

## MULTIPLICATION

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### Overview

Prior to beginning this paper, I want to give you a background of where I am and what I do in my current school. I am at Grandview Elementary, which is a neighborhood school located in the Allentown area. Grandview Elementary is located in one of Pittsburgh's "glamorous" hilltop neighborhoods. The student population is 44.8 African American and 55.2 white/other. My job title is Learning Support/Math Teacher for grades 4-5. My students' abilities range from Kindergarten through Fifth grade levels.

This unit, which can easily be adapted and modified for all students of special needs, will develop the teaching of multiplication and its uses for grade levels 3-5. This will be done while adhering to Everyday Mathematics objectives. Teachers' who wish to expand upon their existing mathematics curriculum for multiplication will benefit from incorporating this unit into their math program. Hopefully, as we attempt to accomplish our goals of teaching students to meet the standards, your students will be quite interested.

Mathematical thinking is central to the mathematical success of the mathematics curriculum. Every multiplication algorithm can be assessed adequately. The students are required to explain the underlying reasons to their answers, rather than simply giving numerical solutions. The multiplication algorithms allow each student to be creative and come up with the correct solutions. This allows the students to work out the problem in the manner with which they are most comfortable. Each grade level has an administered task to assess the students' performance. Multiplication facts are introduced as early as second grade by showing the students the concept of arrays. This is just the beginning of the concepts, so that the children can visually see what and touch the correct numbers. The visuals prove to be a great resource as the children work more in the fourth and fifth grades. The students can think back on their earlier experiences on how they would come up with the answer to a multiplication problem. As teachers, we need to provide all the hands on experiences that we can so that a particular learner is able to relate back to the concepts in an overall picture. As far as scoring, the tasks are scored holistically. The scoring is done by using a procedure that was created by the New Standards Project (NSP). The procedure adequately judges on-demand task performance. Students' work is classified into one of the following categories:

- 0- No Response
- 1- Engaged Task with Little Success
- 2- Partial Success
- 3- Ready for Needed Revision: The response , Although Flawed, Provides Ample Evidence that the Student has Sufficient Mathematical Knowledge to Independently Correct the Flaws in the Response
- 4- Accomplishes the Task

In grade 5, students practice facts through mathematical games. These games test students' speed and knowledge of their basic facts. The game "Beat the Calculator" puts a student against a calculator in solving rudimentary multiplication problems. The game displays insight as to whether the student can calculate the problems using a calculator faster than the student that calculates the problem mentally in their brain. In observance of this game, I have noticed that the brain wins the majority of the time. The students are amazed that they beat the calculator. The student holding the calculator realizes that they would rather be the person classified as "The Brain." Another game called "Top-It" requires students to compete against one another. It is a game that the students use the Everyday Math Deck. The students flip cards and calculate the answers in their brain. The student with the highest product wins all the cards. Finally, the game that sparks the most competition is called "Multiplication Baseball." This game includes three versions to help students memorize their facts 2-12. The concept behind the game is to play baseball with a scoreboard. However, instead of balls and bats the students compute numbers and move from base to base on the knowledge of their facts. The students have had prior knowledge with facts in the grade three Everyday Mathematics curriculum. In grade three, the curriculum introduces the students to fact triangles in an effort to assist them memorize multiplication facts.

Fact triangles cards introduce multiplication as well as division facts. The students play the following games: "Beat the Calculator", "Baseball Multiplication", and "Top-It". These games reinforce the facts in a fun format. As the students work on facts in grade 4, they work on extended facts and play the game called "Multiplication Wrestling", which is spoken about in more detail in this unit. In grades 4 and 5 students track their growth in knowing their facts. They are timed for one minute as they are completing 50 facts. They track their growth on a chart that shows them an overall picture of their progress. When the students shows growth over a period of time they can visually see the graph going up, and they compute their own percentages to show their progress.

#### Rationales

My reason for creating this curriculum is to bring together many objectives through a total unit that covers multiplication. This unit can be easily accessible for

teachers of the Pittsburgh Public Schools. The definition of multiplying or being multiplied is a method used to find the result of adding a certain figure to itself a certain number of times. The question is often asked, “How do we teach multiplication using the Everyday Math Program?” This unit will answer many questions that you may have thought about, but never really had the time to ask your peers. The Everyday Math Program has a spiral effect. If the concepts are not taught starting in the second grade then we are constantly teaching to catch students up to ensure that they are meeting the standards and are proficient in the areas that they need to be proficient in. This unit takes you through the games and talks about the importance of visual arrays. It is important to incorporate rubrics to meet the standards. We are focusing on multiplication because it is the foundation for students to solve more complex, multi-step problems. In the fifth grade the first semester unit is based on prior knowledge of knowing their facts. If the students come into the fifth grade not mastering their facts they will have a very difficult time working with the following concepts in the first unit such as: factors, arrays, divisibility, and square numbers.

Many professionals have become very critical of the Everyday Mathematics algorithms. They are very critical about the program because it doesn't involve a standard method. Teachers are not fully implementing the instructional model for their grade levels. Professional development for all teachers to maintain and improve their skills should be implemented at reasonable times. The main emphasis is for the student to comprehend the basic principals of mathematics, know that there is more than one way to explain the mathematics, and that there is frequently more than one acceptable way. The student can apply a number of different strategies and mathematics principals to complete an item.

## Multiplication

The teaching of multiplication is in the beginning level in the third grade year. According to the general rubric, the students' responses have fragments of appropriate material and show effort to accomplish the task. Students do not explain in either the concepts or procedures involved. Everyday Mathematics teaches the basic multiplication arrays and fact families. This sets a strong foundation which is to be built upon in the fourth grade academic year. In unit 3 with the Everyday Mathematics checklist, the students should be developing the skill of solving basic multiplication facts. The general rubric describes development as the students accomplish part of the task independently. Students can partially explain the process but may need prompting to complete the skill. Therefore, the teacher plays a key role in their success, giving the students the appropriate guidance to achieve at a level with prompting. The fourth grader should become proficient or, at the least, developing with the skill of multiplication facts by the second quarter. The student's

academic success relies heavily on if they have mastered their facts. The rubric that follows this proficient level states that student strategies and executions meet the demands of the task and demonstrate a firm grasp of the concepts and procedures involved. Their responses also demonstrate a broad range of understanding, and students apply their understanding in different contexts. Therefore, the EDM checklist states clearly the student/teacher objectives for every unit K-5 in the elementary grades. The following corresponding codes will be used when referencing the EDM checklist rubric: B-Beginning, D-Developing and P-Proficient.

As we look at the end of the second quarter students should be proficient, and should solve their basic multiplication facts. How can we achieve this difficult goal for all students. The students need to continue to be drilled on their 50 fact test on a daily basis. They have a timed facts test that they take every third week and graph their results. The students can see their progress as the graphing is completed over several weeks. The test gives the students positive reinforcement to the practice of multiplication facts. Students become familiar with graphing, fractions and percents by completing their graph papers. They are able to help each other with meeting individual goals to achieve higher scores. The third quarter fourth grade students should be proficient with their multiplication facts. Students that do not master their facts are setting themselves up for academic failure. The students that have achieved the goal or skill of mastering their facts can move into the next unit and begin to problem solve without hesitation. The students should be developing or proficient with explaining strategies for solving multi-step number stories. The student lacking the basic facts will be falling behind on being able to effectively solve a multi-step problem. The students are still working on a proficient level in the first semester of the fifth grade. The students in the second quarter of the fifth grade should have a successful strategy for multiplying multi-digit whole numbers.

Achieving this skill/concept students need to have an algorithm that they can use to successfully get the correct answer. Everyday Math concentrates on algorithms. An algorithm shows a student ways to invent or share their own ways of doing operations, rather than to learn a standard way of answering a problem. Algorithms seem to convince the children. Basically there is not enough time given for the children to master the algorithms. Often times we see a student using an algorithm that is the wrong process or multiplication. The students will sometimes use an addition algorithm and forget to multiply in the process. The end result leaves the student with a feeling of discouragement when they choose the wrong process. However, the student can use many ways to get the correct answer, giving them an ability to achieve. The most important thing to remember is that if a students can add the numbers correctly and repeatedly their algorithm can be used, and they can have a high level of correct answers. The algorithms that the teacher directs to the students gives them practice on more than one way to solve their problems. This gives all students a choice and creates a tremendous high level of thinking and enthusiasm for

learning Partial Products is an algorithm introduced in the third grade. It is one of the first algorithms for multiplication. Here is an example of how you would complete a problem using a Partial-Products Algorithm.

$$\begin{array}{r}
 67 \\
 * \underline{53} \\
 3000 \quad 50 \text{ (60'S)} \\
 350 \quad 50 \text{ (7'S)} \\
 180 \quad 3 \text{ (60'S)} \\
 21 \quad 3 \text{ (7'S)} \\
 \hline
 \text{EQUALS } 3557
 \end{array}$$

There is a game that can be played called “Multiplication Wrestling”. It reinforces the skills needed to work out the problem, using the Partial-Products Algorithm. The use of arrays could be one way to show students how to visually show all the products of the numbers being used. The most popular method for all students, including learning support students, is the Lattice Method Algorithm. For example, to multiply  $53 \times 67$ : \*Draw a rectangular grid with as many rows as the number of digits in one factor and as many columns as the number of digits in the other factor. (2 by 2 in the example) \*Sketch a diagonal in each cell of the grid, from bottom left to top right. \*Write the factors on the outside of the grid, one digit per cell. Left to right for the horizontal factor, top to bottom for the vertical factor. \*Multiply each digit in one factor by each digit in the other factor and enter the products in the two triangles of the cell corresponding to the pair of digits. If the product is less than 10, enter 0 in the top triangle and the product in the bottom one. \*Beginning in the bottom right triangle of the grid, add the numbers inside the lattice along each diagonal strip and write the result at the open end of the strip (along the bottom and left side of the grid). If the sum in a strip exceeds 9, add the excess 10s to the next diagonal strip up (As if you were carrying number in the traditional right-to-left addition algorithm). \*Read the digits in the answer in order down the left side and across the bottom. To explain why the lattice method works. The following example applies the distributive property as it is used in the Multiplication Wrestling game and in the Partial-Product Algorithm described below:

To multiply:  $53 \times 67$   
 First, rewrite the factors:  $(50+3) \times (60+7)$   
 Next, expand, using the distributive  
 Property:  $(50+3) \times 60 + (50+3) \times 7$   
 Then use the distributive property twice more:  
 $(50 \times 60) + (3 \times 60) + (50 \times 7) + (3 \times 7)$   
 Multiply:  $3000 + 180 + 350 + 21$   
 Add:  $3551$

The Multiplication Wrestling can be used weekly to reinforce the skills during a game day.

The next goal that the students work towards is having a strategy for multiplying fractions. They should be in the beginning and developing categories for multiplying mixed numbers. In the Everyday Mathematics curriculum, students investigate an area model for fraction multiplication that allows them to find products of simple fractions. These simple fractions are fractions that have small enough denominators to make drawing a divided rectangle a reasonable task. For example, to find the product of  $\frac{2}{4}$  and  $\frac{2}{5}$ , you can draw a rectangular region and partition it. The students are able to relate to a visual and can see the fractions easier than talking through the problem.

### Critic

The Everyday Math series has issued a new edition to our school. It is a revision of the current edition that our school utilizes. I compared the two books for third through fifth grades. There are some differences between the two. The new edition increases emphasis on traditional arithmetic procedures and learning the basic facts. Also the teachers' editions are easier to read. Specific materials are provided for meeting individual needs. Next, there are grade-specific assessment books: Hardback student texts for grades 3-5 contain sample problems and answers to help students (and parents) with homework. Another beneficial change from the old version to the new are the expanded parent letters (4 pages per unit) that contain sample problems and answers for homework. The new version states the objectives clearly before each lesson. The lesson is stated and then the objectives are listed first. The lessons in the revised series are meeting the same standards and Everyday Mathematics checklist points. (Secure, Beginning, and Basic) The new series includes the following main areas: Teaching the Lesson, Ongoing Learning, and Individualizing. The program clearly takes you through each lesson providing additional support compared to the older version. There is a NOTE box that offers the teacher information that enhances the lesson. There is an "Adjusting the Activity" memo that helps the lesson flow easier. At the end of the lesson(s) is a Planning Ahead section. This provides information for the teacher to plan for the next day. The really valuable tool that is used third through fifth grades is the Student Reference Book. If a student does not know a concept they can go to the Reference Book and look up there question independently. This is a great source for students that might not want to raise their hand and verbally ask a question. The Reference Book works hand and hand with their Math Boxes. In the lower corner it displays a book with the number on it to reference to find an example for the problem they are working on. The student can look up the concept(s) that they need help with by referencing the number printed in the lower right hand corner. The new edition

seems to be teacher friendly and very clear in meeting individual needs to meet our standards.

Lessons:

### **Multiplying Decimals and Mixed Numbers**

Abstract:

This lesson is designed to reinforce skills that are associated with multiplying decimals and mixed number and allows students to visualize the effects of multiplying by a decimal or mixed number.

### **Objectives**

Upon completion of this lesson, the students will be able to:

- \* multiply decimals and/or mixed numbers.
- \* note the effects of multiplying decimals and mixed numbers.
- \* predict the effects of multiplying a number by a decimal or mixed number.

### **Standards**

The activities and discussions in this lesson address the following NCTM Standards:

Numbers and Operations

Understand numbers, ways of representing numbers, relationships among numbers, and number systems:

- \*work flexibly with fractions, decimals, and percents to solve problems

Understand meanings of operations and how they relate to one another:

- \*understand the meaning and effects of arithmetic operations with fractions, decimals, and integers
- \*understand and use the inverse relationship of addition and subtraction, multiplication and division, and squaring and finding square roots to simplify computations and solve problems

### **Compute fluently and make reasonable estimates**

- \*select appropriate methods and tools for computing with fractions and decimals from among mental computation, estimation, calculators or computers, and paper and pencil, depending on situation, and apply the selected methods

\*develop and analyze algorithms for computing with fractions, decimals, and integers and develop fluency in their use

### *Algebra*

Analyze change in various contexts

\* use graphs to analyze the nature of changes in linear relationships

### **Student Prerequisites:**

*Arithmetic:* Students must be able to:

\*multiply whole numbers.

\*recall some knowledge regarding multiplication of mixed numbers and decimals.

\*It will also prove helpful if students have the skills needed to interpret a line graph.

*Technological* Students must be able to:

\*perform basic mouse manipulations such as point, click and drag

\*use a browser such as Netscape for experimenting with the activities

### **Teacher Preparation**

Students will need:

\*access to a browser

\*Pencil and paper

\*access to a calculator

### Lesson Outline 1

#### 1. Focus and Review

Remind students what has been learned in previous lessons that will be pertinent to this lesson and /or have them begin to think about the words and idea of this lesson:

\*Can someone tell me what a decimal/mixed number is?

\*If I multiply the number 1 by a decimal, will the result be larger or smaller than 1? **OR** If I multiply 1 by a mixed number, will the result be larger or smaller than 1?

\*Entertain a discussion on decimals and mixed numbers, including how to multiply these types of numbers:

Start the lesson with the following:

“Today, class we will be talking about multiplying decimals and mixed numbers. We are going to use the computers to look at the effects of multiplying a number by a decimal or mixed number, but please do not

turn on or go to this page until I ask you to. I want to show you a little about this program first”.

### **Teacher Input**

Explain to the students how you would like for the m to complete the assignment. You should model or demonstrate it for the students, especially if they are not familiar with how to use the Applets on the Project Interactive site.

Steps:

1. Open your browser to the Sequencer in order to demonstrate this activity to the students.
2. Show the class that there is a box where they may enter a starting number. In other words, the number that will be multiplied by.
3. Explain to the class that they should enter a “0” into the add-on box as this lesson is about multiplying decimals, not adding them.
4. Show students where to enter the zero.

### **Guided Practice**

\*After answering all questions that the students might have regarding the “The Sequencer”, walk them students through the worksheet. (Have all of the students in the class use same numbers. For example, 3 for the whole number and 0.43 for the decimal number. For each question, ask two different students what they think the answer might be. Next, ask the students to settle any dispute on what they think the answers are.

### **Closure**

You may wish to bring the class back together for a discussion of the findings. Allow students to describe what steps are needed and how they differ when numbers are multiplied by a decimal, or mixed number.

Lesson outline 2

Multiplication is repeated addition.

\*What this means is multiplication is a fast way of adding a series of numbers.

- $3*5$  means to add 3 together 5 times or  $3+3+3+3+3$
- $6*4$  means 6 added together 4 times or  $6+6+6+6$

Name EDM - NEW VERSION

Date

Time

# 50-Facts Test 1



$7 * 7 = \underline{\hspace{2cm}}$

$5 * 6 = \underline{\hspace{2cm}}$

$3 * 8 = \underline{\hspace{2cm}}$

$7 * 9 = \underline{\hspace{2cm}}$

$0 * 4 = \underline{\hspace{2cm}}$

$6 * 6 = \underline{\hspace{2cm}}$

$4 * 5 = \underline{\hspace{2cm}}$

$3 * 5 = \underline{\hspace{2cm}}$

$9 * 5 = \underline{\hspace{2cm}}$

$4 * 1 = \underline{\hspace{2cm}}$

$2 * 4 = \underline{\hspace{2cm}}$

$5 * 9 = \underline{\hspace{2cm}}$

$4 * 3 = \underline{\hspace{2cm}}$

$9 * 8 = \underline{\hspace{2cm}}$

$4 * 7 = \underline{\hspace{2cm}}$

$2 * 0 = \underline{\hspace{2cm}}$

$4 * 9 = \underline{\hspace{2cm}}$

$1 * 0 = \underline{\hspace{2cm}}$

$2 * 7 = \underline{\hspace{2cm}}$

$8 * 4 = \underline{\hspace{2cm}}$

$8 * 2 = \underline{\hspace{2cm}}$

$2 * 6 = \underline{\hspace{2cm}}$

$4 * 8 = \underline{\hspace{2cm}}$

$8 * 6 = \underline{\hspace{2cm}}$

$6 * 5 = \underline{\hspace{2cm}}$

$6 * 3 = \underline{\hspace{2cm}}$

$5 * 8 = \underline{\hspace{2cm}}$

$5 * 3 = \underline{\hspace{2cm}}$

$7 * 8 = \underline{\hspace{2cm}}$

$6 * 4 = \underline{\hspace{2cm}}$

$3 * 9 = \underline{\hspace{2cm}}$

$7 * 6 = \underline{\hspace{2cm}}$

$5 * 5 = \underline{\hspace{2cm}}$

$9 * 9 = \underline{\hspace{2cm}}$

$7 * 2 = \underline{\hspace{2cm}}$

$2 * 9 = \underline{\hspace{2cm}}$

$4 * 4 = \underline{\hspace{2cm}}$

$8 * 8 = \underline{\hspace{2cm}}$

$5 * 7 = \underline{\hspace{2cm}}$

$5 * 2 = \underline{\hspace{2cm}}$

$9 * 4 = \underline{\hspace{2cm}}$

$6 * 9 = \underline{\hspace{2cm}}$

$8 * 9 = \underline{\hspace{2cm}}$

$7 * 3 = \underline{\hspace{2cm}}$

$5 * 4 = \underline{\hspace{2cm}}$

$9 * 7 = \underline{\hspace{2cm}}$

$9 * 6 = \underline{\hspace{2cm}}$

$8 * 7 = \underline{\hspace{2cm}}$

$7 * 5 = \underline{\hspace{2cm}}$

$3 * 3 = \underline{\hspace{2cm}}$

1-Minute Score:  $\frac{\underline{\hspace{2cm}}}{50} = \frac{\underline{\hspace{2cm}}}{100} = \underline{\hspace{2cm}}\%$

3-Minute Score:  $\frac{\underline{\hspace{2cm}}}{50} = \frac{\underline{\hspace{2cm}}}{100} = \underline{\hspace{2cm}}\%$

Name \_\_\_\_\_

Date \_\_\_\_\_

Time \_\_\_\_\_

**50-Facts Test 1**



$7 * 7 =$  \_\_\_\_\_

$9 * 8 =$  \_\_\_\_\_

$5 * 8 =$  \_\_\_\_\_

$5 * 7 =$  \_\_\_\_\_

$5 * 6 =$  \_\_\_\_\_

$2 * 2 =$  \_\_\_\_\_

$5 * 3 =$  \_\_\_\_\_

$5 * 2 =$  \_\_\_\_\_

$3 * 8 =$  \_\_\_\_\_

$2 * 0 =$  \_\_\_\_\_

$7 * 8 =$  \_\_\_\_\_

$9 * 4 =$  \_\_\_\_\_

$7 * 9 =$  \_\_\_\_\_

$4 * 9 =$  \_\_\_\_\_

$6 * 4 =$  \_\_\_\_\_

$6 * 9 =$  \_\_\_\_\_

$0 * 4 =$  \_\_\_\_\_

$1 * 0 =$  \_\_\_\_\_

$3 * 9 =$  \_\_\_\_\_

$8 * 9 =$  \_\_\_\_\_

$6 * 2 =$  \_\_\_\_\_

$2 * 7 =$  \_\_\_\_\_

$7 * 6 =$  \_\_\_\_\_

$7 * 3 =$  \_\_\_\_\_

$4 * 5 =$  \_\_\_\_\_

$8 * 4 =$  \_\_\_\_\_

$5 * 5 =$  \_\_\_\_\_

$5 * 4 =$  \_\_\_\_\_

$3 * 5 =$  \_\_\_\_\_

$8 * 2 =$  \_\_\_\_\_

$9 * 9 =$  \_\_\_\_\_

$4 * 2 =$  \_\_\_\_\_

$9 * 5 =$  \_\_\_\_\_

$10 * 3 =$  \_\_\_\_\_

$7 * 2 =$  \_\_\_\_\_

$9 * 2 =$  \_\_\_\_\_

$4 * 1 =$  \_\_\_\_\_

$4 * 8 =$  \_\_\_\_\_

$2 * 9 =$  \_\_\_\_\_

$8 * 7 =$  \_\_\_\_\_

$6 * 10 =$  \_\_\_\_\_

$8 * 6 =$  \_\_\_\_\_

$3 * 2 =$  \_\_\_\_\_

$7 * 5 =$  \_\_\_\_\_

$5 * 9 =$  \_\_\_\_\_

$6 * 5 =$  \_\_\_\_\_

$8 * 8 =$  \_\_\_\_\_

$3 * 3 =$  \_\_\_\_\_

$4 * 3 =$  \_\_\_\_\_

$6 * 3 =$  \_\_\_\_\_

Score: \_\_\_\_\_

50

100

Percent: \_\_\_\_\_ %

## **Bibliography**

Everyday Mathematics Teacher's Manual  
McGraw-Hill 1999

Everyday Mathematics Reference Manual Grades 3,4,5  
McGraw-Hill 1999

Everyday Mathematics Teacher's Manual Versions 4-6  
McGraw-Hill 2002