COURSE OF STUDY FOR THE PUBLIC SCHOOLS OF NEWARK, N. J.

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OF

NEWARK, N. J.

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MATHEMATICS.

Arithmetic is the science of numbers, not the art of "figuring." This art is secondary and subsidiary. Through the study of mathematics, children should acquire a conception of number and dimension, which are the content of the study. They express their conception of this content through the art of "figuring," which constitutes the "Form" of the subject.

Mathematics should introduce the child to an accurate knowledge of the physical world. It should always deal with real things rather than with the signs of things. This is particularly important in the primary grades. The two most common errors in the teaching of arithmetic are, first, the limiting of its application too closely to commercial transactions, thus belittling the science ; and second, dealing with figures, characters and signs rather than with real quantities.

In the primary grades all work should be concrete. The computation should be based upon dealings with actual things, measured or counted. Children naturally recognize the various relations expressed by addition, subtraction, multiplication, division and partition upon such numbers as they can readily handle and comprehend. Going through the processes of addition or subtraction upon very large numbers is for young children meaningless.

All schools should be supplied with scales for measuring, with measures of capacity and with rules, and much of the elementary work should be the actual use of these tools. Illustration by means of pictures also tends to make the work real. As soon as children comprehend the relations through actual experiment or illustration, they can be led to abstract calculation, but in the primary grades this should be confined to numbers within their comprehension. More should be made of dimension than is commonly made. Many of the subjects usually treated in arithmetic have a

178483

limited practical value, being either matters of special business concern or belonging to the sphere of higher mathematics, and have been omitted from this course.

MATHEMATICS.

FIRST GRADE, "B" CLASS.

Numbers 1-6.

Operations.—Addition, subtraction, multiplication, division, partition. Halves of 2, 4 and 6. Thirds of 6. Halves of 1.

Recognition and estimates of capacity of units of volume, as pint, quart, gallon; the number of feet in a yard.

All work concrete.

If pupils have had proper kindergarten training the present outline can be adapted to their degree of proficiency.

FIRST GRADE, "A" CLASS.

Numbers 6-12.

Operations.—The same as given above for Class "B."

In addition, units of volume in dry measure and a study of relative capacity.

Halves of all numbers studied.

Fourths of 4, 8; thirds of 3, 6 and 9.

Halves, quarters and thirds of 1.

Use of figures to represent numbers.

Concrete work.

Telling time by clock.

SECOND GRADE, "B" CLASS.

Numbers.—Review of first year's work. Advance 12-20.

Operations.—Addition, multiplication, subtraction, division, partition; short distances in feet or yards.

Subjects.—Lines, as yard, foot, inch; areas, as square

yard, and number of square feet composing the same. Number of square yards or square feet in convenient surfaces.

Dozen and half-dozen.

Pound and ounces composing the same.

Practical problems as to the cost of paper, slates, pencils, food and clothing.

Change of yards and feet to feet, and the reverse

Like operations with gallons, quarts and pints, bushels and pecks.

Halves of all numbers studied.

Thirds and fourths of all numbers capable of equal division.

Relations of halves and quarters, thirds and sixths of 1. Concrete work.

SECOND GRADE, "A" CLASS.

Numbers.—Review of work of previous class. Advance through 30.

Operations.—Same as in "B" Second.

Subjects.—Same as in "B" Second.

In advance take simple problems in addition, multiplication, subtraction and division of compound numbers; also notation and numeration through 30, using bundles of sticks in developing the tens. Have actual operations in building, in adding and subtracting performed before representing work by figures.

All abstract and drill work should follow concrete work.

In fractions of 1, change of halves to quarters and eighths; thirds to sixths and ninths, using square and circle for purposes of illustration.

Study of time table, divisions of day, parts of the hour, time of day, days in week or month, weeks in month and months in year. Written work in addition and subtraction involving carrying.

THIRD GRADE.

"B" Class.—Numbers through 50.

"A" Class.—Numbers through 100.

Operations.—Division, partition, subtraction, multiplication, addition. Notation and numeration, both Roman and Arabic, through 1,000; development of tenths and hundredths; addition and subtraction of simple fractions.

Subjects—

1. Compound numbers.

Actual measurements by inches, feet, yards and rods. Drawing diagrams and maps to scale, ½ inch to a foot, etc. Measurements of the boundaries of rectangles. Square inches, feet and yards on surfaces of tables, boxes, boards, floors, etc. Cost of carpeting and papering. Buying and selling of quantities of liquids; pints, quarts, gallons, barrels, etc. Introduce problems involving change of denominations.

Apply the same processes to units in dry measure. Minutes, hours, days, months and years.

Practice in telling time of day.

Money, buying and selling; wages for labor.

2. Aliquot parts, after 100 is developed.

½ or .50, or 50%; ¼ or .25, or 25%; ⅛ or .12½, or 12½%; ⅓ or .33⅓, or 33⅓%; ⅕, ⅔, etc.

3. Fractional parts of 1.

Thirds and ninths.

Thirds and sixths.

Halves and sixths.

Halves and eighths.

Fifths and fifteenths.

Halves and quarters.

Use square and circle for purposes of development and illustration. For instance: A man sells ⅓ of his land to one man and ¼ to another. What part or parts were left? What part or parts sold?

Take examples from science study.

Review work of the year. .

Suggestions.—Illustration is of use in arithmetic only when by its use pupils actually solve problems. Never allow a pupil to first solve a problem and afterwards illustrate it. The diagram should be drawn first to fit the conditions of the problem and the questions answered from this diagram. Seat work in the first four grades should be largely from the concrete.

All facts in number should be developed by actual experiment on the part of children under the direction of the teacher.

Class work should be partly new work and partly work which will fix in the memory combinations of numbers until their formation becomes automatic.

In all grades above the third, fifteen minutes daily should be given to rapid mechanical work in addition, subtraction, multiplication, and division of whole numbers and fractions.

Give many problems for seat work, that require diagrams, in order that children may comprehend their use. Thus:

FOR "B" THIRD AND "A" THIRD.

COMBINATIONS—EQUAL NUMBERS—MULTIPLICATION TABLE.

$$4\begin{cases} 2\times 2 \end{cases} \quad 9\begin{cases} 3\times 3 \end{cases} \quad 14\begin{cases} 3\times 7 \\ 7\times 2 \end{cases}$$

$$18\begin{cases} 3\times 6 \\ 6\times 3 \\ 2\times 9 \\ 9\times 2 \end{cases} \quad 22\begin{cases} 11\times 2 \\ 2\times 11 \end{cases}$$

$$6\begin{cases} 2\times 3 \\ 3\times 2 \end{cases} \quad 10\begin{cases} 5\times 2 \\ 2\times 5 \end{cases} \quad 15\begin{cases} 5\times 3 \\ 3\times 5 \end{cases}$$

$$20\begin{cases} 2\times 10 \\ 10\times 2 \\ 4\times 5 \\ 5\times 4 \end{cases} \quad 24\begin{cases} 8\times 3 \\ 3\times 8 \\ 6\times 4 \\ 4\times 6 \\ 2\times 12 \\ 12\times 2 \end{cases}$$

$$8\begin{cases} 4\times 2 \\ 2\times 4 \end{cases} \quad 12\begin{cases} 6\times 2 \\ 2\times 6 \\ 3\times 4 \\ 4\times 3 \end{cases} \quad 16\begin{cases} 4\times 4 \\ 2\times 8 \\ 8\times 2 \end{cases} \quad 21\begin{cases} 3\times 7 \\ 7\times 3 \end{cases} \quad 25\begin{cases} 5\times 5 \end{cases}$$

$27 \begin{cases} 3\times 9 \\ 9\times 3 \end{cases}$ $35 \begin{cases} 7\times 5 \\ 5\times 7 \end{cases}$ $44 \begin{cases} 11\times 4 \\ 4\times11 \end{cases}$ $56 \begin{cases} 7\times 8 \\ 8\times 7 \end{cases}$ $77 \begin{cases} 11\times 7 \\ 7\times11 \end{cases}$

$28 \begin{cases} 7\times 4 \\ 4\times 7 \end{cases}$ $36 \begin{cases} 6\times 6 \\ 3\times12 \\ 12\times 3 \end{cases}$ $45 \begin{cases} 5\times 9 \\ 9\times 5 \end{cases}$ $60 \begin{cases} 6\times10 \\ 10\times 6 \\ 12\times 5 \\ 5\times12 \end{cases}$ $80 \begin{cases} 8\times10 \\ 10\times 8 \end{cases}$ $81 \begin{cases} 9\times 9 \end{cases}$

$30 \begin{cases} 8\times10 \\ 10\times 8 \\ 5\times 6 \\ 6\times 5 \end{cases}$ $40 \begin{cases} 9\times 4 \\ 4\times 9 \\ 4\times10 \\ 10\times 4 \\ 8\times 5 \\ 5\times 8 \end{cases}$ $48 \begin{cases} 8\times 6 \\ 6\times 8 \\ 4\times12 \\ 12\times 4 \end{cases}$ $66 \begin{cases} 11\times 6 \\ 6\times11 \end{cases}$ $88 \begin{cases} 8\times11 \\ 11\times 8 \end{cases}$ $90 \begin{cases} 9\times10 \\ 10\times 9 \end{cases}$

$70 \begin{cases} 7\times10 \\ 10\times 7 \end{cases}$ $96 \begin{cases} 8\times12 \\ 12\times 8 \end{cases}$

$32 \begin{cases} 8\times 4 \\ 4\times 8 \end{cases}$ $50 \begin{cases} 5\times10 \\ 10\times 5 \end{cases}$ $72 \begin{cases} 9\times 8 \\ 8\times 9 \\ 6\times12 \\ 12\times 6 \end{cases}$ $99 \begin{cases} 9\times11 \\ 11\times 9 \end{cases}$ $100 \begin{cases} 10\times10 \end{cases}$

$33 \begin{cases} 11\times 3 \\ 3\times11 \end{cases}$ $42 \begin{cases} 6\times 7 \\ 7\times 6 \end{cases}$ $54 \begin{cases} 9\times 6 \\ 6\times 9 \end{cases}$

Give much drill on multiplication table at each step, using all factors or numbers as high as studied. Confine the work of development to composite numbers.

THE MULTIPLICATION TABLE.

After children are taught to draw to a scale, develop the facts in the multiplication table by the use of rectangles. Thus : Children draw a figure 6 by 9 inches, dividing it into square inches and finding all possible combinations in it.

Written work in addition, subtraction and multiplication, involving carrying.

After these combinations are properly developed see that children learn them perfectly.