

Introduction v

September 1

Work with Cuisenaire® rods	3
Recognizing geometric solids	6
Recognizing numerals	6
Counting	8
Recognizing number groups	8
One-to-one correspondence	8
Recognizing number groups	12
Diagnostic chalkboard session	12
Counting	15
One-to-one correspondence	15
Work with Cuisenaire® rods	18
Counting	22
One-to-one correspondence	22
Recognizing geometric solids	27
Counting	27
Counting: tally method	30
Work with Cuisenaire® rods	30
Cuisenaire® rods	33
Counting	33
One-to-one correspondence	33
Work with Cuisenaire® rods	37
Work with Cuisenaire® rods	40
Addition	40
Counting	44
Work with rods	44

October 49

Number line	51
Number line	54

Geometric recognition	54
Numeral recognition	54
Number line	58
Subtraction with	
Cuisenaire® rods	58
Inequalities	60
Counting	60
Cuisenaire® rods	63
Addition and subtraction	65
Addition and subtraction	67
Summary of work	67
Evaluation	67
Sets	70
Word problems:	
multiplication	76
Addition and subtraction	78
Multiplication using	
Cuisenaire® rods	80
Special work	80
Geoboards: rows and columns	84
Logic	84
Writing numerals	88
Difficult problems	88
The past month	92
Number line: addition and	
multiplication	95
Cuisenaire® rods: addition	
and subtraction	95
Cuisenaire® rods:	
mixed operations	97
Number line: odd and even	100
Rod patterns	101

Numeral recognition:
odd-even 103
Rod models: beginning use
of parentheses 103

November 105

Odd-even 107
Addition and subtraction 108
Addition and subtraction 109
Addition and subtraction 111
Distinguishing numeral
from number 112
Addition and subtraction 116
Fractions 118
Mixed operations 120
Work with fractions 120
Addition and subtraction 122
Factoring 123
Number line 125
Fractions 125
Free play 128
Addition 129
Work with rods 129
Mixed operations 131
Rod game 131
Rod patterns 133
The clock 135
Ratios 136
Place value 136
The clock 140
Factoring 140

December 145

Clocks 147
Computation 147
Clocks 149
Place value 149
Addition and subtraction 153
Number line 153
Addition, subtraction, and
multiplication 155

Addition, subtraction, and
multiplication 157
Clocks 158
Addition, subtraction, and
multiplication 158
Progressions 160
Addition and subtraction 160
Odd-even 160

January 163

Addition, subtraction, and
multiplication 165
Multiplication 166
Series and progressions 166
Odd-even 169
Clock arithmetic 169
Money problems 169
Doubling and halving 173
Fractions 175
Multiplication 176
Fractions 176
Series and progressions 177
Fractions 177
Mixed operations 178
Squares 178
Series and progressions 180
Squares 183
Equalities and inequalities 185
Equalities and inequalities 188
Geometric recognition 188

February–June 191

Arithmetic operations 193
Counting 198
Frame arithmetic 199
Equalities and inequalities 201
Doubling and halving 202
Fractions 205
Word problems 207

Introduction



The *First-Grade Diary* is a daily log of the progress of a group of 20 primary-grade children in the mathematics laboratory in 1960–61. Most of the children in this class had participated in a readiness program in kindergarten, where they had many free-play sessions with Cuisenaire® rods and other concrete materials. Often they were able to grasp concepts more rapidly and easily than is usual for first-graders and were free to move ahead to new concepts and activities.

The *Diary* was originally kept as a cumulative case history of a specific class to refine methods and procedures for the benefit of future classes. It records games, materials, sequences of developmental activities, and children's responses and insights into mathematical concepts. The learning experiences of these children throughout the school year, their successes and their failures, are described here as an example of one approach to teaching mathematics to a group of first-graders. The children's rapid progress, enthusiasm, and independence indicated that these classroom notes might be of interest and help to others.

Entries for the first part of the school year (September through January) are detailed accounts of the actual daily work of the children. They include diagrams of a variety of concrete materials and teaching aids, specific references to Cuisenaire® rods and to some of the lab sheets as they were used in the activities of the first-grade class. Many of the group activities were recorded in dialogue form so that the responses of the children—even their errors—might illustrate their thinking in the process of discovering certain mathematical concepts. In addition to the actual descriptive class notes, records of work with individual children and evaluations of pupil progress are included.

By the end of January, the children spent most of their time working independently on written materials. The class notes for February through June have been brought together under topics so that instruction for any particular subject can be pursued as far as children require.

The *Diary* is not intended to serve as a manual in the traditional sense, and the teacher is cautioned against following it as a daily guide. It is hoped that

teachers will be inspired to develop their own methods of presenting the materials. Since no two groups of children are exactly alike and no two teachers are exactly alike in their style and technique, no two first-grade classes should be expected to follow the same path in learning mathematics.

Teachers who have used the *Diary* report that it has served as a ready source of stimulating ideas. Many of those who teach grades higher than the first have found useful ideas for remedial and review work. We hope that teachers will be inspired to build on this diary, to keep diaries of their own, and to develop their own personal approaches to the Mathematics Laboratory Materials.

September

Summary of Topics

Order
Inequalities
Establishing unit
Building rod patterns
Counting
Numeral recognition
Recognizing number groups
Ordering numbers
One-to-one correspondence
Tallying
Arithmetic operations
Fractions
Geometric recognition

Work with Cuisenaire® rods



I

Free play with rods (10 minutes)

Piles of assorted rods were placed on each table. The children were free to build with the rods. (The majority of the children had attended the kindergarten at Miquon School and had been exposed to the Cuisenaire® rods previously.)

- 1 Four boys built a “water plant,” a “piping system,” and an “oil refinery.” Other children built pyramids, flat patterns and designs, houses, and boats.
- 2 Free play ended with a trip around the room to inspect each other’s buildings.

II

Group activity:

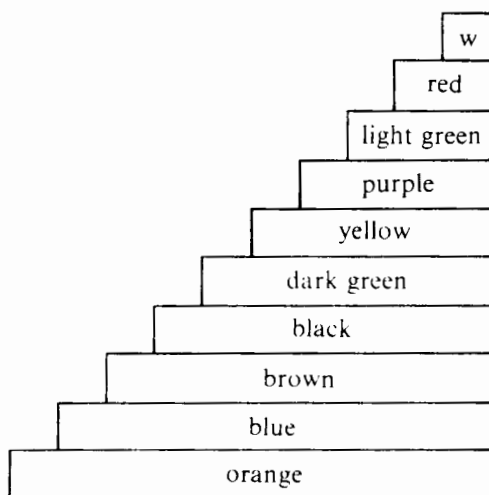
Discovering one-to-one correspondence

A pile of assorted rods was placed on each table.

- 1 Lore picked a yellow demonstration rod and held it up in front of the class. The children responded by each picking a yellow rod from his collection of rods. Then Lore held up a red demonstration rod and the children held up a red rod. This procedure continued until the one-to-one correspondence between the demonstration rods and Cuisenaire® rods was established. (The demonstration rods are homemade and cut on an inch scale, while the Cuisenaire® rods are cut on a centimeter scale.)

- 2 Lore picked a white demonstration rod and gave the following direction: Start with the white rod and build a color stairs.

The children built color stairs with Cuisenaire® rods. (Only two children had “gaps” in their stairs.)



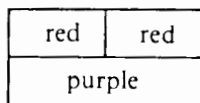
The color stairs

III

Game: “Half of”

Children entering first grade seem to understand the concept of *half*. This probably stems from early experience in sharing with other children—breaking a cookie “in half” (two equal or nearly equal pieces).

- 1 Lore: Find the rod that is “half of” the purple rod. Find “half of” the red rod. Find “half of” the dark green rod. Find “half of” the orange rod.
- 2 The red rod is half the length of the purple rod.



The white rod is “half of” the red rod; the light green rod is “half of” the dark green rod; the yellow rod is “half of” the orange rod. (The children appeared to grasp this concept easily.)

IV

A close look at the white cube

Directions from Lore and children's responses:

- 1 Lore: Select one of the little white blocks from your collection of rods. This is called a *cube*.



- 2 Lore: Press the face of the cube against the fleshy part of your thumb or your arm. The shape you see is called a square.



- 3 Lore: Make a stamp of the edge of the cube on your hand. What do you see?

Children: A line. —

- 4 Lore: Press the corner of the cube against the fleshy part of your thumb or arm. What do you see?

Children: A dot. A point. ●

- 5 Lore: How many "faces" does the white cube have? [Children's answers ranged between four and seven.]

- 6 Lore then held up a white cube and asked the children to count the faces.

V

Comments

Jeff and Anne were able to measure with a ruler (centimeter scale) and read off the heights of the pyramids they built during free play. Jeff found not only that his pyramid was 21 centimeters high, but also that it was made up of 21 layers of rods.

About half of the children participated easily in some oral responses to these problems: $3 + 3 = \square$; $4 + 2 = \square$; $5 + 1 = \square$. These were introduced in the course of the discussion about the rods.