1969 the Cambridge Conference on the Correlation of Science and Mathematics in the Schools suggested that children in the primary grades should learn the metric system and decimal notation.

To help children studying decimal fractions and percent for the first time in any grade, it is useful to relate these new concepts to some ideas with which the children are familiar, such as common fractions and operations on sets of numbers. Instructional aids can demonstrate the close relationship between these "old" and "new" concepts. This article attempts to present a variety of physical models which elementary school teachers can use when developing concepts of decimal fractions and percent.
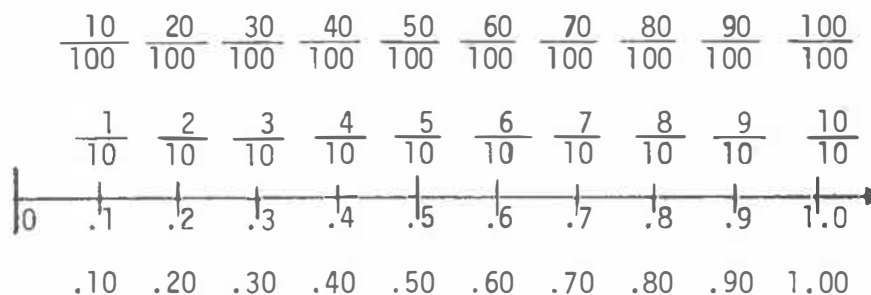
The models described here include some patterns which have resulted from the author's classroom experience and research and also some ideas collected by pre-service teachers enrolled in "Teaching Mathematics in the Elementary School" at Madison College. Providing for the creative involvement of pupils in discovery-type situations, these models emphasize observation and exploration.

NUMBER LINE. The decimal number line can be used as early as Grade I, provided the whole number line is introduced first.
1. With the help of the decimal number line, the teacher can demonstrate the basic number operations.
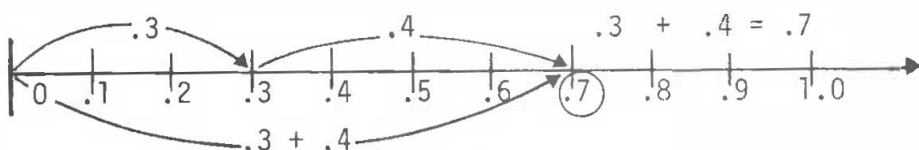
2. The composite number line which includes both common and decimal fractions is useful for teaching the reading of decimals; it shows clearly the relationship between the number of zeros in the denominator of a common fraction and its respective decimal fraction.

$$\frac{10}{100} \quad \frac{20}{100} \quad \frac{30}{100} \quad \frac{40}{100} \quad \frac{50}{100} \quad \frac{60}{100} \quad \frac{70}{100} \quad \frac{80}{100} \quad \frac{90}{100} \quad \frac{100}{100}$$

$$\frac{1}{10} \quad \frac{2}{10} \quad \frac{3}{10} \quad \frac{4}{10} \quad \frac{5}{10} \quad \frac{6}{10} \quad \frac{7}{10} \quad \frac{8}{10} \quad \frac{9}{10} \quad \frac{10}{10}$$

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|----+----+----+----+----+----+----+----+----+---->
0   .1   .2   .3   .4   .5   .6   .7   .8   .9  1.0
```

.10 .20 .30 .40 .50 .60 .70 .80 .90 1.00

METER STICK. If a meter stick is used to represent a unit, then the deci-meter and centimeter will demonstrate tenths and hundredths, respectively.

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| 1  2  3  4  5  6  7  8  9  10  11  /
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MONEY. Dollars can easily be used to represent whole numbers; dimes, tenths; and cents, hundredths. A chart can be prepared summarizing the use of money to demonstrate the equivalence of fractions, decimals, and percents.

	decimal	percent	fraction
1¢	.01	1% of $	1/100 of $
10¢	.10	10% of $	10/100 of $
25¢	.25	25% of $	25/100 of $
50¢	.50	50% of $	50/100 of $

SNAP OR POP BEADS. Assemble nine beads of one color and a tenth bead of a different color. This bead ruler can be as long as 100 beads, and can be used to measure things in the classroom.

METRIC RULERS. Such rulers can be prepared from paper grided with centimeter squares. The students will then use the rulers to measure many things in the classroom.

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| .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 |1.0 |
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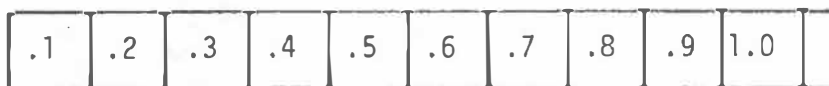
TABS. Equivalent fractions, decimals, and percents can be displayed by preparing and taping tabs to a ruler.

```
12 ─
11 ─
10 ─   1.0   1.00   100%
 9 ─R   .9    .90    90%
 8 ─U   .8    .80    80%
 7 ─L   .7    .70    70%
 6 ─E   .6    .60    60%
 5 ─R   .5    .50    50%
 4 ─    .4    .40    40%
 3 ─    .3    .30    30%
 2 ─    .2    .20    20%
 1 ─    .1    .10    10%
```

CUISENAIRE RODS. The white and orange rods can be used to represent units and tenths, respectively.
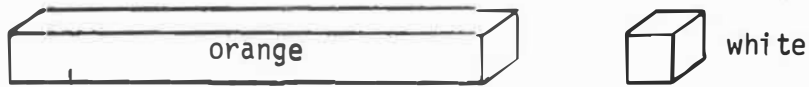
PAPER FOLDING AND SHADING. Strips of paper can be folded to show equivalent fractions, decimals, and percents.
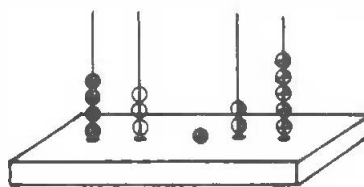
1/4 = .25 = 25%
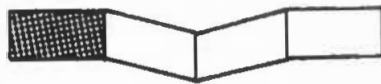
HUNDRED BOARD. This board can be used to show relationships between fractions, decimals, and percents. Let the entire board represent one or 100% so that each of the 100 squares or disks represents 1/100, .01, or 1%.
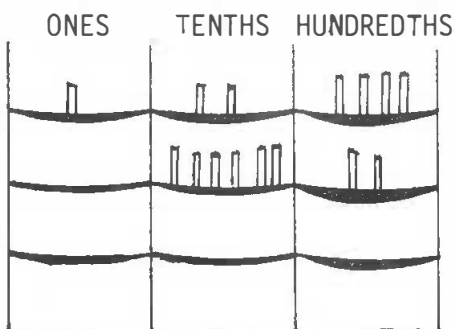
ABACUS. This device is effectively used to demonstrate decimal place value and the four basic operations involving decimal fractions.
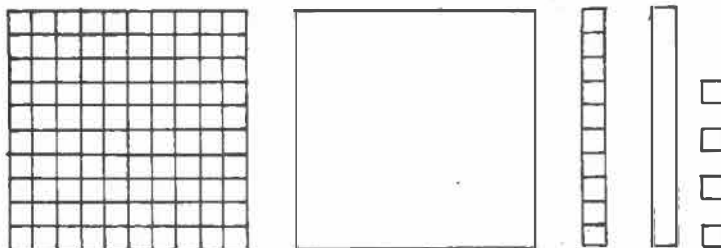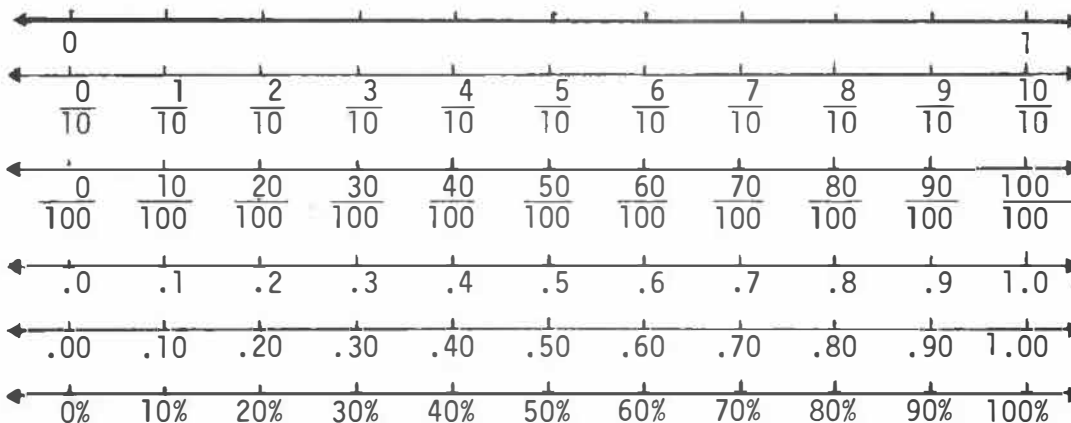
43.25

DECIMAL PLACE VALUE CHART. Place value and the basic operations involving decimal fractions can be demonstrated using this chart.

ONES   TENTHS   HUNDREDTHS

SQUARES AND RECTANGULAR STRIPS. The larger square with one side ruled and the other plain represents 1, 1.00, or 100%. A single strip represents 1/10, .1, and 10% whereas the small squares represent 1/100, .01, and 1%.

FRACTION-DECIMAL-PERCENT EQUIVALENCE CHART

| 0 | | | | | | | | | | 1 |

| $\frac{0}{10}$ | $\frac{1}{10}$ | $\frac{2}{10}$ | $\frac{3}{10}$ | $\frac{4}{10}$ | $\frac{5}{10}$ | $\frac{6}{10}$ | $\frac{7}{10}$ | $\frac{8}{10}$ | $\frac{9}{10}$ | $\frac{10}{10}$ |

| $\frac{0}{100}$ | $\frac{10}{100}$ | $\frac{20}{100}$ | $\frac{30}{100}$ | $\frac{40}{100}$ | $\frac{50}{100}$ | $\frac{60}{100}$ | $\frac{70}{100}$ | $\frac{80}{100}$ | $\frac{90}{100}$ | $\frac{100}{100}$ |

| .0 | .1 | .2 | .3 | .4 | .5 | .6 | .7 | .8 | .9 | 1.0 |

| .00 | .10 | .20 | .30 | .40 | .50 | .60 | .70 | .80 | .90 | 1.00 |

| 0% | 10% | 20% | 30% | 40% | 50% | 60% | 70% | 80% | 90% | 100% |

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HUNDRED GRID. To display equivalents of fractions, decimals, and percents, shade parts of the hundred grid.

$\frac{1}{4}$

.25

25%
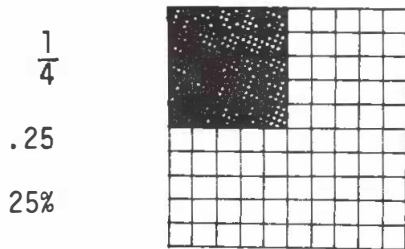
ODOMETER. This device can be used to illustrate decimal place value. Pre-pare (1) by encircling a can using individual 1"-wide strips of paper marked with a decimal point or the numerals 0-9

Reads
24.32 ⟶

or (2) by cutting a window in an index card and inserting a strip bearing the decimal numbers.
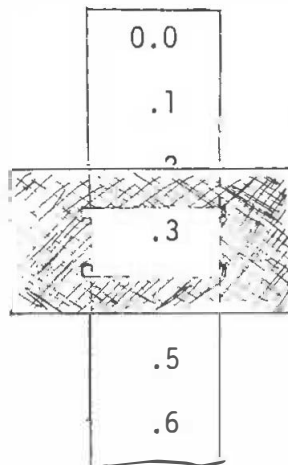

Odometer (1) also can be used to show addition, subtraction, and multiplication.

PEG BOARD. This board, in addition to showing equivalent fractions, deci-mals, and percents, can be used to demonstrate the four basic operations involving common and decimal fractions.

$\frac{1}{10}$

.10

10%

24
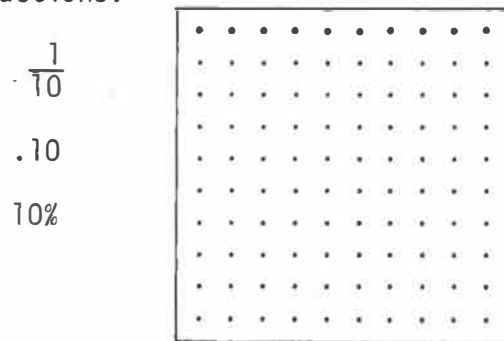
NOTCH CARDS. Prepare notched cardboard; the upper card should be covered with plastic on which different numerals can be written with a grease pencil. The lower card should be marked with a single decimal point. By moving the numerals to the right or left of the decimal point, the value of the number displayed will change in multiples of 10. The upper card can also be used in front of a class if the decimal point is placed on the chalkboard.
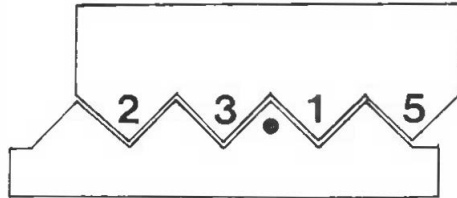

MIXED, DECIMAL, AND FRACTIONAL NUMBER COMPARISON CHART. This chart should assist students in extending their comparison skills to numbers in excess of one.

Mixed Number	Hundreds	Tens	Ones		Tenths	Hundredths	Fraction
6 + 7/10			6	.	7		67/100
25 + 83/100		2	5	.	8	3	2583/100

CELLOGRAPH PIE CHART. Such a chart is used to illustrate equivalent fractions, decimals, and percents. It is marked from 0-100 with numerals appearing at every fifth interval.

0%
100%

75%   25%

50%
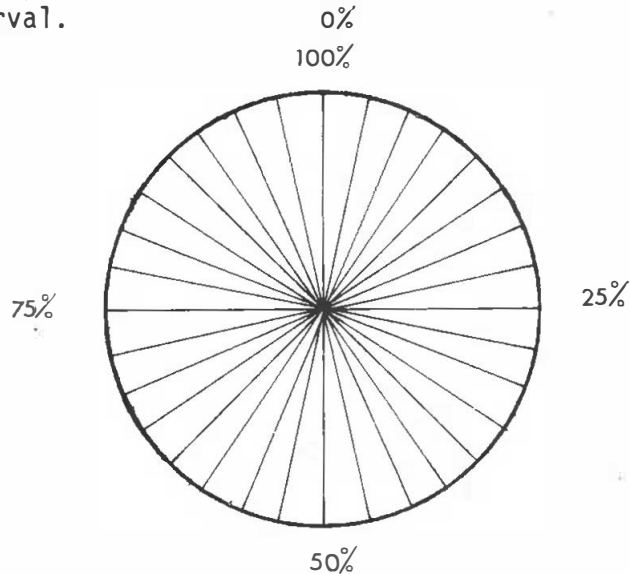
DOMINOES. Such a set can be easily constructed from cardboard, tiles, or wooden blocks. They are used to evaluate knowledge of equivalent fractions, decimals, and percents.

$\frac{1}{5}$	▣	30%
		.2
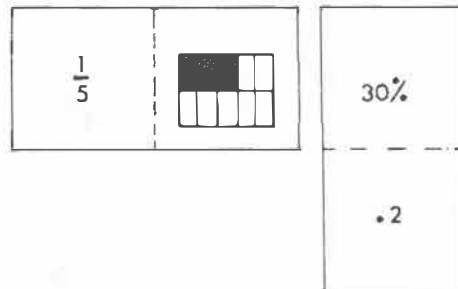
MAGIC SQUARES. These squares can be designed using decimal fractions.

.8	1.8	.4
.6	1.0	1.4
1.6	.2	1.2

⸋⸋⸋

GO METRIC

"...The Metric System is taught naturally in connection with decimals, and is easily learned. Only the units employed furnish any difficulty. Only the units employed furnish any difficulty. The great number of problems given under the Metric System is to familiarize the learner with the units of the system, to show the simplicity of the system in its application to everyday problems, and at the same time to give practice in operations involving decimals. This system is used in the laboratories of science and in international transactions. Though not yet adopted by the United States in the common affairs of life, it has certainly forced its way to a position requiring recognition in all secondary schools of the country..." - G.A. Wentworth
                                        Exeter, New Hampshire
                                        June 1898
(from the Preface to his book *Advanced Arithmetic*, Ginn & Company, Publishers, 1901).