Include Fractions in the Elementary School Curriculum

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During the sixties, Alberta's elementary mathematics curriculum was critically reviewed. As a result of the decision to adopt the Metric System (S.I.) in Canada, work with common fractions was eliminated. The focus was on decimal numeration and the extension to S.I. prefixes, while instruction in common fractions was limited to halves, thirds, fourths, fifths and tenths.

The current Alberta curriculum encourages integration and continuity of instruction. Integration should not only be across subjects but also within a subject. Continuity rightly includes the continued use of the same materials or models throughout the grades. It should also include students' developing ideas and the ability to express those ideas clearly and concisely. Manipulatives provide just such an opportunity for integration and continuity within the mathematics curriculum. The best opportunity for language development occurs in a small-group situation, where the size of the group may be less important than the opportunity for discussion.

The ideas that follow are not new. Many of the diagrams can be found in elementary or Grade 7 mathematics texts. However, the idea of students developing manipulatives rather than using prepared materials may be new to some readers. Students enjoy using materials they or their colleagues have developed. I have not indicated the grade levels for which these exercises are appropriate. I have tried them out on Grade 4 students, who were excited by and enjoyed developing and using a fraction kit consisting of strips of paper. Could some of these experiences be tried at a lower level? The question, I hope, is rhetorical.

Developing the Kit and Related Activities

I. Whole

Provide each student with a uniform set of rectangular paper strips.

Have students explore some of the questions that follow:

1. Are the strips the same size? Why?
2. Are the measures of opposite sides the same?
3. How do the measures of the angles compare?
4. Do the strips have the same area?

These are properties of congruency. After the exploration label the unit strip.

Illustration 1

II. Halves

Ask each student to take a new paper strip. Estimate where the halfway point of the strip would be. Check. Challenge students to find the halfway point another way (measure, fold, refine estimate). Accept all correct responses.

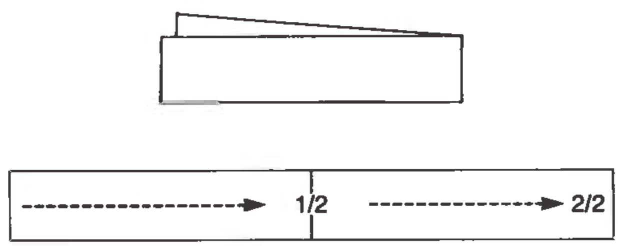


Illustration 2

Discuss properties of congruent figures developed with the unit strip. Ask:

1. How many halves in one?
2. If a strip (unit) is divided into two equal (congruent) parts, what is the size of each part?

Label as in Illustration 2. Is there another term for one?

Note that the order of developing fractions on the paper strip that I follow here is completely arbitrary. Teachers could develop thirds next.

III. Fourths

Before providing students with a new strip ask them if they can divide a strip into four equal (congruent) parts. Have each of them justify or illustrate the method used. Accept all correct responses.

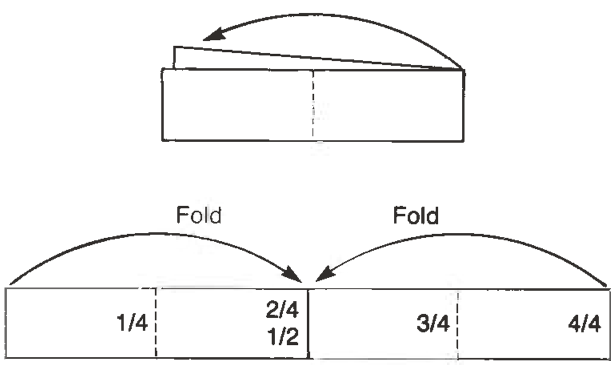


Illustration 3

Possible questions to explore include:

1. How many equal parts are there?
2. What is the name of each part? Quarters?
3. Compare: How many halves in one?
   How many quarters in one?
4. How much of the whole one is
   1/2 + 1/4?
   1/4 + 1/2? Prove.
5. How many ways of naming one?
   1, 2/2, 4/4, . . .
6. Extend to eighths and sixteenths. Some students may do this on their own.

IV. Thirds and Sixths

After thirds, sixths and possibly twelfths may be developed.

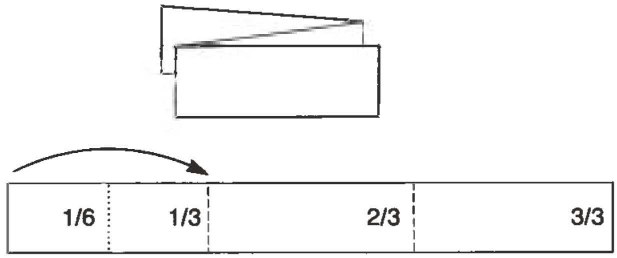


Illustration 4

Continue developing equivalent fractions. Challenge the students to determine whether they have formed a generalization. Verify with fraction strips or diagrams.

V. Denominators ≥ Five

As the number of folds increases, the measures become less precise. A handy, accurate measuring device can be developed using parallel lines. Figure 1 shows a line segment divided into fractions. The fractions equivalent to one-half are also marked. Other equivalents are evident. Incidentally, why this works might be a good investigation for a high school geometry class.

VI. Decimal Fractions

Comparing the halves and fifths to the tenths strip generates the decimal equivalents. Additions and subtractions can be made, such as:

$$1/2 + 1/5 = 0.5 + 0.2$$
$$1/2 - 1/5 = 0.5 - 0.2$$
$$1/10 + 0.5 = 1/10 + 1/2$$

VII. Fraction Chart

Students should be encouraged to develop their own charts. (See Figures 2 and 2A).

List equivalent fractions. Challenge the students.

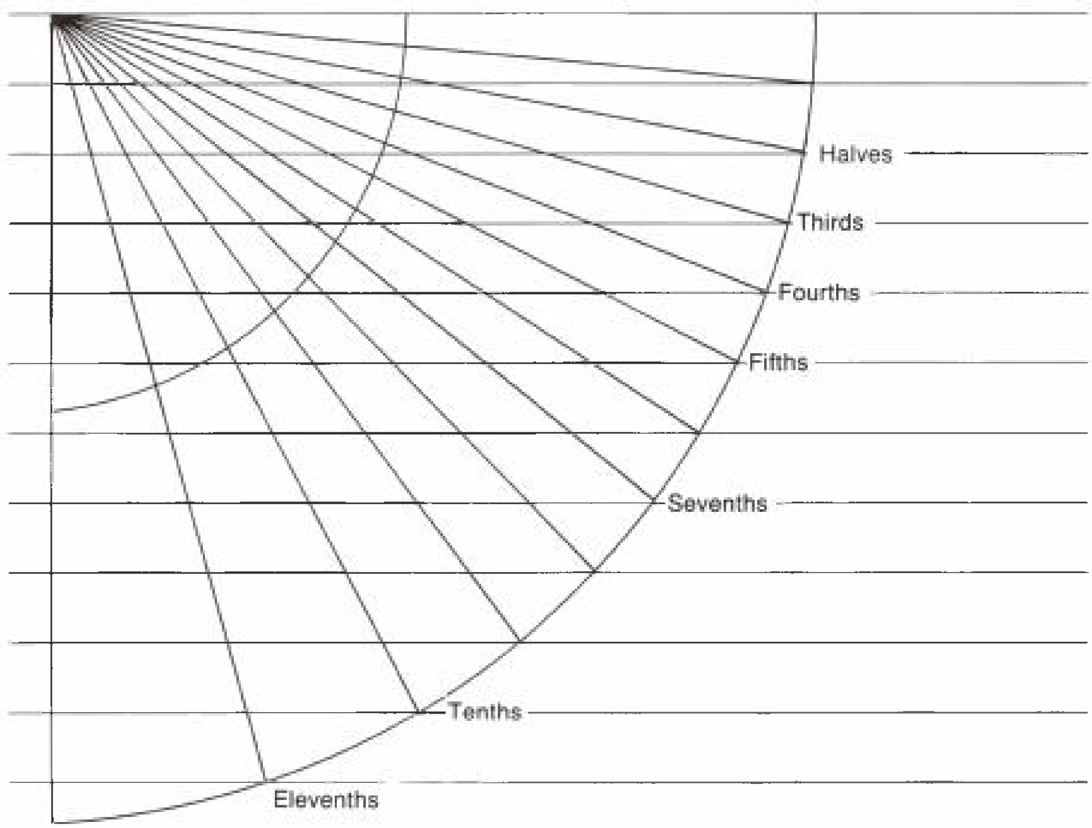
1/2 = 2/4
1/2 = ?/3
1/2 = 3/6
1/2 = 4/8
:   :
1/2 = ?/16

The chart also shows the following:

$$1/2 - 1/3 = 2/3 - 1/2$$
$$1/3 - 1/4 = 3/4 - 2/3$$
$$1/4 - 1/5 = 4/5 - 3/4$$
$$\vdots \qquad \vdots$$
$$\frac{1}{n} - \frac{1}{n+1} = \frac{n}{n+1} - \frac{n-1}{n}$$

Figure 1

Fraction Generator



Identify the line segments. Estimate. Use strips to verify. Allow students to determine the fractional equivalents (common denominator) for each minuend and subtrahend.

Sums and minuends greater than one can be illustrated by placing two strips end to end. It can be shown that:

$$1/2 + 7/10 = 5/10 + 7/10$$
$$= 12/10$$

or

$$0.5 + 0.7 = 1.2$$

Multiplication can be incorporated:
3 x 1/2 means placing 3 units of 1/2 end to end
4 x 2/3 means . . .

Division can also be shown. Consider the following questions:

1. How many quarters are in one-half?
   $1/2 \div 1/4 = ?$
2. What is the size of each part when one-half is divided into two equal parts?
   $1/2 \div 2 = ?$

By now some readers are probably saying: But, this isn't part of the elementary curriculum! I'll concede that! Perhaps, however, the teaching of fractions in elementary grades should be reintroduced if integration, continuity, estimation, use of manipulatives, thinking and language development are part of the curriculum. Evaluation procedures must allow the use of manipulatives. Developing and applying rules of operation should be left for the junior high school. Rather, inductive, problem solving strategies should be used to set the stage for the deductive approach to teaching mathematics in the elementary grades.

Figure 2

Fraction Chart

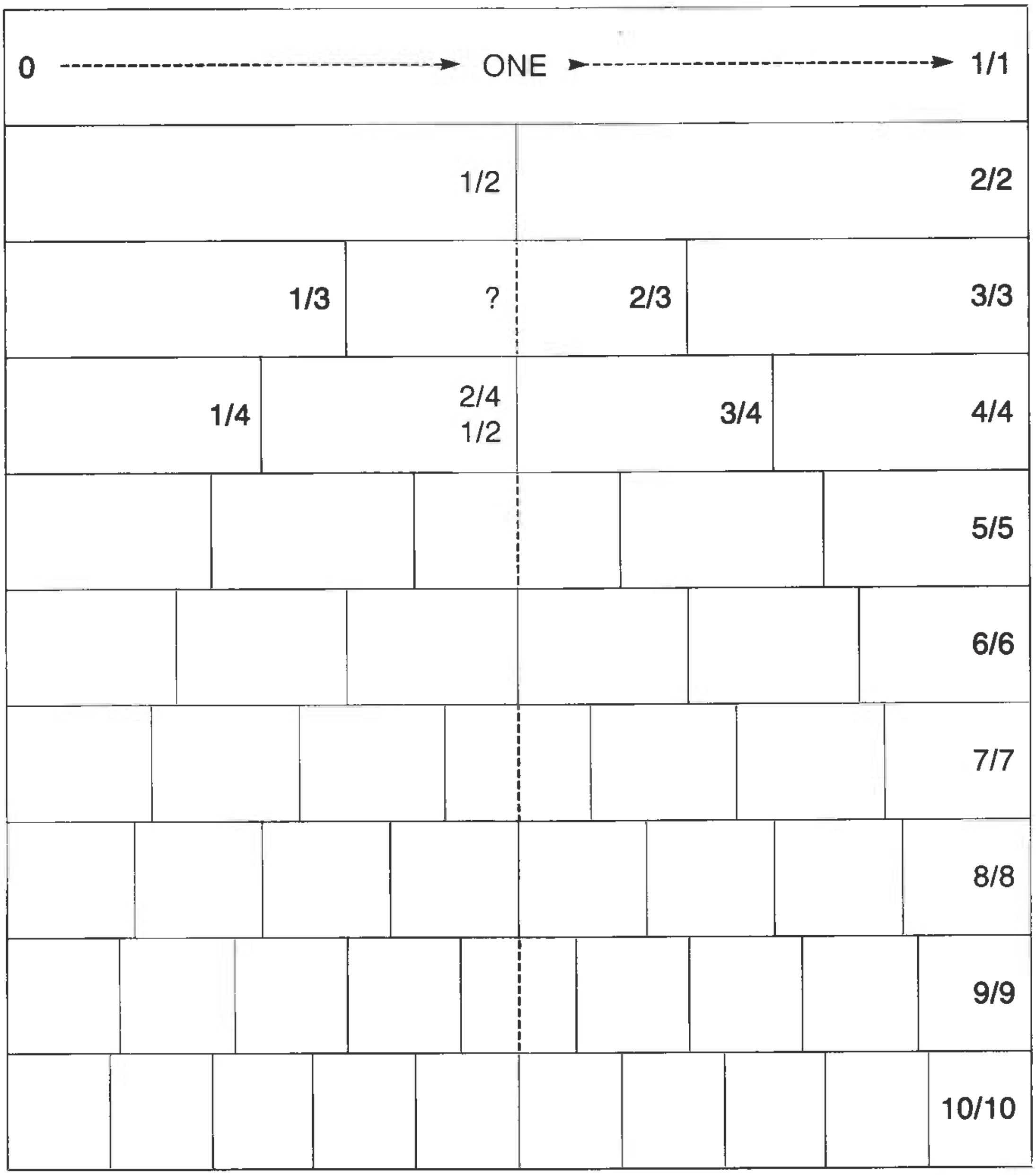
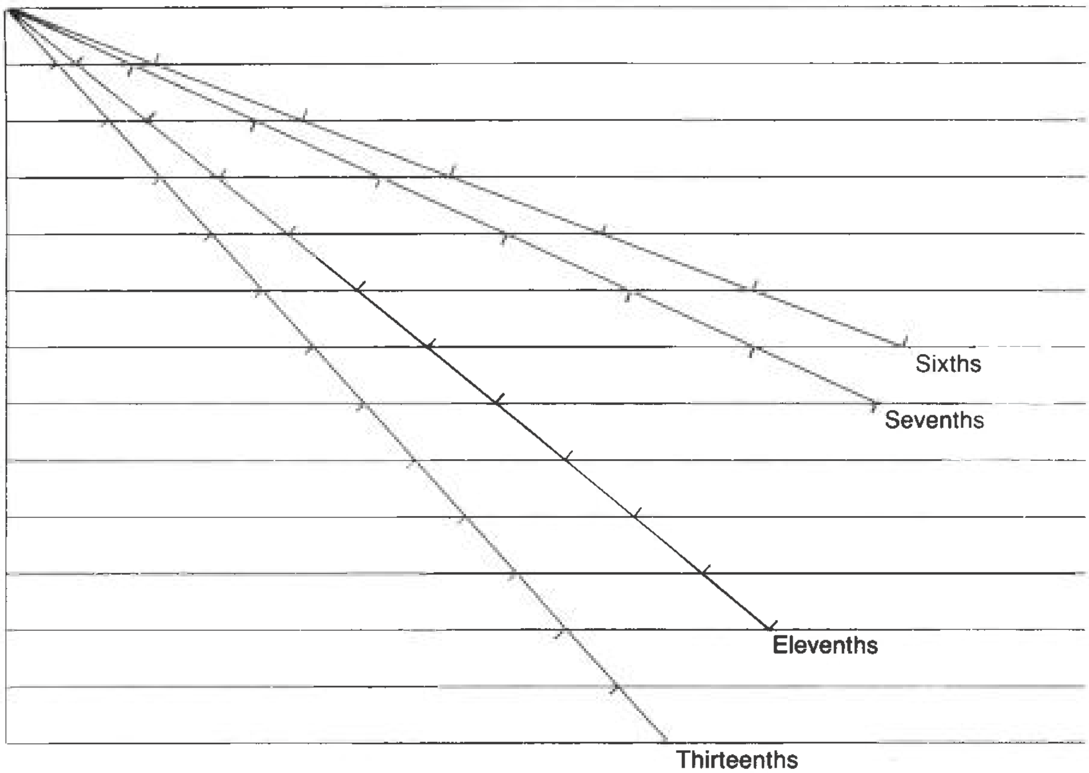


Figure 2A



An adaptation of Figure 1, this provides number lines for the fractions given. The lines are 14 cm long as are the strips in Figure 2.