

## Grade 5 Mathematics Lesson Plan

Date: June 26 (Tuesday), 2007, Period 5

Class: Takehaya Attached Elementary School,

Tokyo Gakugei University

Grade 5 Class # 2 (39 students)

Teacher: Masahiro Seki

1. Name of the unit: Let's think about multiplying and dividing decimal numbers  
(decimal number  $\times$  whole number; decimal number  $\div$  whole number)

2. Goals of the unit

- Students will understand the meaning of and procedures for multiplying decimal numbers by whole numbers.
- Students will understand the meaning of and procedures for dividing decimal numbers by whole numbers or dividing whole numbers by whole numbers with decimal quotients.
- Students will further develop their ability to use these computations.

[Interest, Desire, Attitude]

- Students will try to relate what they learned previously about multiplying and dividing whole numbers to multiplying and dividing decimal numbers by whole numbers [Mathematical Thinking].
- Students will think about how to multiply and divide decimal numbers based on their understanding of multiplication and division of whole numbers.
- Students will be able to identify the correct operation needed by using tools such as double number lines to understand the relationship between two quantities.

[Representations, Procedures]

- Students will be able to calculate a decimal number  $\times$  a whole number and a decimal number  $\div$  a whole number.
- Students will be able to represent the relationship between two quantities using tools such as double number lines.

[Knowledge, Understanding]

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- Students will understand the meaning of and the procedures for multiplying and dividing decimal numbers by whole numbers.

### 3. Plan of Instruction (14 lessons)

Sub-units	Lessons	Content of instruction	
1. Multiplying decimal numbers	4	1	<ul style="list-style-type: none"> <li>• Students will understand the meaning of multiplying decimal numbers.</li> <li>• <b>Students will be able to represent relationships between two quantities using double number lines.</b></li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will think about how to multiply decimal numbers by whole numbers.</li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will be able to use the multiplication algorithm to multiply decimal numbers (to the tenths place) by whole numbers.</li> </ul>
		1	<ul style="list-style-type: none"> <li>• <b>Students will be able to use the multiplication algorithm to multiply decimal numbers (to the hundredths place) by whole numbers.</b></li> </ul>
2. Dividing decimal numbers	6	1	<ul style="list-style-type: none"> <li>• Students will understand the meaning of dividing decimal numbers by whole numbers.</li> <li>• <b>Students will be able to represent relationships between two quantities using double number lines.</b></li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will think about how to divide decimal numbers by whole numbers.</li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will be able to use the division algorithm to divide decimal numbers (to the tenths place) by whole numbers.</li> </ul>
		1	<ul style="list-style-type: none"> <li>• <b>Students will be able to use the division algorithm to divide decimal numbers (to the hundredths place) by 1- or 2-digit whole numbers.</b></li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will think about the position of the decimal point in the remainder.</li> <li>• Students will be able to check the result of division with remainders.</li> </ul>
		1	<ul style="list-style-type: none"> <li>• Students will be able to divide completely (continue the division algorithm beyond the last decimal place in the quotient).</li> </ul>
3. Using multiplication and division	2	1	<ul style="list-style-type: none"> <li>• <b>Students will be able to solve problems to determine the “per-unit quantity.”</b> (Today’s lesson)</li> </ul>
		1	<ul style="list-style-type: none"> <li>• <b>Students will be able to solve problems by selecting the correct operation (multiplication or division).</b></li> </ul>
4. “Times as much” and decimal numbers	1	1	<ul style="list-style-type: none"> <li>• Students will understand the meaning of “times as much” involving decimal numbers.</li> <li>• Students will be able to represent the “times as much” relationship involving decimal numbers using double number lines.</li> </ul>

5. Summary	1	1	• Students will complete “Check” and “Challenge” problems.
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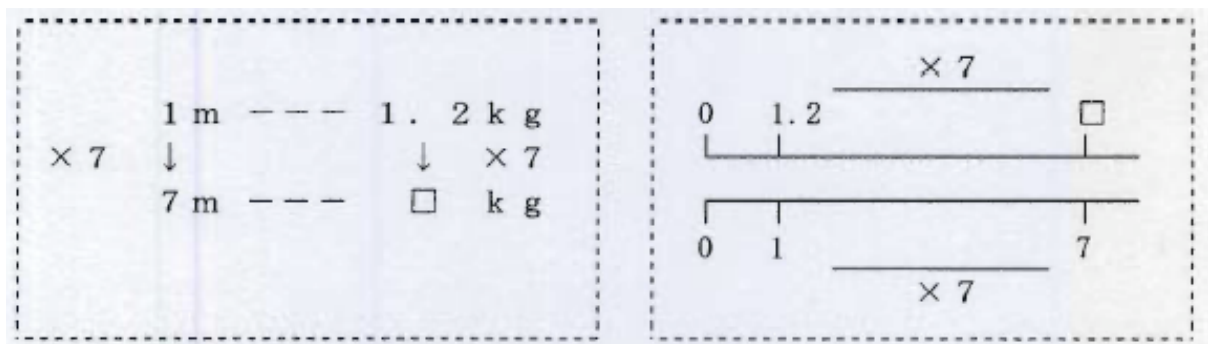
Note: Bold letters above indicate topics that have been included in the unit even though they are not in the current textbooks.

#### 4. About the unit

##### (1) Discussing the topics that are not in the textbook

###### 1. *Representing relationships between two quantities using double number lines*

Students must be able to determine whether to use multiplication or division to solve problems by examining the situation of the problem. Students should not select the operation, however, by reasoning that “since the answer must be larger (or smaller), I need to multiply (or divide).” On the contrary, students need to be able to present their reasoning by using diagrams. For example:



###### 2. *Decimal points to the hundredths place*

In the textbook, only decimal numbers to the tenths place are discussed. However, students have already learned about decimal numbers to the hundredths place in an earlier unit in Grade 5. Therefore, it is natural for them to want to learn to calculate decimal numbers to the hundredths place.

###### 3. *Problems that do not provide “per-unit quantity” explicitly*

See section (3), “Instruction of the concept, times as much, and possible problems in today’s lesson.”

###### 4. *Solving problems by identifying the correct operation to be used*

Achievement test results show that, in general, many children struggle with being able to determine the correct operation needed to solve problems. The same trend exists in this class as well. Therefore, after this unit on multiplying and dividing decimal numbers, our goal is to help students become more proficient in being able to determine the correct operation by simultaneously presenting students with 4 to 5

mixed problems involving multiplication or division.

## (2) Multiplication and division across the grades

The specific topics related to multiplication and division discussed in the elementary school grades are as follows (bold letters indicate topics that are in current unit being studied):

### **Grade 1**

(manipulation) <Foundations of multiplication and division>

- Count by making groups of 2; make groups of the same size
- Identify how many groups there are

### **Grade 2**

<Introduction of multiplication>

- Based on students' experiences in Grade 1, develop the meanings of multiplication and construct the basic multiplication table (1x1 through 9x9). [The meanings of multiplication include the concept of "times as many/much." This is the first treatment of the concept of "times as many/much."]  
(Reverse thinking of multiplication, e.g., 24 is 3x8, is the foundation of division.)

### **Grade 3**

<Introduction to division>

- Students will understand the two situations in which division is used:
  - Measurement ( $a \times \square = c$ ) → If we give 3 pieces to each person, how many people can get pieces?
  - Fair sharing ( $\square \times b = c$ ) → If we share objects equally among 3 people, how many will each person get?
- Students will be able to determine quotients by using the basic multiplication facts and the concept of "times as many/much."

<Multiplication algorithm>

### **Grade 4**

<Division algorithm>

- Students will develop the division algorithm by using the distributive property, the meanings of division, and the relationship between multiplication and division.
- Students will be able to divide 3-digit numbers by 2-digit numbers.

(Introduction of fractions)

(Introduction of decimal numbers)

### **Grade 5**

<Multiplying and dividing decimal numbers>

- **Students will develop methods for multiplying (or dividing) decimal numbers by**

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**whole numbers by considering the distributive property and looking at decimal numbers using 0.1 as the base unit.**

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- **Students will be able to determine the “times as many/much” relationship with decimal numbers by using whole number ÷ whole number.**

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- Students will extend the meaning of multiplication by developing the method for multiplying decimal numbers. (The concept of “times as many/much” is treated for the second time.)

(From whole numbers to decimal numbers, ○ times as many/much = relative value

↓

- Students will develop the method for dividing by decimal numbers based on the relationship between multiplication and division and multiplying by decimal numbers.

### Grade 6

<Multiplication and division of fractions>

- Students will understand fractions x whole numbers and fractions ÷ whole numbers (by viewing fractions using another fraction as a unit)

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- Students will develop the method for multiplying by a fraction

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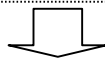
- Students will understand a fraction ÷ a fraction

(3) Instruction of the concept of “times as much” and possible problems in today’s lesson

The phrase, “times as many/much,” is first introduced in Grade 2. At first, students learn that “2 times, 3 times, 4 times, ... as many/much” means there are “2 sets, 3 sets, 4 sets, ... of a unit. Therefore, when we multiply by a whole number (that is, when the multiplier is a whole number), the result can be calculated by repeated addition. In Grade 5, the meaning of “times as many/much” is expanded in the context of multiplication by decimal numbers (that is, when the multiplier becomes a decimal number). In explaining this expanded meaning, double number line diagrams are invaluable.

$$\begin{array}{l} 6 \times 3 = 6 + 6 + 6 \\ = 18 \end{array} \quad \begin{array}{l} 3.7 \times 4 = 3.7 + 3.7 + 3.7 + 3.7 \\ = 14.8 \end{array}$$

{Repeated addition may be used to explain}

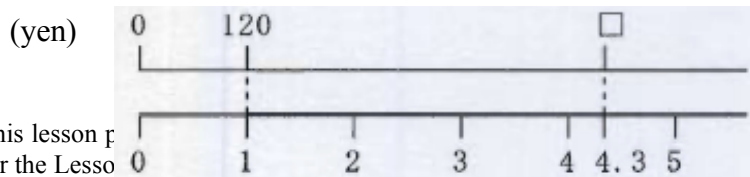


If 1 m of ribbon costs 120 yen, then the cost of 4.2 m of ribbon can be determined by  $120 \times 4.2$ , and the □ in the diagram below represents the cost.

{Repeated addition cannot be used to explain}

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{double number line is used}



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(*m*)

However, this representation is based on the assumption that the two quantities (in this context, the length in *meters* and the cost in *yen*) are in proportion. Problems in the textbook explicitly state per-unit quantities with terms such as “for one meter” and “for one day.” Therefore, it is not necessary for students to understand the proportional relationship in order to solve the problems. In today’s lesson, students will be given a problem where the per-unit quantity is not explicitly given so that they may become more aware of the proportional relationship between the two quantities in the problem and the usefulness of double number lines.

(3) Current state of learning of the students in the class

It has been almost two months since these students began studying together as a class. [Note: students spend two years together as a class – Grades 1 and 2, 3 and 4, and 5 and 6.] Although many of the students like mathematics, there are still significant individual differences, such as in computational skills. During mathematics lessons, students are encouraged to use diverse thinking strategies as they experience problem-solving based instruction. The students are beginning to exhibit the ability to compare and contrast the different ideas presented by their classmates and analyze the merits of different strategies.

5. Today’s lesson

(1) Goals

- Students will be able to grasp the relationship between two quantities by using tools such as double number lines, and write correct mathematical expressions.

[Mathematical Thinking]

- Students will be able to express the reason for writing a particular mathematical expression. [Mathematical Thinking] [Representations, Procedures]

(2) Flow of the lesson

Instruction and Anticipated Responses	Evaluation/Points of Consideration
1 Understand the problem  2 <i>m</i> of wire weigh 24.8 g. If you have 6 <i>m</i> of the same wire, how much will it weigh?	<ul style="list-style-type: none"><li>• Prepare actual wires.</li><li>• Make sure students understand that the longer the wire, the heavier it is.</li></ul> # Did the students understand that the

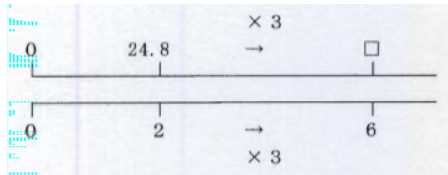
<p>T: I think we can calculate the weight. Please explain why you chose to use this calculation.</p> <div style="border: 1px solid black; padding: 5px; margin: 10px 0;"> <p>Explain what operation you used and why – include explanation and/or diagram.</p> </div> <p>2 Develop a plan T: Please raise your hand if you have a way to solve this problem. C: Raise hand. C: I don't understand.</p> <p>3 Individual problem solving C: Able to solve the problem. C: I don't understand</p> <p>4 Whole class discussion T: Please share your answers. C1 <math>24.8 \div 2 = 12.4</math> <math>12.4 \times 6 = 74.4</math> Ans. 74.4 g Because 2 m of the wire weighs 24.8 g, 1 m of the wire weighs 12.4 g. Then, we can find the weight that is 6 times as much as the weight of 1 m of wire.</p> <p>C2 <math>6 \div 2 = 3</math> <math>24.8 \times 3 = 74.4</math> Ans. 74.4 g Because 6 m is 3 times as long as 2 m, the weight must also be 3 times as much.</p> <p>C3 <math>2\ m \dots\dots\dots 24.8\ g</math> <math>\downarrow 3\ \text{times} \qquad \qquad \downarrow 3\ \text{times}</math> <math>6\ m \dots\dots\dots \square\ g</math> <math>\square = 24.8 \times 3</math> <math>= 74.4</math></p>	<p>length and the weight are proportional?</p> <ul style="list-style-type: none"> <li>• Make sure that students understand that finding the weight is not the only task.</li> <li>• Provide individual support to those children who cannot think of a way to solve the problem. (Consider group or whole-class instruction, depending on the number of children who need help.)</li> <li>• Circulate among children and provide appropriate support as necessary.  # Are the students trying to solve the problem by using a variety of thinking approaches instead of being fixed on a single approach?</li> <li>• If the whole class appears to agree that the answer is 74.4 g, it is ok to affirm that it is the correct answer.</li> </ul>
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C4

$$\times 6 \left( \begin{array}{l} 1 \text{ m} \dots\dots\dots 12.4 \text{ g} \\ \uparrow \div 2 \qquad \qquad \uparrow \div 2 \\ 2 \text{ m} \dots\dots\dots 24.8 \text{ g} \end{array} \right) \times 6$$

6 m .....  $\square$  g  
 $24.8 \div 2 = 12.4$   
 $12.4 \times 6 = 74.7$

C 5



$$24.8 \times 3 = 74.4$$

C 6  $24.8 \times 6 = 148.8$  (incorrect answer)

T: We have many different solutions.

- How are they similar?
- How are they different?

C7 Some solutions use both division and multiplication. Others only use multiplication.

C8 C1 and C4 are alike because they both find the weight of 1 m of the wire.

C9 It's easy to see that C3, C4, and C5 use the idea of "times as much."

C10 If you use the double number line model as in C5, you can explain C1 and C2's solutions too.

5 Summarize (reflection)

T: Did you understand your friends' ideas?

C11 Yes.

C12 I didn't really understand what \_\_\_\_\_ meant by \_\_\_\_\_.

T: Was there anything in today's lesson that you thought "was a good idea"?

C13 \_\_\_\_\_'s idea was very easy to

# Did the students realize that a chart or a diagram makes it easier to grasp the relationship between 2 quantities?

- Utilize "reflection cards"

# Did the students realize that what they need to understand is the "times as much" relationship between the two quantities (length, m, and weight, g)?

<p>understand.</p> <p>C14 Even though what they wrote was different, all of them used the same idea. I understood that if you know that when the length becomes a certain # of times as much, then the weight also becomes the same # of times as much. Then, we can easily write the correct math sentence and solve the problem.</p>	
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