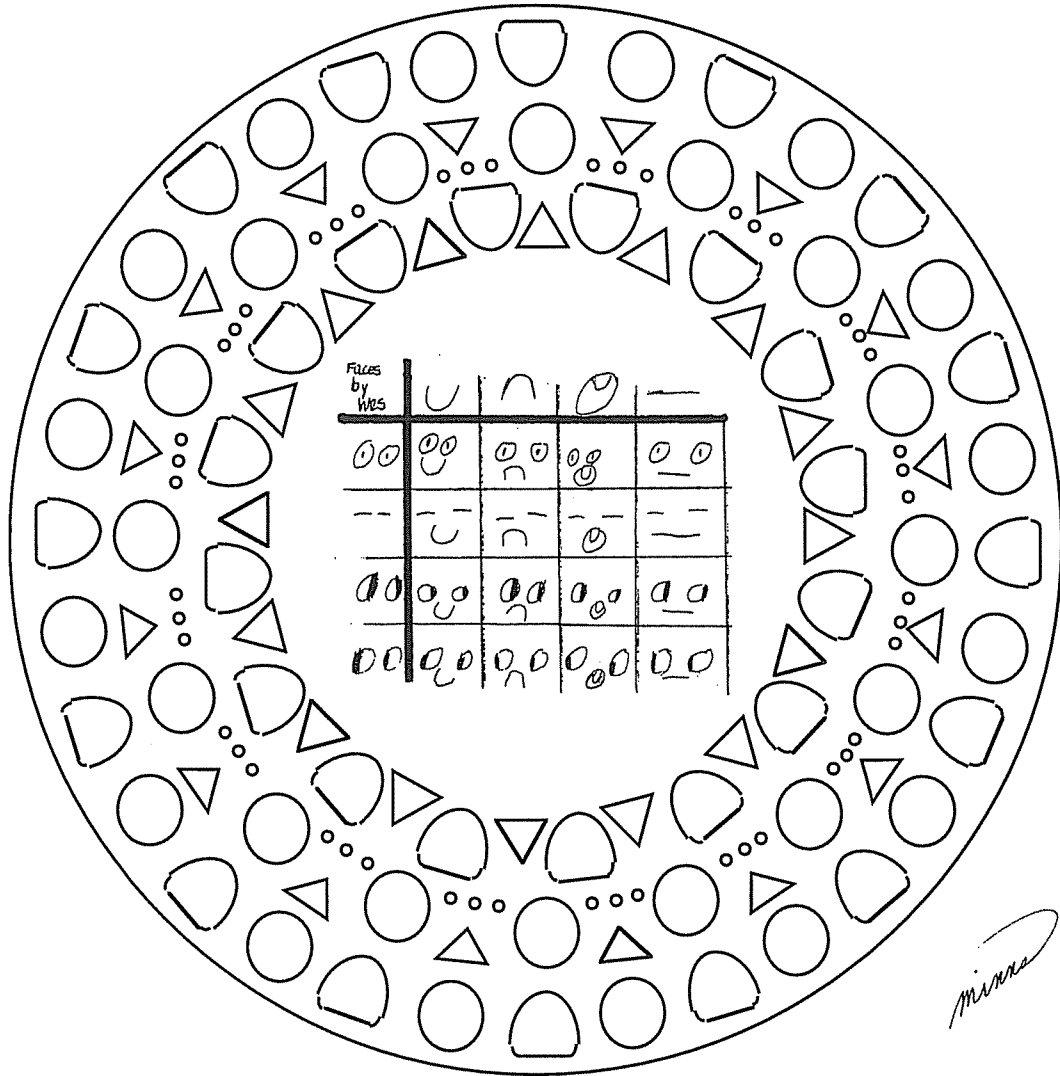


# Patterns in Arithmetic

## Multiplication - Booklet 1 PDF

### Basic Concepts

# Parent/Teacher Guide



By Alysia Krafel, Susan Carpenter, and Suki Glenn

Illustrations by Karen Minns and Suki Glenn

Based on methods developed by Prof. Michael Butler at the  
 UCI Farm Elementary School  
 University of California, Irvine

## Multiplication: Booklet 1 - PDF - Basic Concepts

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This booklet is dedicated to Murray Francis, Susan Carpenter's beloved husband. Multiplication: Booklet 1 completed on 11/19/13.

### Acknowledgments

The knowledge, patience, and dedication of Professor Michael Butler made the UCI Farm Elementary School and this mathematics program possible. Special thanks go to Alysia Krafel and Susan Carpenter, who helped develop much of the math materials based on the teachings, ideas, and insights of Professor Butler.

For many years Farm School teachers, students, parents, and staff have shared their unfailing delight in learning. Thank you for your support and dedication.

The books would never have been completed if the students at Chrysalis Charter School in Redding, California, under the guidance of Alysia and Paul Krafel, hadn't needed them. Thank you for your patience through all of the draft copies.

Susan Carpenter edited, added her wise words, useful suggestions, and helped make the Answer Keys a reality. Karán Founds-Benton contributed her meticulous editing skill and knowledge. Diligent and thorough copy editing was done by Jacqueline Logue.

The cover mandala and many delightful illustrations are by Karen Marie Christa Minns. Other illustrations are by Suki Glenn and ClickArt by T/Maker.

To all of the mathematicians, from antiquity to the present, who discovered the principles of mathematics goes our heartfelt appreciation for your dedication.

Patterns in Arithmetic: Multiplication - Booklet 1 PDF

Parent/Teacher Guide

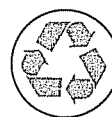
©2014 Pattern Press

Published by Pattern Press  
P.O. Box 2737  
Fallbrook, CA 92088  
(760)728-3731

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Practice worksheets may be duplicated.

Printed on recycled paper.



ISBN 978-1-935559-88-7

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## Assessment Guide

**Purpose** The purpose of this guide is to assess the fundamental knowledge necessary for success in this booklet. Pre-Assessment: Part 1 is review material from *Patterns in Arithmetic: Book 2*. Since this is the first booklet of multiplication, Part 1 will assess a student coming from any other math program. Pre-Assessment: Part 2 is a preview of the new material presented in this booklet and is used to set the baseline for what the student already knows at the beginning of instruction.

The Post-Assessment is administered to determine if the student learned the material that was presented in this booklet. A comparison of the score on Pre-Assessment: Part 2 to the score on the Post-Assessment will give both you and your student a sense of growth. The Post-Assessment is the same as Pre-Assessment: Part 2.

**Prerequisites** Basic addition with regrouping

**Materials** Multiplication - Booklet 1: Pre-Assessment, pages i and ii, Post-Assessment, page 54  
Scoring Guides  
Cuisenaire Rods  
Centimeter ruler

**Instructions** Instruct the student to attempt all the problems. If he does not know how to do a problem, he should put a question mark by it. This will let you know he looked at the item and decided he could not do it.

It is acceptable to read the items to a student. We are assessing math, not reading. Do not explain any items to him. If he does not know what the question means, tell him to put a question mark on that item.

Do the assessment in two parts. Give Pre-Assessment: Part 1 and check it for readiness for this booklet. If he is not ready for this booklet, there is no point in giving Pre-Assessment: Part 2. If he passes all the readiness items, then give Pre-Assessment: Part 2.

After scoring Pre-Assessment: Part 2, use the Booklet Selection Guide to determine the correct booklet for your student based on the results of the assessment.

**Assessment Guide** This Assessment Guide explains what concept each item on the test is assessing. The item numbers match the item numbers on the student test page. The title of the lesson and Booklet number tell you where the concept is taught. In the Assessment Guide, under each lesson title are several assessment criteria. Each criterion is labeled with capital letters 'A,' 'B,' etc. These criteria tell you what to look for in the student work. On the student test, sometimes multiple problems are used to test a concept. These multiple problems are labeled with small letters 'a,' 'b,' etc. Score sheets that match the Assessment Guide for Pre-Assessment: Part 1, Pre-Assessment: Part 2, and the Post-Assessment follow.

Pre-Assessment: Part 1, page i, is in the Student Workbook. You can also write it on a piece of paper or on the board because it is so short.\* This Parent/Teacher Guide has Pre-Assessment: Part 2 and the Post Assessment on pages 6 and 7.

1. Solve: a.  $4 + 5 + 6 = \underline{\quad}$     b.  $4 + 4 + 4 + 4 + 4 = \underline{\quad}$     c.  $\begin{array}{r} 13 \\ 13 \\ 13 \\ + 13 \\ \hline \end{array}$

### Assessment Criteria for Pre-Assessment: Part 1

Can the student:

#### 1. Addition Number Sentences (*Patterns in Arithmetic: Books 1 and 2*)

- A. give the correct answer for both addition number sentences in problems a and b?
- B. give the correct answer to the addition problem c, which requires regrouping?

### Assessment Criteria for Pre-Assessment: Part 2

Can the student:

#### 1. Multiplication Concept (Multiplication: Booklet 1)

- A. identify a multiplication problem from a picture? Must get both a and b correct for a Yes.

In the picture there are five groups of four blocks. This represents  $4 \times 5 = 20$ . A student new to this program may label the problem as  $5 \times 4 = 20$ . This is acceptable. The number sentence will be defined in the first lesson of the booklet.

#### 2. Multiplication Concept (Multiplication: Booklet 1)

- A. draw a picture of a multiplication problem?

The picture should show four groups of three, or for a new student three groups of four is acceptable. If he draws three blocks and then four blocks, he can not demonstrate that he knows that multiplication is repeated addition of the same number.

- B. show that multiplication is repeated addition of the same number?  $3 \times 4 = 3 + 3 + 3 + 3$  or  $4 + 4 + 4$ ? Count it a No if he writes 3, 6, 9, 12, etc.

#### 3. Building Tables and Associative Property (Multiplication: Booklet 1)

- A. correctly solve two of three multiplication fact problems (a, b, and c) using any method?
- B. demonstrate that he has memorized the multiplication tables as he does problems a, b, and c?

Observe him while he does problems a, b, and c. For a Yes, he should write the answers quickly without using a manipulative—counting on his fingers, skip counting, or using addition on the side. If he gets a Yes on 3A and a No on 3B, make a note of what strategy he is using to get the answers.

- C. multiply three numbers together correctly in one of the two problems (d or e)?

D. demonstrate that he knows that multiplying by a 0 (e) will cause the answer to be zero regardless of what the other numbers are?

#### 4. Multiplication by Addition (Multiplication: Booklet 1)

- A. correctly solve two of the three larger problems?

B. use repeated addition? Give a Yes if the repeated strategy is used even if the answer is incorrect.

- C. use the standard multiplication procedure? Give a Yes if the standard strategy is used even

\*A Pre-Assessment: Part 1 worksheet with a score sheet is included on page 28 of this booklet.

if the answer is incorrect. The standard procedure for this kind of problem is taught in Multiplication: Booklet 2.

5. Building Word Problems (Multiplication: Booklet 1)

A. formulate a multiplication word problem for a given multiplication fact?

6. Beginning Factoring (Multiplication: Booklet 1)

A. show correctly the factors of fifteen?

B. show correctly one of the factor pairs for twenty-four? Give a bonus point if he showed more than one factor pair for twenty-four.

**Booklet Selection Guide based on the results of the assessment:**

Pre-Assessment: Part 1

Item 1A must be a Yes for the student to begin this booklet. He must be able to interpret a number sentence and get the correct answer. If this item is a No, begin with *Patterns in Arithmetic: Book 1*.

If Item 1A is a Yes and Item 1B is a No, begin with *Patterns in Arithmetic: Book 2*.

If Items 1A and 1B are Yes, then have him complete Pre-Assessment: Part 2.

Pre-Assessment: Part 2

If the page is full of question marks, this is the correct booklet to start him in.

If Item 3B or 4A are a Yes but Items 1, 2, and 4B are No, then the student has had exposure to multiplication and has memorized the facts but can not demonstrate understanding. Again, this booklet is appropriate.

If he correctly answered Items 1A, 2A, 3A, and 4A and B but missed Items 4C, 4D, 5, or 6, you should teach only the needed lessons and move on to Multiplication: Booklet 2. If he is new to this program, give ample free exploration of Cuisenaire Rods before beginning the lesson on Trains.

If he used the standard procedure to answer problems a, b, and c in Item 4 and gave the correct answers and has a Yes on Items 1 - 3, move on to Multiplication: Booklet 2. Consider doing the Building Tables section of Multiplication: Booklet 1 as an investigation of patterns.

**Part 1**

Can the student:

1. Addition Number Sentences (*Patterns in Arithmetic*: Books 1 and 2)

Yes No A. give the correct answer for both addition number sentences in problems a and b?

Yes No B. give the correct answer to the addition problem c, which requires regrouping?

**Part 2**

Can the student:

## 1. Multiplication Concept (Multiplication: Booklet 1)

Yes No A. identify at least one multiplication problem from a picture and give the correct number sentence?

## 2. Multiplication Concept (Multiplication: Booklet 1)

Yes No A. draw correctly a picture of a multiplication problem?

Yes No B. show that multiplication is repeated addition of the same number?

## 3. Building Tables and Associative Property (Multiplication: Booklet 1)

Yes No A. correctly solve two of three multiplication fact problems (a, b, and c) using any method?

Yes No B. demonstrate that he has memorized the multiplication tables as he does problems a, b, and c? See note in criterion 3B on page 2.

Yes No C. multiply three numbers together correctly in one of the two problems (d or e)?

Yes No D. demonstrate that he knows that multiplying by a zero (e) will cause the answer to be zero regardless of what the other numbers are?

## 4. Multiplication as Addition (Multiplication: Booklet 1)

Yes No A. solve correctly two of the three larger problems?

Yes No B. use repeated addition? Give a Yes if the repeated addition strategy is used even if the answer is incorrect.

Yes No C. use the standard multiplication procedure? Give a Yes if the standard strategy is used even if the answer is incorrect. This procedure is not taught in this booklet. We are testing for previous memorization of the procedure.

## 5. Building Word Problems (Multiplication: Booklet 1)

Yes No A. formulate a multiplication word problem for a given multiplication fact?

## 6. Beginning Factoring (Multiplication: Booklet 1)

Yes No A. show correctly the factors of fifteen?

Yes No B. show correctly one of the factor pairs for twenty-four?

Bonus point: Give an extra point if he writes more than one correct factor pair for twenty-four.

12 points possible Score \_\_\_\_\_ Placement: \_\_\_\_\_

**Post-Assessment Score Sheet**

Name \_\_\_\_\_ Date \_\_\_\_\_

Can the student:

1. Multiplication Concept (Multiplication: Booklet 1)

Yes No A. identify at least one multiplication problem from a picture and give the correct number sentence?

2. Multiplication Concept (Multiplication: Booklet 1)

Yes No A. draw correctly a picture of a multiplication problem?  
Yes No B. show that multiplication is repeated addition of the same number?

3. Building Tables and Associative Property (Multiplication: Booklet 1)

Yes No A. correctly solve two of three multiplication fact problems (a, b, and c) using any method?  
Yes No B. demonstrate that he has memorized the multiplication tables as he does problems a, b, and c? See note in criterion 3B on page 2.  
Yes No C. multiply three numbers together correctly in one of the two problems (d or e)?  
Yes No D. demonstrate that he knows that multiplying by a zero (e) will cause the answer to be zero regardless of what the other numbers are?

4. Multiplication as Addition (Multiplication: Booklet 1)

Yes No A. solve correctly two of the three larger problems?  
Yes No B. use repeated addition? Give a Yes if the repeated addition strategy is used even if the answer is incorrect.  
Yes No C. use the standard multiplication procedure? Give a Yes if the standard strategy is used even if the answer is incorrect. This procedure is not taught in this booklet. We are testing for previous memorization of the procedure.

5. Building Word Problems (Multiplication: Booklet 1)

Yes No A. formulate a multiplication word problem for a given multiplication fact?

6. Beginning Factoring (Multiplication: Booklet 1)

Yes No A. show correctly the factors of fifteen?  
Yes No B. show correctly one of the factor pairs for twenty-four?  
Bonus point: Give an extra point if he writes more than one correct factor pair for twenty-four.

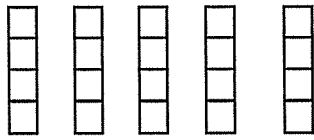
12 points possible Score \_\_\_\_\_ 9 points needed to pass to Multiplication: Booklet 2

**Pre-Assessment: Part 2**

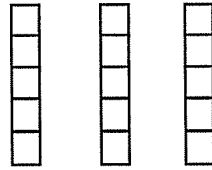
Date \_\_\_\_\_

Put a question mark next to any problem you do not know how to do.

1. What multiplication problem is shown in each picture?



a.  $\underline{\quad} \times \underline{\quad} = \underline{\quad}$



b.  $\underline{\quad} \times \underline{\quad} = \underline{\quad}$

2. a. Draw a picture of  $3 \times 4$ .

b. Show  $3 \times 4$  as an addition problem.

3. Solve these problems.

a. 
$$\begin{array}{r} 3 \\ \times 2 \\ \hline \end{array}$$

b. 
$$\begin{array}{r} 6 \\ \times 4 \\ \hline \end{array}$$

c. 
$$\begin{array}{r} 7 \\ \times 3 \\ \hline \end{array}$$

d.  $2 \times 3 \times 4 = \underline{\quad}$

e.  $5 \times 7 \times 0 = \underline{\quad}$

4. Use addition to solve.

a. 
$$\begin{array}{r} 14 \\ \times 5 \\ \hline \end{array}$$

b. 
$$\begin{array}{r} 25 \\ \times 4 \\ \hline \end{array}$$

c. 
$$\begin{array}{r} 32 \\ \times 6 \\ \hline \end{array}$$

5. Write a word problem that uses the problem  $6 \times 3 = \underline{\quad}$ .

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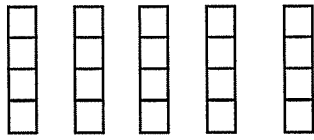
6. Factor these numbers.

a. 
$$\begin{array}{c} 15 \\ \diagup \quad \diagdown \\ \underline{\quad} \times \underline{\quad} \end{array}$$

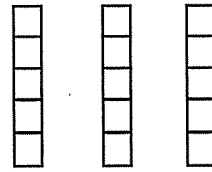
b. 
$$\begin{array}{c} 24 \\ \diagup \quad \diagdown \\ \underline{\quad} \times \underline{\quad} \end{array}$$



1. What multiplication problem is shown in each picture?



a.  $\underline{\quad} \times \underline{\quad} = \underline{\quad}$



b.  $\underline{\quad} \times \underline{\quad} = \underline{\quad}$

2. a. Draw a picture of  $3 \times 4$ .

b. Show  $3 \times 4$  as an addition problem.

3. Solve these problems.

a. 
$$\begin{array}{r} 3 \\ \times 2 \\ \hline \end{array}$$

b. 
$$\begin{array}{r} 6 \\ \times 4 \\ \hline \end{array}$$

c. 
$$\begin{array}{r} 7 \\ \times 3 \\ \hline \end{array}$$

d.  $2 \times 3 \times 4 = \underline{\quad}$

e.  $5 \times 7 \times 0 = \underline{\quad}$

4. Use addition to solve.

a. 
$$\begin{array}{r} 14 \\ \times 5 \\ \hline \end{array}$$

b. 
$$\begin{array}{r} 25 \\ \times 4 \\ \hline \end{array}$$

c. 
$$\begin{array}{r} 32 \\ \times 6 \\ \hline \end{array}$$

5. Write a word problem that uses the problem  $6 \times 3 = \underline{\quad}$ .

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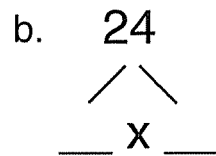
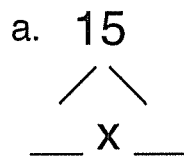


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6. Factor these numbers.



## Multiplication Concept and Number Sentence Review

There are two ways to interpret a multiplication number sentence.

$4 \times 2 = 8$  can mean  $2 + 2 + 2 + 2 = 8$  or  $4 + 4 = 8$ .

Both ways are mathematically correct. Most people use them interchangeably. Students, however, are learning what multiplication means and to what each number in the problem refers. There is a profound difference between "four groups of two" and "two groups of four." Students will become familiar with this difference (and eventually discover that both concepts share the same answer) by building models to represent the multiplication problems.

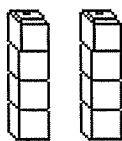
In order to make these models and to be able to visualize a multiplication problem, a student needs to know which number in the multiplication problem represents the *size* of the groups to be made and which number represents the *number of times* that group will be made or added. The choice of which representation each number bears is arbitrary. But it is important for explicit thinking, model building, and proving answers that the numbers in the written problem have the same meaning every time.

*You must be consistent in the language you use and the form of the models you build.*

This book adopts the following convention.

$4 \times 2 = 8$  as  $4 + 4 = 8$

Four, two times



The sentence, read from left to right, says make a group of four, two times. The first number tells the *size* of the group to be made; the second number tells the *number of times* the group is made. The reason for this choice is that when building models of number sentences it is easier for students if the first number of the sentence *always* tells them how many blocks to start with and the second number in the sentence *always* tells them what to do next. The order of the words and the action of the hands should correspond. Build a group of a certain size, then repeat that action a certain number of times.

The language that corresponds to this meaning of  $4 \times 2$  is "Make a group of four, two times." Or shortened to "Build four, two times."

This wording may sound awkward if you are used to saying, "Make two groups of four." This language switches the positions of the numbers, which can be a source of confusion for some learners.

Be aware that many books read  $4 \times 2$  as four groups of two. Here the first number (the four) tells the number of groups and the second number (the two) tells the size of the groups and looks like this:



This is the opposite of how this book conceptualizes multiplication. There is nothing incorrect about that format. *Do not* use the two forms interchangeably, however. A serious semantic and conceptual confusion can arise from reading the sentence  $4 \times 2$  as four groups of two. When the problem is shown horizontally as  $4 \times 2$  meaning  $2 + 2 + 2 + 2$ , the student reads it as four times two and thinks, make four groups of two. But when the problem is shown vertically as  $\begin{array}{r} 4 \\ \times 2 \\ \hline \end{array}$ , the same book often shows the problem as  $\begin{array}{r} 4 \\ + 4 \\ \hline \end{array}$ .

The student reads this problem as four times two also. But please note, that now the four stands for the *size* of the group being added (or the number being added) and the two stands for the *number of times* it is added. The meanings of the numbers are now reversed! This will confound the student's understanding of the meaning of the number sentence.

This problem can be avoided if the first number of a horizontally written problem and the top number of a vertically written problem have the same meaning.

These differences and problems are mentioned so that you will be aware of them when you use supplementary materials. Use them with care. You will also understand why we have chosen the format we have. This format is consistent throughout our books, no matter what operation is being used.

It is important that students learn and become fluent with the multiplication facts. Fractions, long multiplication, and division are a misery without them. However, at this point students are still working on the conceptual level and will need to use manipulatives and counting to find answers. Do not have the students memorize the tables until they can easily, if slowly, calculate the answers to given problems like  $6 \times 7$ . *Never substitute memorization of these series of numbers for a firmly based conceptual understanding of multiplication.* If you do, you will end up with a student who thinks that understanding doesn't matter. Many students will memorize the facts on their own when they tire of calculating them time and time again. Knowing facts from memory and speed of recall is worked on in Multiplication: Booklets 3 and 4..

**Worksheets** Multiplication Concept, page 1, and Number Sentence: Review - Worksheets 1 and 2, on pages 2 and 3 in the Student Workbook.

Party Word Problems - Worksheets 1 and 2, pages 4 and 5 are for solving and recording word problems. For students who have done *Patterns in Arithmetic: Books 1 and 2* this is review. If your student is new to this program, work together on these pages. See the Answer Key if you have any questions on how to do these pages.

Rainbow Times - Worksheets 1 and 2, pages 6 and 7 can be done together with the student. See the Answer Key if you have any questions on how to do these pages.

## Trains on Tracks

**Purpose** The purpose is to develop understanding of multiplication as repeated addition.

**Prerequisites** Counting, Basic Addition, experience with Cuisenaire Rods.

**Materials** Trains on Tracks - Worksheets 1 and 2, pages 8 and 9  
Cuisenaire Rods  
Centimeter ruler

**Lesson** Start with four red Cuisenaire Rods. 

**Session 1**  
Oral/  
manipulative

**"This is a red train. How many cars does it have?"** "Four."  
Each rod is a car. **"What is the size of each car?"** "Two centimeters (or two white rods)."  
**"How long is this red train?"**  
Have the student devise a way of determining the length. One way is to measure it on the centimeter ruler.  
"Eight centimeters." Or, "Eight little white rods." **"How do you know it's eight?"**  
"I measured it." Or, "Each little white rod is a centimeter."

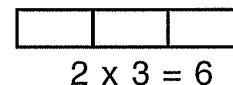
**"What is the multiplication number sentence for this train?"**  $2 \times 4 = 8.$   
**"What is the addition number sentence for this train?"**  $2 + 2 + 2 + 2 = 8.$

**"Build a train with six red rods. What is the multiplication number sentence for this train?"**  $2 \times 3 = 6.$

**"What is the addition number sentence for this train?"**  $2 + 2 + 2 = 6.$   
Repeat this a few times with different amounts of rods.

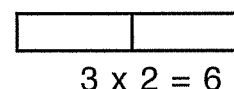
**Session 2**  
Recording


Give each student Trains on Tracks - Worksheet 1.



**"Build a train with red rods on the top rectangle."**  
**"The lines are drawn in for you on the first example. How long is each car?"**  
"Two." **"How many cars?"** "Three."  
**"What is the multiplication number sentence for this train?"**  $2 \times 3.$   
**"That number sentence is written for you."**

**"Build a different one-color train. Draw in lines to show each car. Write the number sentence that goes with this train."**  $3 \times 2 = 6.$



**"Where is the three?"** "The green rod is three rods long." **"Where is the two?"**  
 "There are two green rods. **"Where is the six?"** "Six is the answer. See, line up six white rods." **"Your answers tell me you understand. You can complete the page on your own."**

**Worksheets** Give Trains on Tracks - Worksheet 2, page 9 to complete independently.  
Number Lines, page 10, has no teacher instructions as the worksheet is self-explanatory.

## Attribute Grids

### Purpose

The purpose is to create sets from attributes. To lay the foundation for multiplication facts charts. To begin coordinate graphing in a visual way.

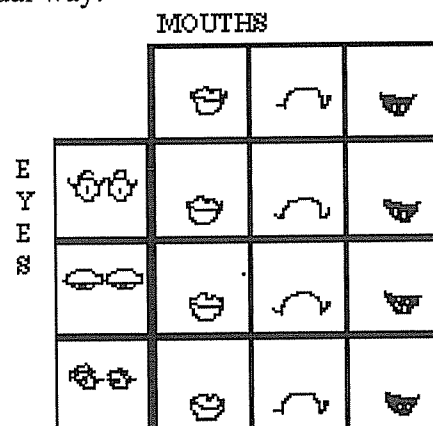
### Materials

Attribute Grids - Worksheets 1 and 2, pages 11 and 12

### Lesson

Give Attribute Grids - Worksheet 1, page 11. Across the top row there are three different mouths. In the columns below each picture, the same mouth is drawn three times.

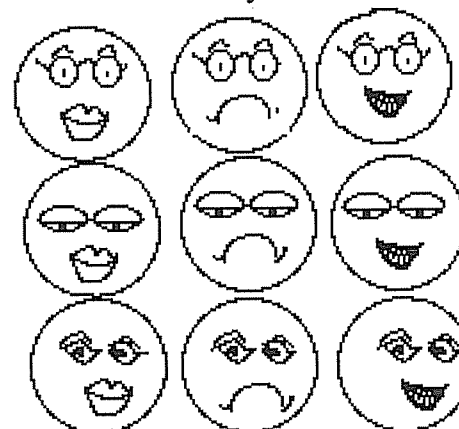
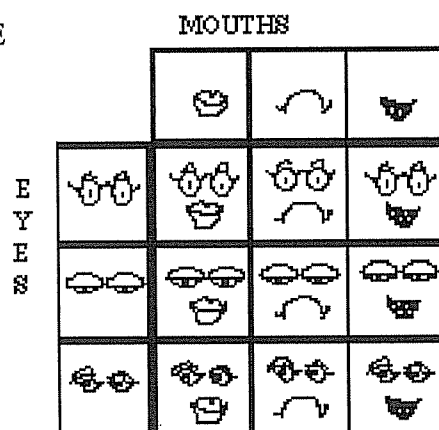
Down the side three different pairs of eyes are drawn. Then in the rows next to each picture, the same eyes are drawn three times. Each set of eyes matched with each kind of mouth results in nine funny faces. Have the student complete the grid. In the second grid the category is addition.



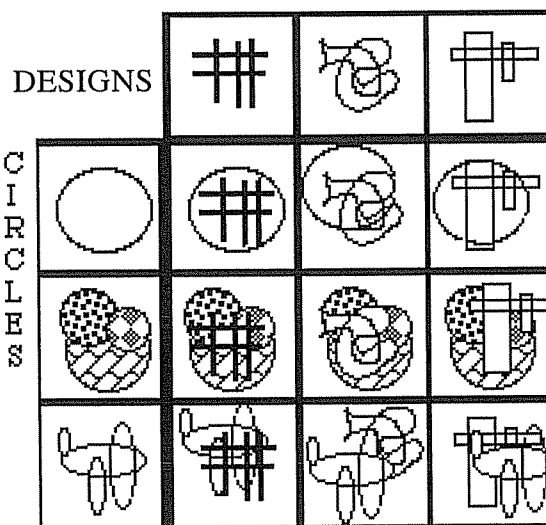
### Worksheet

Attribute Grids - Worksheet 2, page 12. Have the student choose a category of things to draw such as monsters, bugs, or cars. Then choose two attributes of the subject has that can be varied. Record the categories on the Worksheet. In this example, the category is faces. The two things to be varied are mouths and eyes.

FACE



LINES

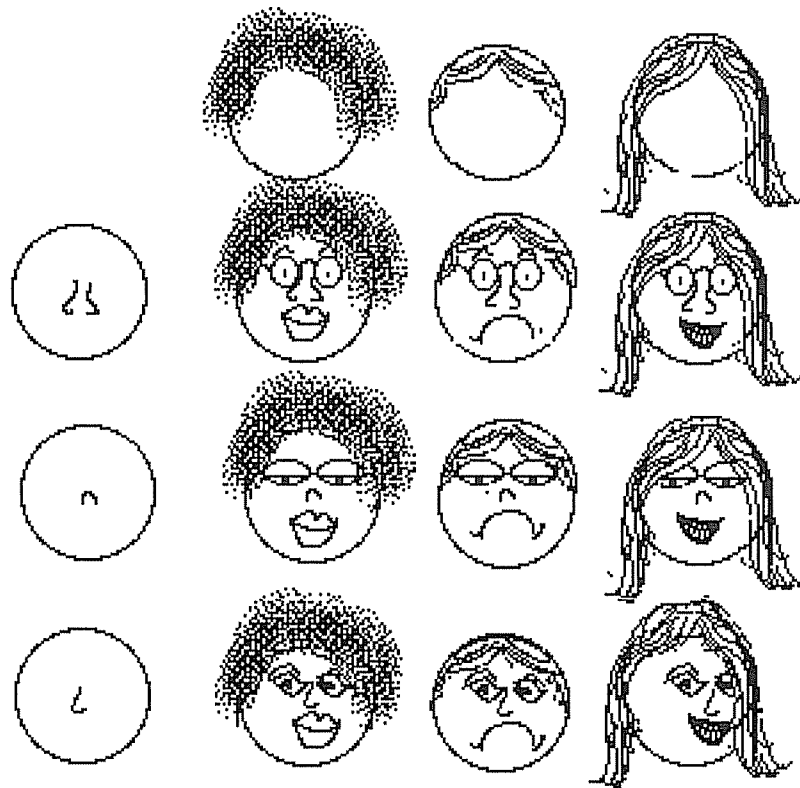


Do several grids like this using different subjects.

Another example:

In this picture grid, the subject is designs. The variables are straight lines and circles. These drawings are fun to do on computers.

After some practice at making attribute grids, you can add more attributes to the pictures. This is easily done by drawing onto clear plastic (clear plastic report covers or protective covers work well) with a Vis-A-Vis erasable pen, and making the new variables on a new sheet and overlaying them. It is also easily done on a computer. This example uses the faces drawn on the first grid and adds on hair and noses.

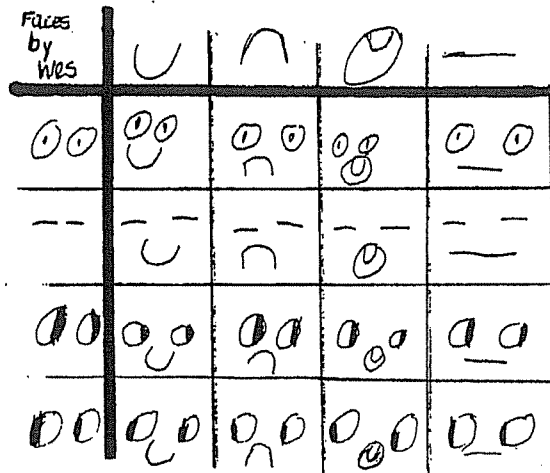


### Worksheets

Attribute Grids - Worksheets 1 and 2, pages 11 and 12. There are worksheets for Coordinate Graphing in General Math: Booklet 3, Coordinate Graphing: Worksheets 1 and 2 and Coordinate Graphing: Treasure Hunt - Worksheets 1 and 2.

### Extension

You could also take one favorite funny face outline and put it into all nine squares resulting in nine expressions. A set of cartoon figures could be developed and used to write a story or cartoon strip. Another activity is to label the emotion that is shown on each face.



## Building Times Tables

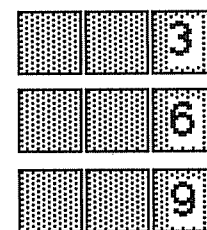
**Purpose** The purpose is to develop fluency with the facts and patterns in the multiplication tables one through ten. To understand the meaning of multiplication through the use of equal jumps on a number line or counting chart.

**Prerequisites** Multiplication Concept, Multiplication Number Sentences, *Patterns in Arithmetic: Book 2*, Attribute Grids, and Coordinate Graphing (in General Math: Booklet 3)

**Materials** Multiplication Facts Chart, page 15  
Building Times Tables - Worksheets 1 - 18, pages 16 - 33  
Cuisenaire Rods (preferred) or colored blocks, tiles, or beans  
Meter stick

Cuisenaire Rods are preferred for Activity 1 because they form an accurate visual image of a number added several times. The two rod is two centimeters long, the three rod is three centimeters long, and so on. The student can push the rods against a meter stick and measure the length of the rods to get the answers. Since we are working on developing the tables, measuring the total rod lengths to get answers relieves a great deal of tedium and gives accurate answers.

If you are using cubes or tiles, the student should place them in rows like this:



Numbering the last tile in each row will allow the student to keep a running total. This way he will not have to constantly recount the tiles.

**Lesson** This lesson is a series of activities that will be repeated for each table. The entire series for all tables will take ten weeks or so. One table each week can be featured.

**Session 1** Using Cuisenaire Rods and a meter stick (or tiles or blocks), have the student build the table being featured. The student will use the Building Times Tables Worksheet to record the work as it is being done.

The three times table is used as an example. Have the student turn up an empty palm.

**"How many threes do you have in your hand?"** "None."

**"What number is used to show nothing?"** "Zero."

**"If I add three zero times, how much will I end up with?"** "Zero."

Record this in the first set of boxes on Building Times Tables - Worksheet 3 as fo

$$\boxed{3} \times \boxed{0} = \boxed{0}$$

**"Pick up a three rod (light green) or one group of three tiles."**

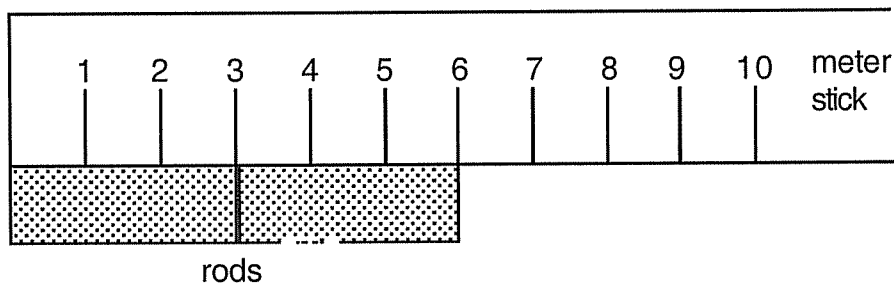
**"How many threes do you have now?"** "One three."

**"If I add three one time, how much will I end up with?"** "Three."

Record this in the second set of boxes on Worksheet.3.

$$\boxed{3} = \boxed{3} \times \boxed{1} = \boxed{3}$$

"Pick up another three rod and lay it next to the first one." Be sure the student pushes the rods up against the side of the meter stick with the first rod flush with the zero end of the stick.



"How many threes do you have now?" "Two threes."

"If I add three two times, how much will I end up with?" "Six."

Record this in the third set of boxes on the worksheet as follows.

$$\boxed{3} + \boxed{3} = \boxed{3} \times \boxed{2} = \boxed{6}$$

"Pick up another three rod. Put it next to the last one, against the meter stick."

"How many threes do you have now?" "Three threes."

"If I add three times, how much will I end up with?" "Nine."

Record this in the fourth set of boxes on the worksheet as follows.

$$\boxed{3} + \boxed{3} + \boxed{3} = \boxed{3} \times \boxed{3} = \boxed{9}$$

Continue this procedure to the end of the worksheet. After some practice, the student will be able to do this activity alone.

## Worksheet

Multiplication Facts Chart, page 15 After he has built the table in Session 1, the student uses the chart to record the table. Encourage pattern finding.

On the chart, the number that is being added is shown along the side. The number of times it is added is shown across the top. Have him put his left index finger on the number being added (the table he is working on, the threes, for example). Have him put his right index finger on the number of times it is added (four times, for example). Then he slides his left index finger sideways (to the right) and the right index finger down until the fingers meet in a square. He records the answer (twelve) in that square. A chart completed to the three times table will look like this:

		1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10	
2	2	4	6	8	10	12	14	16	18	20	
3	3	6	9	12	15	18	21	24	27	30	

## Session 2

For each times table, the student completes a Building Times Tables and Building Times Tables: Finding Patterns worksheet. The Multiplication Facts Chart should not be available for this activity; otherwise, the student often simply copies the numbers instead of rethinking them in a new way.



First the student counts by twos or threes, or whatever the table is, and records the numbers on the worksheet. Many students will count in their heads or use their fingers. Some will want counters of some kind. Next he will be asked how much six threes make. There are nine problems like this. Allow the student to use the series he wrote out at the beginning to help him. He will also fill in the missing numbers in the sequence of numbers that form the table being worked on.

On the second half of the Patterns in Tables, the student writes the table down the page and looks for patterns in the answers. Have him also look at the last digit in the answers to find patterns. The digits are added in the answers to find additional patterns. To sum the digits in the answer, take the answer to a problem, e.g.,  $3 \times 8 = 24$ , and add the numbers in the answer  $2 + 4$  to get six. The six is recorded on the second row of lines next to the answers to the multiplication problems. Sometimes, as in  $7 \times 8 = 56$ , the sum of the digits is a two digit number,  $5 + 6 = 11$ . The 1 + 1 from the 11 are added to make two.

Look for patterns in the completed Multiplication Facts Chart and have the students compare and discuss them.

## Worksheets

Finding Patterns in Tables - Worksheets 1 and 2, pages 34 and 35. The multiples of each times table is shaded in, making different patterns.

## Test for Understanding

It is important to give continuous practice on the tables. Give around twenty problems per week until the facts are fluent. In Extensions are two good sources of practice worksheets, but any standard math text will do the job also. When the student can answer the Test for Understanding questions, you can safely drop the use of the manipulatives and have the student get the answers by addition and memory. It takes most students a year or two to master the multiplication tables.

1. Give this series of numbers: 16, 20, 24, 28, 32. **"Which multiplication table does this series of numbers come from?"**
2. Ask the student to figure out what the answer to  $7 \times 8$  is and explain how he got the answer.
3. Take out six nine rods (dark blue) and place them end to end on the table. **"What multiplication problem is this?"**  $9 \times 6$ . **"What is the next multiplication problem in the series and what is the answer to that problem?"**  $9 \times 7 = 63$ .
4. **"Show  $6 \times 7$  with Cuisenaire Rods. What is the answer?"** "Forty-two." **"What problem would come two problems before this one in the six times table?"**  $6 \times 5$ . **"What is the answer to the new problem using the answer to the old  $6 \times 7$ ?"** This is a hard question. Students may have to manipulate to find the answer.

Answers to the Test for Understanding

1. This series shows part of the four times table. The student can tell this because

the numbers are all four apart. If he can't identify the table, he does not understand the serial nature of the tables.

2. The answer is 56. Most students will get it by adding seven, eight times.
3. The problem is  $9 \times 6$  or nine added six times; the answer is fifty-four. The next problem in the series would be  $9 \times 7$  or nine added seven times. This adds one more nine to the six nines given in the first problem. Check to see if the student adds from scratch, nine seven times or if he simply adds one more nine to the fifty-four to get sixty-three. If he does the former, press him to use the fifty-four to help him. Starting over indicates uncertainty on the concept of serial addition, which is what the tables are all about.
4. He should show you seven dark green rods or seven rows of six tiles. Two problems before this one in the series is  $6 \times 5$ . Using the answer forty-two from  $6 \times 7$ , he should be able to subtract two sixes to get the new answer of thirty.

## Drills

Start Daily Skip Count, pages 36 and 37, and Merry Mix Up Drill, page 38, *after* the lesson Finding Patterns in Tables. The student fills in blanks for the times table he is working on. Time the student for sixty-five seconds while the student does the problems. Correct and count the right problems. Divide sixty-five by the number of problems done correctly. Students may use a calculator. To pass, the student needs to do all problems correctly in sixty-five seconds. Example:

Daily Skip Count by <u>4</u> s		
Try to do all of these in 65 seconds or less and get them all correct.		
<u>4</u> x 10 = ___	<u>4</u> x 1 = ___	<u>4</u> x 5 = ___
<u>4</u> x 2 = ___	<u>4</u> x 4 = ___	<u>4</u> x 9 = ___
<u>4</u> x 6 = ___	<u>4</u> x 11 = ___	<u>4</u> x 12 = ___
<u>4</u> x 3 = ___	<u>4</u> x 7 = ___	<u>4</u> x 8 = ___
<u>4</u> x 0 = ___	_____ # correct	pass    redo

The second section is for the student to skip count the times table he is working on. He skip counts and fills in the numbers. "Zero, four, eight, twelve, sixteen, twenty, twenty-four, twenty-eight, thirty-two, thirty-six, forty, forty-four, forty-eight."

0, 4, 8, 12, 16, 20, 24, 28, 32, 36, 40, 44, 48

Each day he folds the page up to cover the previous day's work.

A page with numbers in a different order is on the following page.

## Extensions

Investigate the results of multiplying odd and even numbers together. If you multiply an even times an even, will the answer be odd or even? What about an odd times an odd? An even times an odd?

*Those Amazing Tables* This book works on finding patterns in the multiplication chart.

*Spectrum Mathematics - Grade 3*, pages 76 through 95. Drills and word problems.

*Mathemagination - Book A*, pages 7 through 18. Self-correcting drills.

Daily Skip Count by \_\_\_ s

Date \_\_\_\_\_

Try to do all of these in 65 seconds or less and get them all correct.

\_\_\_ x 11 = \_\_\_      \_\_\_ x 4 = \_\_\_      \_\_\_ x 7 = \_\_\_

\_\_\_ x 9 = \_\_\_      \_\_\_ x 6 = \_\_\_      \_\_\_ x 8 = \_\_\_

\_\_\_ x 2 = \_\_\_      \_\_\_ x 12 = \_\_\_      \_\_\_ x 10 = \_\_\_

\_\_\_ x 1 = \_\_\_      \_\_\_ x 5 = \_\_\_      \_\_\_ x 3 = \_\_\_

\_\_\_ x 0 = \_\_\_      \_\_\_\_\_ # correct      pass      redo

Cover the ones you have already done with a piece of paper. Do not copy.

0, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_

0, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_

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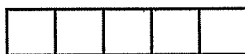
0, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_, \_\_

## Tiles

**Purpose** The purpose is to understand the meaning of multiplication through the use of an array that is another representation of multiplication problems.

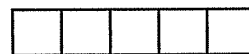
**Materials** Tiles, 1 inch squares of paper, or playing cards

**Lesson** To be consistent with lessons later, we call the number represented on the horizontal a row.



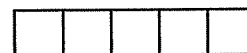
### Session 1

Show and say, "This array is one row of five."



"Build two equal rows of five."

It's less confusing to have a gap between the rows at first.



two rows of five

Have the student build several different arrays: three rows of four, two rows of six, four rows of five, seven rows of two, five rows of one, etc. Also have the student make up problems.

### Session 2

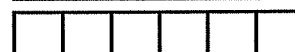
Next ask the student to count the tiles in the array.

"How many tiles would you need to build four rows of two? Guess first, then build and count." Do several of these. Most students need several days of work to master this.



### Session 3

"Build, then draw a picture of three rows of six."



"How many tiles would you need to build four rows of seven? Guess first, then build, count and draw it." Give several more problems. Have the student make up problems.

### Test for

#### Understanding

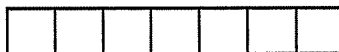
1) "Build three rows of five."

"Build and draw a picture of two rows of four."

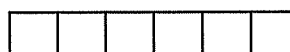
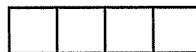
2) "What problem is this?"



"Two rows of seven."



3) "What do you notice here?"



"It is not a 'rows of' problem because the rows are not even. It's  $4 + 6$ ."

Or say, "Something is different here. Can you fix it?" Or, "How would you make this fit our 'rows of' pattern?"

"Add two to the top row."

Or, "Take two from the bottom row."

Or, "Take one from the bottom row and add it to the top row."

## Commutative Property: Manipulative


**Purpose** The purpose is to discover the property of commutativity of multiplication: two, three times is equal to three, two times, or  $2 \times 3 = 3 \times 2$  (or two times three is equal to three times two).


**Prerequisites** Understanding basic multiplication and Tiles



**Materials** Unifix cubes or blocks. Interlocking blocks work best for building stacks.

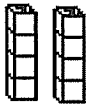

**Lesson** Give the student a pile of cubes.



### Session 1

"What kind of equal stacks can you make with three blocks?"  "Three, one time."

"Is there another way to arrange the blocks?"  "One, three times."

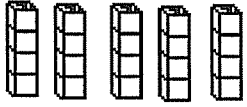
"Build three, two times."  "Build two, three times." 

"Build four, two times."  "Build two, four times." 

"Build six, one time."  "Build one, six times." 

"Do you see a pattern?" "The stacks are all opposite."



"If you build five, four times, what is the opposite? Build and name it."

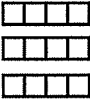

"Four, five times." 

Give several more examples and have the student build the models.

### Session 2

Use tiles instead of Unifix cubes. Have the tiles touch each other in the rows.

"Build one, four times."  "Change it to four, one time." 

"Build four, three times."  "Change it to three, four times." 

Give several problems.

Observe how the student changes the tiles. There are several levels of understanding and sophistication.

She counts out new tiles to make the second arrangement.

She uses the same tiles to rebuild the second arrangement.

She takes the first arrangement completely apart and re-forms it for the second one.

She takes one tile off of each row and uses these to form a new bottom row.

She pivots the array.


## Commutative Property: Recording

**Purpose** The purpose is to record the property of commutativity: two, three times is equal to three, two times, or  $2 \times 3 = 3 \times 2$  (or two times three is equal to three times two).

**Prerequisites** Understanding basic multiplication, Commutative Property: Manipulative

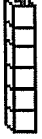

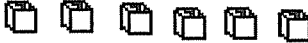
**Materials** Properties of Multiplication: Worksheets 1 and 2, pages 39 and 40  
Unifix cubes or blocks. Interlocking blocks work best for building stacks.

**Lesson** Give the student a pile of cubes.

"Build three, two times."  "What multiplication problem is this?"  
"3 x 2."


"What is three times two equal to?" "Six."


"Build other multiplication problems that equal six."

 "6 x 1."  "2 x 3."  "1 x 6."

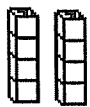
"Which of these problems uses the same numbers as 3 x 2?" "2 x 3."

"What other problems are here?" "6 x 1, 1 x 6."

"Build four, two times."  "What is four, two times equal to?" "Eight."

"Build another multiplication problem that uses the same numbers and still equals eight." 

"Write the multiplication and addition number sentences for each problem."



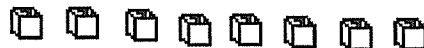
$$4 + 4 = 8$$

$$4 \times 2 = 8$$



$$2 + 2 + 2 + 2 = 8$$

$$2 \times 4 = 8$$



$$1 + 1 + 1 + 1 + 1 + 1 + 1 + 1 = 8$$

$$1 \times 8 = 8$$

$$8 \times 1 = 8$$



"How are the problems the same?" "They have the same answer."

"How are the problems different?" "Four plus four is not the same as two plus two plus two plus two. The numbers two and four are switched around in the times problem. The numbers one and eight are switched around also."

"Try some more multiplication problems."

"Did you find this pattern? How would you phrase it?"

After more exploration, ask, "Does it always work?" "Yes."

"This is called the Commutative Property of Multiplication."

## Worksheet

Properties of Multiplication: Worksheet 1, page 39. Students discover what happens when numbers are multiplied by zero and one. The names can be discussed after the student has written the rules: Zero Property of Multiplication and the Identity Property of Multiplication. In Worksheet 2, page 40 the Commutative Property is recorded.

## Associative Property

**Purpose** The purpose is to build a three-dimensional representation of the Associative Property, to record a number sentence, and to use parentheses as a tool for grouping numbers together to indicate order of combination.

**Prerequisites** Understanding basic multiplication, Tiles, Commutative Principle: Manipulative, Commutative Principle: Recording, and Using Parentheses (in General Math: Booklet 3)

**Materials** Unifix cubes and rubber bands or Multilink cubes  
Paper and pencil

**Lesson Session 1** "Start with one block. Add blocks to make a larger rectangular solid that has two blocks on each side. Guess how many blocks it will take."

Student builds the model.



"How long is your rectangular solid?" Two blocks.

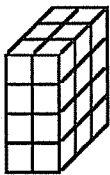
"How wide is your rectangular solid?" Two blocks.

"How tall is your rectangular solid?" Two blocks.

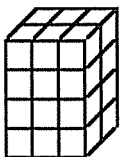
"What number sentence describes this rectangular solid?"

"2 x 2." "Show how that matches the rectangular solid." (Student indicates a 2 x 2 rectangle.) "What do you call the rest of the blocks?" "I have the same amount again." "Oh, you have another 2 x 2 square?" "Yes." "How can you write that?"

"2 x 2." "How would you write that all together?" "2 x 2 x 2." "Show me each two of the rectangular solid." Student indicates any two of the blocks. The second indicates a group of four blocks showing that it is two times two. And finally the student indicates the other four blocks, which is the second 2 x 2 or 2 x 2 x 2. "How many blocks did it take? Does that match the number sentence?" "Eight. Yes."



2 x 3 x 4



3 x 2 x 4

"Build a rectangular solid that is two blocks long, three blocks wide, and four blocks high. Name the number sentence that matches this solid."

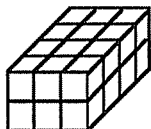
"Build a rectangular solid that is three blocks long, four blocks wide, and two blocks high. Name the number sentence that matches this solid."

"Using the same amount of blocks, build all the rectangular solids that can be made. Name the number sentence that matches each solid."

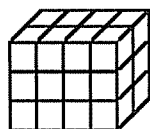
**Worksheets** After the student successfully builds these solids, give Associative Property: Worksheets 1 - 3, pages 41 - 43.

**Session 2** Worksheets 4 and 5 record the Associative Property using parentheses to group numbers together to indicate the order of combination.

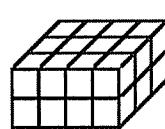
**Worksheets** Associative Property: Worksheets 4 - 5, pages 44 - 45



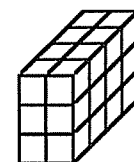
3 x 4 x 2



4 x 2 x 3



4 x 3 x 2



2 x 4 x 3

## Uneven Stacks

- Purpose** The purpose is to develop the use of parentheses.
- Prerequisites** Understanding basic multiplication and addition, and Using Parentheses (in General Math - Booklet 3)
- Materials** Unifix cubes or blocks. Interlocking blocks work best for building stacks.

### Lesson

Give the student a pile of cubes.

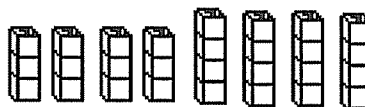
**"What multiplication problem is this?"**

"Three, four times or  $3 \times 4$ ."



**"What multiplication problem is this?"**

"That's not a multiplication problem."



**"Why not?"** "Because all the stacks aren't the same."

**"Is there any way to calculate the total number of blocks by using multiplication?"** "You solve the parts that are the same first and then add them together. If it was just addition you just add all the stacks together."

**"Try it. We'll compare the answers. What are the little parts?"**

" $3 \times 4$  and  $4 \times 4$ ."

**"In math, parentheses are used to make complicated problems easier to read and solve. Parentheses are like little fences that keep the parts separate. How could you use parentheses in this problem? Parentheses look like ( ). The numbers written inside them mean 'Do me first.'"** " $(3 \times 4) (4 \times 4)$ ."

**"Yes, the fences (parentheses) go around each little multiplication problem. There is one more part that is needed, though. When you said the problem before, you said " $3 \times 4$  and  $4 \times 4$ . What symbol means 'and'?"** "+ (plus sign)."

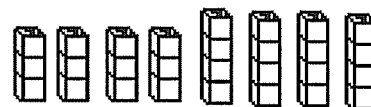
**"Write it again using the + sign."** " $(3 \times 4) + (4 \times 4)$ ."

" $(3 \times 4) = 12$  and  $(4 \times 4) = 16$ . Twelve plus sixteen is twenty-eight."

**"We write the rest of the problem adding the little parts together."**

**"What did you get for an answer when you added all the stacks?"** "I got twenty-eight too."

**"Twenty-eight equals twenty-eight. That verifies it. Nice work."**



$$(3 \times 4) + (4 \times 4)$$

$$12 + 16 = 28$$

### Worksheet


Uneven stacks, page 46




## Factoring: Manipulative

**Purpose** The purpose is to begin factoring with manipulatives and to record. Factoring is a very important mathematical tool.

**Prerequisites** Understanding basic multiplication and Commutative Property

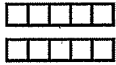
**Materials** Tiles or 1 inch squares of paper  
Paper and pencil. To be consistent with lessons later, we call the number represented on the horizontal a row. 

**Lesson** Show and say, "This array is five, one time." 

### Session 1

"Build five, two times. What multiplication problem is it?"

"Five times two,  $5 \times 2$ , or also stated five, two times."

It's less confusing to have a gap between the rows at first. 


five, two times or  $5 \times 2$


Have the student build several different arrays: three rows of four, two rows of six, four rows of five, seven rows of two, five rows of one, etc. Also have the student make up problems.

### Session 2

"Build with three tiles. How many arrays can you make with three tiles?"



"One, three times and three, one time."

 one, three times

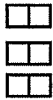
 three, one time


"Build with four tiles. How many arrays can you make with four tiles?" "Four, one time; one, four times; and two, two times."




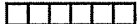
 

"Show all the ways you can make an array of six. Draw a picture of each arrangement. Label each picture." *Do not tell the student to reverse the arrangements.*

  
two, three times  
 $2 \times 3 = 6$

  
one, six times  
 $1 \times 6 = 6$

  
three, two times  
 $3 \times 2 = 6$

  
six, one time  
 $6 \times 1 = 6$

### Worksheets

Factoring: Manipulative - Worksheets 1 and 2, pages 47 and 48, record this procedure with nine, ten, eleven, twelve, eighteen, twenty, and twenty-four tiles. Make sure all the arrangements possible are found for each number. Have the student circle the arrays that display the Commutative Property.

### Test for Understanding

1. Watch for fluency and systematic versus random searching. Does the student automatically reverse each arrangement?
2. "Are you sure there are no more arrangements of that number?" "Yes, I'm sure." "How do you know?"

## Factoring: Recording

### Purpose

The purpose is to record factoring.

### Prerequisites

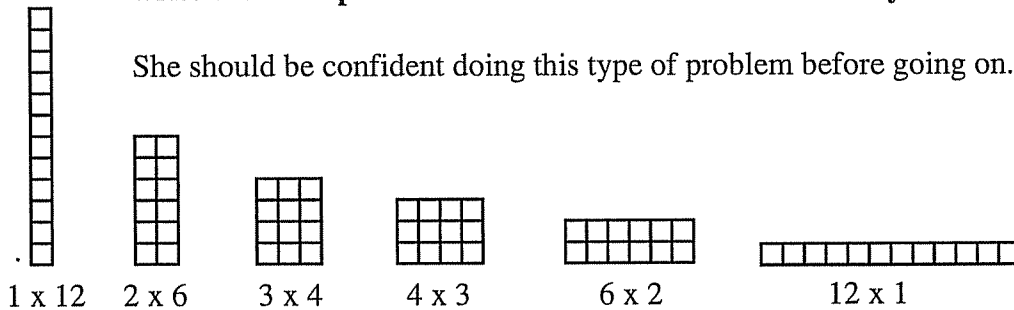
Basic tables, Commutative Property, Factoring: Manipulative

### Materials

Factoring: Recording - Worksheet 1, page 49  
Paper and pencil  
Tiles or Cuisenaire Rods

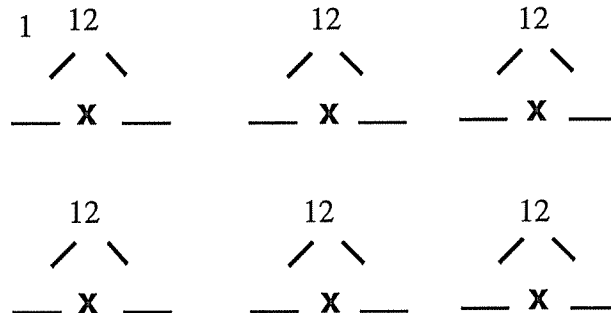
### Lesson

**"Build all possible arrays using twelve tiles. Record on Worksheet 1 and write the multiplication number sentence for each array."**



**"In the equation  $2 \times 6 = 12$ , the two and the six are called factors and the answer is called the product. There is a way of recording the different factors of a number to make factoring numbers easier to do."**

**"Record the factors for twelve in this new form."**



### Worksheet

After the student records the factors of twelve correctly, have her complete the page independently and give Factoring: Recording - Worksheet 2, page 50.

## Multiplication by Addition

**Purpose** The purpose is to use addition to solve larger multiplication problems.

**Prerequisites** Basic multiplication and column addition

**Materials** Cuisenaire Rods or Base Ten Blocks

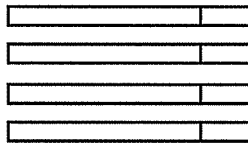
**Lesson** "Solve this problem:  $3 \times 4$ ." " $3 \times 4 = 12$ ."

"How would you solve  $13 \times 4$ ?"

Most students solve it with addition.

Some solve by building the problem.

$$\begin{array}{r} 13 \\ 13 \\ 13 \\ + 13 \\ \hline 52 \end{array}$$



Give several problems. To encourage the student to solve by addition, give more difficult problems.

$$\begin{array}{r} 35 \\ \times 6 \\ \hline \end{array}$$

$$\begin{array}{r} 35 \\ 35 \\ 35 \\ 35 \\ + 35 \\ \hline 210 \end{array}$$

$$\begin{array}{r} 58 \\ \times 7 \\ \hline \end{array}$$

$$\begin{array}{r} 58 \\ 58 \\ 58 \\ 58 \\ 58 \\ + 58 \\ \hline 406 \end{array}$$

$$\begin{array}{r} 132 \\ \times 4 \\ \hline \end{array}$$

$$\begin{array}{r} 132 \\ 132 \\ 132 \\ + 132 \\ \hline 528 \end{array}$$

**Worksheet** Multiplication by Addition, page 51

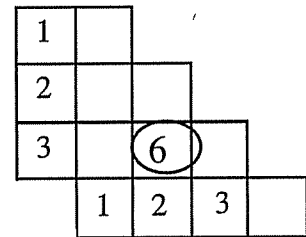
# Picture My Learning

Date \_\_\_\_\_

Practice - Make multiple copies, page follows.

This picture will help a student visualize what facts she needs to learn.

Randomly choose a box, e.g., the one with the circle in it, and say, "**3 x 2.**" Count in your mind and estimate how long it takes the student to give a correct response.



If the correct response comes in 3 seconds or less, color the square green for "I've got it."

In 4 - 6 seconds, color the square orange for "I've almost got it."

In 7 - 10 seconds, color the square yellow for "I don't know it but I can figure it out." If it takes over 10 seconds, color it red, "I'm still working on it." Do this every couple of weeks until the top is all green and possibly orange in the lower right hand corner.

1									
2									
3									
4									
5									
6									
7									
8									
9									
<b>X</b>	1	2	3	4	5	6	7	8	9

**Color Code**

Green - 1 to 3 seconds

Orange - 4 to 6 seconds

Yellow - 7 to 10 seconds

Red - more than 10 seconds or a wrong answer

Picture My Learning  
Practice - Make multiple copies.

Date \_\_\_\_\_

1									
2									
3									
4									
5									
6									
7									
8									
9									
<b>X</b>	1	2	3	4	5	6	7	8	9

**Pre-Assessment - Part 1**

Date \_\_\_\_\_

Put a question mark next to any problem you do not know how to do.

1. Solve. a.  $4 + 5 + 6 = \underline{\quad}$

b.  $4 + 4 + 4 + 4 + 4 = \underline{\quad}$

c.  $13$

$13$

$13$

$+ 13$

**Pre-Assessment - Part 1 Score Sheet**

**Part 1**

Can the student:

1. Addition Number Sentences (Books 1 and 2)

Yes No

A. give the correct answer for both addition number sentences in problems a and b?

Yes No

B. give the correct answer to the addition problem c, which requires regrouping?

**Notes**

# Patterns in Arithmetic

## Multiplication: Booklet 1

### Basic Concepts

### Answer Key

### for the

## Student Workbook

By Suki Glenn and Susan Carpenter

#### Answer Key Legend

AWV = answer(s) will vary Cuisenaire Rods

BUWV = break up will vary 1 w = white

OWV = order will vary 2 r = red

3 lg = light green

#### Pattern Blocks

4 p = purple

r = red trapezoid

5 y = yellow

g = green triangle

6 dg = dark green

y = yellow hexagon

7 bk = black

o = orange square

8 bn = brown

b = blue parallelogram

9 bl = blue

t = tan rhombus

10 o = orange

Note: Some items and pages are left out of the answer key.

1) Some pages in which the answers are open-ended or will vary.

2) Make your own problems. Since students create their own problems and solutions, these sections give valuable information about the level of confidence and competence. It can be a useful source of curriculum for other students.

3) Blank practice pages

4) Workboards

5) Games

6) Self correcting pages

7) Instructions only pages

Patterns in Arithmetic: Multiplication - Booklet 1

Student Workbook Answer Key

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Published by Pattern Press

P.O. Box 2737

Fallbrook, CA 92088

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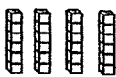




ISBN 978-1-935559-18-4

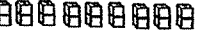
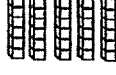
# Multiplication - Booklet 1


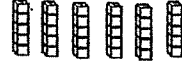
## Multiplication Concept - Worksheet 1

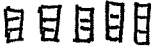
Look at the picture. Write the addition and multiplication number sentences. Example:


 $6 + 6 + 6 + 6 = 24$  Addition  
 $6 \times 4 = 24$  Multiplication

 Addition $4 + 4 + 4 + 4 = 20$ Multiplication $4 \times 5 = 20$	 Addition $3 + 3 + 3 + 3 + 3 + 3 + 3 = 24$ Multiplication $3 \times 8 = 24$
---	---

 Addition $2 + 2 + 2 + 2 + 2 + 2 + 2 + 2 = 18$ Multiplication $2 \times 9 = 18$	 Addition $6 + 6 + 6 + 6 + 6 = 30$ Multiplication $6 \times 5 = 30$
---	---

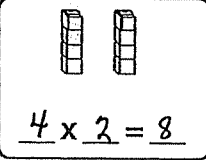
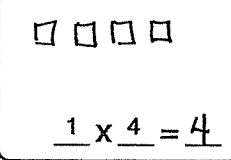
 Addition $7 + 7 + 7 = 21$ Multiplication $7 \times 3 = 21$	 Addition $5 + 5 + 5 + 5 + 5 = 30$ Multiplication $5 \times 6 = 30$
---	---

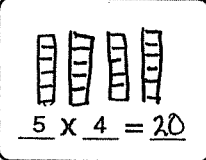
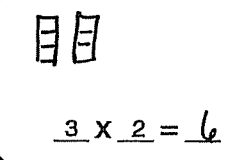
Draw the picture.  $3 + 3 + 3 + 3 + 3 = 15$ $3 \times 5 = 15$	Make your own. Answer will be unique. Addition Multiplication $\_\_ \times \_\_ = \_\_$
---	--

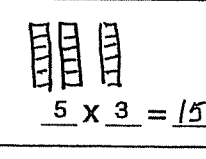
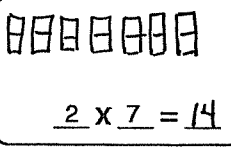
1

## Number Sentence: Review - Worksheet 2

Build the problem and draw a picture.

Write $\downarrow$ $\begin{array}{r} 4 \\ \times 2 \\ \hline 8 \end{array}$	 $4 \times 2 = 8$	$\begin{array}{r} 1 \\ \times 4 \\ \hline 4 \end{array}$	 $1 \times 4 = 4$
---	---	--	---

$\begin{array}{r} 5 \\ \times 4 \\ \hline 20 \end{array}$	 $5 \times 4 = 20$	$\begin{array}{r} 3 \\ \times 2 \\ \hline 6 \end{array}$	 $3 \times 2 = 6$
---	--	--	---

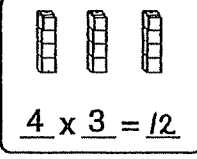
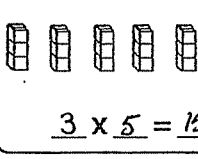
$\begin{array}{r} 5 \\ \times 3 \\ \hline 15 \end{array}$	 $5 \times 3 = 15$	$\begin{array}{r} 2 \\ \times 7 \\ \hline 14 \end{array}$	 $2 \times 7 = 14$
---	--	---	--

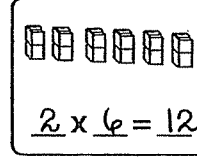
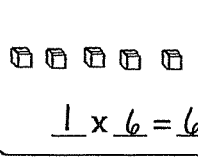
Write two word problems to solve.

3

## Number Sentence: Review - Worksheet 1

The number of blocks in each group.	X	The number of times each group is made.	=	The total number of blocks.
-------------------------------------	---	---	---	-----------------------------

$\begin{array}{r} 4 \\ \times 3 \\ \hline 12 \end{array}$	 $4 \times 3 = 12$	$\begin{array}{r} 3 \\ \times 5 \\ \hline 15 \end{array}$	 $3 \times 5 = 15$
---	---	---	--

$\begin{array}{r} 2 \\ \times 6 \\ \hline 12 \end{array}$	 $2 \times 6 = 12$	$\begin{array}{r} 1 \\ \times 6 \\ \hline 6 \end{array}$	 $1 \times 6 = 6$
---	---	--	---

Make your own.

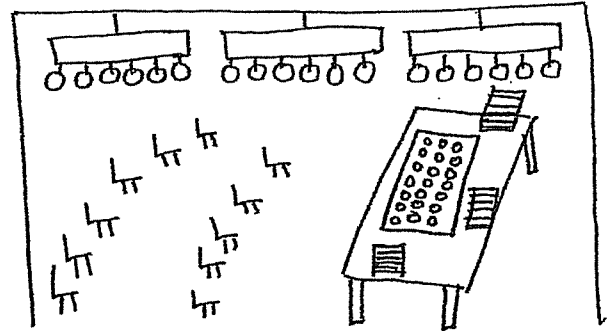
AWV

$\_\_ \times \_\_ = \_\_$	$\_\_ \times \_\_ = \_\_$
---------------------------	---------------------------

$\_\_ \times \_\_ = \_\_$	$\_\_ \times \_\_ = \_\_$
---------------------------	---------------------------

## Party Word Problems - Worksheet 1

Draw a room with three large lights near the ceiling.



1. Mimi and Shania decided to decorate the classroom for a party for their Math 3 class. They are going to hang balloons from the lights. There are 3 lights. Shania and Mimi put 6 balloons on each of the lights. Draw the balloon into your picture.

Question:  
How many balloons did they use? 18 balloons

Answer: Write the number sentence.  
 $6 \times 3 = 18$

2. Mrs. K decided to invite the Math 2 group to the party. Mimi needs to make sure everyone has a chair. There are 6 students in the Math 3 group and 5 students in the Math 2 group. Mimi asked Emily to get the chairs. Draw the chairs into your picture.

Question:  
How many chairs does Emily need? 11 chairs.

4



## Party Word Problems - Worksheet 2

Answer: Write the number sentence.

$$\underline{6} + \underline{5} = \underline{11}$$

Answer in words. Why did you add on problem 2 and multiply in problem 1?

Because in problem 1 all the numbers are the same; 6+6+6, so you multiply. In 6+5 the numbers are different, so you add.

3. Kalynn made cookies for the party at home. Kalynn put the cookies in rows of three on the cookie sheet. He fit 7 rows of cookies on one sheet.

Draw a table into your picture. Then draw the cookie sheet so you can see how many cookies are on the tray.

Question:

How many cookies did Kalynn bake? 21 cookies

Answer Write the number sentence.

$$\underline{3} \times \underline{7} = \underline{21}$$

4. Everyone loved Kalynn's cookies. But they were very sticky. Samantha decided they needed to get out some napkins. Samantha put a stack of 6 napkins at one end of the table. She made another stack of 6 and put it at the other end of the table. She then made a stack of 6 in the middle of the table.

Draw the napkins onto your table so you can see how many napkins are in each stack.

Question:

How many napkins did Samantha set out? 18 napkins

Answer Write the number sentence.

$$\underline{6} + \underline{6} + \underline{6} = \underline{18}$$

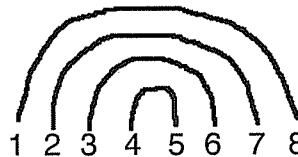
You could also multiply to get this answer

$$\underline{6} \times \underline{3} = \underline{18}$$

5

## Rainbow Times - Worksheet 1

This is a math rainbow.



Add the pairs of numbers connected in the rainbow.

$$1 + 8 = \underline{9} \quad 2 + 7 = \underline{9} \quad 3 + 6 = \underline{9} \quad 4 + 5 = \underline{9}$$

What pattern do you see? All the answers are the same.

Do you think the same pattern will come up if you multiply the pairs? Try it.

$$1 \times 8 = \underline{8} \quad 2 \times 7 = \underline{14} \quad 3 \times 6 = \underline{18} \quad 4 \times 5 = \underline{20}$$

What happened? The answers are all different.

Put the answers to the multiplication problems in order on the spaces below. Then find the difference between each number. Put that on the lower line which is between each number.

$$\begin{array}{cccc} \underline{8} & \underline{14} & \underline{18} & \underline{20} \\ \underline{6} & \underline{4} & \underline{2} & \end{array}$$

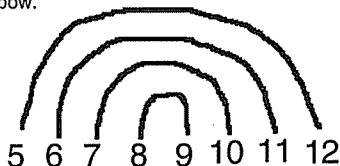
What do you notice about the differences between the answers?

All are even numbers. Each one is two less than the previous number.

6

## Rainbow Times - Worksheet 2

Try this rainbow.



Add the four pairs of numbers connected in the rainbow.

$$5 + 12 = 17 \quad 6 + 11 = 17 \quad 7 + 10 = 17 \quad 8 + 9 = 17$$

What pattern do you see? The answers all equal 17.

What is the difference between the answers when you add? Zero

Now multiply the pairs.  $5 \times 12 = 60$   $7 \times 10 = 70$   
 $6 \times 11 = 66$   $8 \times 9 = 72$

Do you think the same pattern of differences will come up again? AWV

$$\begin{array}{cccc} \underline{60} & \underline{66} & \underline{70} & \underline{72} \\ \underline{6} & \underline{4} & \underline{2} & \end{array}$$

Make two more rainbows with an odd number of numbers in each one. How can you make the center sum equal to the others?

Double the center number.

The pattern of differences this time is: The difference numbers are all odd. The difference between the differences is still two.

My general rule is: Adding the pairs equals the same number. Multiplying the pairs makes different answers and the answers' differences equal two. Even numbered rainbows

have even differences. Odd numbered rainbows

have odd differences.

7

## Trains on Tracks - Worksheet 1

One Color Trains  
Cuisenaire Rods



6 Trains

R	R	R	= 2 x 3 = 6
LG			= 3 x 2 = 6
DG			= 6 x 1 = 6
W			= 1 x 6 = 6

Using Cuisenaire Rods show the different one color trains for each number. Build and record. Write the number sentence.

8 Trains

BN	= 8 x 1 = 8
R	= 2 x 4 = 8
P	= 4 x 2 = 8
W	= 1 x 8 = 8

10 Trains

O	= 10 x 1 = 10
Y	= 5 x 2 = 10
R	= 2 x 5 = 10
W	= 1 x 10 = 10

9 Trains

LG	= 3 x 3 = 9
BL	= 9 x 1 = 9
W	= 1 x 9 = 9

8



## Building Word Problems - Worksheet 2

3. Janie bought three boxes of carpet squares. Draw Janie into your picture. Put the three boxes of carpet squares into your picture. Draw the label and price tag on each box. The price was \$3 per box. What was the total amount Janie paid for the carpet squares?

Write the number

$$3 \times 3 = \$9 \text{ for the carpet squares.}$$

4. Marsha walked into the yard with her wagon. Draw Marsha and her wagon in your picture. In the wagon, she had 5 cans of green paint. Draw in the cans of green paint and put the price on each can. Each can cost \$6. What was the total cost of the paint?

Write the number

$$6 \times 5 = \$30 \text{ for the paint}$$

5. Andrew and John bought 10 brushes. Each boy held the same number of brushes. Draw the boys with their brushes on the ground in front of them. On each brush write the price. The brushes cost 50 cents each. How many dollars did the boys pay for the brushes?  $\$5.00$

Write the number sentence.

$$50¢ \times 10 = \$5.00 \text{ for the paint brushes}$$

6. How much money did the Club spend in all for all their supplies?  $\$58.00$   
Show your work.

$$\begin{array}{r} \$6 \\ 8 \\ 9 \\ 30 \\ \hline 5 \\ \$58 \end{array}$$

14

15

## Multiplication Facts Chart

X	1	2	3	4	5	6	7	8	9	10
1	1	2	3	4	5	6	7	8	9	10
2	2	4	6	8	10	12	14	16	18	20
3	3	6	9	12	15	18	21	24	27	30
4	4	8	12	16	20	24	28	32	36	40
5	5	10	15	20	25	30	35	40	45	50
6	6	12	18	24	30	36	42	48	54	60
7	7	14	21	28	35	42	49	56	63	70
8	8	16	24	32	40	48	56	64	72	80
9	9	18	27	36	45	54	63	72	81	90
10	10	20	30	40	50	60	70	80	90	100

## Building Times Tables - Worksheet 1

BUILDING TIMES TABLES

I am building the 2 times table.

$$= \boxed{2} \times \boxed{1} = \boxed{2}$$

$$\boxed{2} = \boxed{2} \times \boxed{1} = \boxed{2}$$

$$\boxed{2} + \boxed{2} = \boxed{2} \times \boxed{2} = \boxed{4}$$

$$\boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{3} = \boxed{6}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{4} = \boxed{8}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{5} = \boxed{10}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{6} = \boxed{12}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{7} = \boxed{14}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{8} = \boxed{16}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{9} = \boxed{18}$$

$$\boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} + \boxed{2} = \boxed{2} \times \boxed{10} = \boxed{20}$$

Write each problem in the table here.

$\begin{array}{r} \boxed{2} \\ \times 0 \\ \hline \boxed{0} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 1 \\ \hline \boxed{2} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 2 \\ \hline \boxed{4} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 3 \\ \hline \boxed{6} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 4 \\ \hline \boxed{8} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 5 \\ \hline \boxed{10} \end{array}$
$\begin{array}{r} \boxed{2} \\ \times 6 \\ \hline \boxed{12} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 7 \\ \hline \boxed{14} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 8 \\ \hline \boxed{16} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 9 \\ \hline \boxed{18} \end{array}$	$\begin{array}{r} \boxed{2} \\ \times 10 \\ \hline \boxed{20} \end{array}$	

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## Building Times Tables - Worksheet 2

Patterns in Tables

Count by 2s from 0 to 20.

0 2 4 6 8 10 12 14 16 18 20

Find the answers.

$$2 \times 0 = \underline{0}$$

$$2 \times 1 = \underline{2}$$

$$2 \times 2 = \underline{4}$$

$$2 \times 3 = \underline{6}$$

$$2 \times 4 = \underline{8}$$

$$2 \times 5 = \underline{10}$$

$$2 \times 6 = \underline{12}$$

$$2 \times 7 = \underline{14}$$

$$2 \times 8 = \underline{16}$$

$$2 \times 9 = \underline{18}$$

$$2 \times 10 = \underline{20}$$

$$2 \times 11 = \underline{22}$$

$$2 \times 12 = \underline{24}$$

$$2 \times 13 = \underline{26}$$

$$2 \times 14 = \underline{28}$$

$$2 \times 15 = \underline{30}$$

$$2 \times 16 = \underline{32}$$

$$2 \times 17 = \underline{34}$$

$$2 \times 18 = \underline{36}$$

$$2 \times 19 = \underline{38}$$

$$2 \times 20 = \underline{40}$$

Add the digits of answers

$$\underline{0}$$

$$\underline{2}$$

$$\underline{4}$$

$$\underline{6}$$

$$\underline{8}$$

$$1 (1+0)$$

$$3 (1+2)$$

$$\underline{5}$$

$$\underline{7}$$

$$\underline{9}$$

$$\underline{5}$$

$$\underline{4}$$

$$\underline{6}$$

$$\underline{8}$$

$$\underline{1}$$

$$\underline{3}$$

$$\underline{5}$$

$$\underline{7}$$

$$\underline{9}$$

$$1+1 = \underline{2}$$

$$\underline{4}$$

What patterns do you see in the answers?

All are even numbers.

Each answer is 2 greater than the previous one.

What patterns do you see when you add the digits?

After 0, 2, 4, 6, 8, 1, 3, 5, 7, 9 repeats.

All even numbers in a series, then odd.

Six 2s make 12 Four 2s make 8

Three 2s make 6 Ten 2s make 20

Nine 2s make 18 Eight 2s make 16

Two 2s make 4 Five 2s make 10

Seven 2s make 14 Twelve 2s make 24

Fill in the missing numbers.

20 22 24 26 28 30 32 34 36 38 40

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### Building Times Tables Worksheet 3

BUILDING TIMES TABLES

DATE \_\_\_\_\_

I am building the 3 times table.

$$= 3 \times 0 = 0$$

$$3 = 3 \times 1 = 3$$

$$3 + 3 = 3 \times 2 = 6$$

$$3 + 3 + 3 = 3 \times 3 = 9$$

$$3 + 3 + 3 + 3 = 3 \times 4 = 12$$

$$3 + 3 + 3 + 3 + 3 = 3 \times 5 = 15$$

$$3 + 3 + 3 + 3 + 3 + 3 = 3 \times 6 = 18$$

$$3 + 3 + 3 + 3 + 3 + 3 + 3 = 3 \times 7 = 21$$

$$3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 3 \times 8 = 24$$

$$3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 3 \times 9 = 27$$

$$3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 + 3 = 3 \times 10 = 30$$

Write each problem in the table here.

$\begin{array}{r} 3 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 3 \\ \times 1 \\ \hline 3 \end{array}$	$\begin{array}{r} 3 \\ \times 2 \\ \hline 6 \end{array}$	$\begin{array}{r} 3 \\ \times 3 \\ \hline 9 \end{array}$	$\begin{array}{r} 3 \\ \times 4 \\ \hline 12 \end{array}$	$\begin{array}{r} 3 \\ \times 5 \\ \hline 15 \end{array}$
$\begin{array}{r} 3 \\ \times 6 \\ \hline 18 \end{array}$	$\begin{array}{r} 3 \\ \times 7 \\ \hline 21 \end{array}$	$\begin{array}{r} 3 \\ \times 8 \\ \hline 24 \end{array}$	$\begin{array}{r} 3 \\ \times 9 \\ \hline 27 \end{array}$	$\begin{array}{r} 3 \\ \times 10 \\ \hline 30 \end{array}$	

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### Building Times Tables Worksheet 5

I am building the 4 times tables.

Skip jump by fours to build the four times tables. Circle each multiple of four.

0	1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20	
21	22	23	24	25	26	27	28	29	30	
31	32	33	34	35	36	37	38	39	40	
41	42	43	44	45	46	47	48	49	50	
51	52	53	54	55	56	57	58	59	60	
61	62	63	64	65	66	67	68	69	70	
71	72	73	74	75	76	77	78	79	80	
81	82	83	84	85	86	87	88	89	90	
91	92	93	94	95	96	97	98	99	100	

Write each problem in the table here.

$\begin{array}{r} 4 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 4 \\ \times 1 \\ \hline 4 \end{array}$	$\begin{array}{r} 4 \\ \times 2 \\ \hline 8 \end{array}$	$\begin{array}{r} 4 \\ \times 3 \\ \hline 12 \end{array}$	$\begin{array}{r} 4 \\ \times 4 \\ \hline 16 \end{array}$	$\begin{array}{r} 4 \\ \times 5 \\ \hline 20 \end{array}$
$\begin{array}{r} 4 \\ \times 6 \\ \hline 24 \end{array}$	$\begin{array}{r} 4 \\ \times 7 \\ \hline 28 \end{array}$	$\begin{array}{r} 4 \\ \times 8 \\ \hline 32 \end{array}$	$\begin{array}{r} 4 \\ \times 9 \\ \hline 36 \end{array}$	$\begin{array}{r} 4 \\ \times 10 \\ \hline 40 \end{array}$	

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### Building Times Tables Worksheet 4

Patterns in Tables

Count by 3s from 0 to 30.

0 3 6 9 12 15 18 21 24 27 30

Find the answers.

$3 \times 0 = 0$	$0$
$3 \times 1 = 3$	$3$
$3 \times 2 = 6$	$6$
$3 \times 3 = 9$	$9$
$3 \times 4 = 12$	$12$
$3 \times 5 = 15$	$15$
$3 \times 6 = 18$	$18$
$3 \times 7 = 21$	$21$
$3 \times 8 = 24$	$24$
$3 \times 9 = 27$	$27$
$3 \times 10 = 30$	$30$
$3 \times 11 = 33$	$33$
$3 \times 12 = 36$	$36$
$3 \times 13 = 39$	$39$
$3 \times 14 = 42$	$42$
$3 \times 15 = 45$	$45$

Add the digits of the answers

What patterns do you see in the answers?  
Increase by three.

What patterns do you see when you add the digits?  
After 0; 3, 6, 9 repeats

Six 3s make 18 Four 3s make 12

Three 3s make 9 Ten 3s make 30

Nine 3s make 27 Eight 3s make 24

Two 3s make 6 Five 3s make 15

Seven 3s make 21

Twelve 3s make 36

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### Building Times Tables Worksheet 6

Patterns in Tables

Count by 4s from 0 to 48.

0 4 8 12 16 20 24 28 32 36 40 44 48

Find the answers.

$4 \times 0 = 0$	$0$
$4 \times 1 = 4$	$4$
$4 \times 2 = 8$	$8$
$4 \times 3 = 12$	$12$
$4 \times 4 = 16$	$16$
$4 \times 5 = 20$	$20$
$4 \times 6 = 24$	$24$
$4 \times 7 = 28$	$28$
$4 \times 8 = 32$	$32$
$4 \times 9 = 36$	$36$
$4 \times 10 = 40$	$40$
$4 \times 11 = 44$	$44$
$4 \times 12 = 48$	$48$

Add the digits of the answers

Find as many patterns in the numbers as you can. Write the patterns you find below.

Answers get larger by 4.

0, 4, 8, 2, 6 repeats in ones column.

Answers are all even numbers.

List all the problems in the 3 times tables whose answers are even.

$3 \times 2$   
 $3 \times 4$   
 $3 \times 6$   
 $3 \times 8$   
 $3 \times 10$   
 $3 \times 12$   
 $3 \times 14$

Six 4s make 24 Four 4s make 16

Ten 4s make 40 Eleven 4s make 44

Nine 4s make 36 Eight 4s make 32

Two 4s make 8 Five 4s make 20

Seven 4s make 28 Twelve 4s make 48

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### Building Times Tables Worksheet 7

I am building the 5 times tables.

Tally marks I, II, III, IIII, IIIII are often used to keep track of things in a way that is easy to add up.

$$= \boxed{5 \times 0} = \boxed{0}$$

$$\text{|||||} = \boxed{5 \times 1} = \boxed{5}$$

$$\text{|||||} + \text{|||||} = \boxed{5 \times 2} = \boxed{10}$$

$$\text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 3} = \boxed{15}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 4} = \boxed{20}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 5} = \boxed{25}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 6} = \boxed{30}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 7} = \boxed{35}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 8} = \boxed{40}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 9} = \boxed{45}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{5 \times 10} = \boxed{50}$$

Write each problem in the table here.

$\begin{array}{r} 5 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 5 \\ \times 1 \\ \hline 5 \end{array}$	$\begin{array}{r} 5 \\ \times 2 \\ \hline 10 \end{array}$	$\begin{array}{r} 5 \\ \times 3 \\ \hline 15 \end{array}$	$\begin{array}{r} 5 \\ \times 4 \\ \hline 20 \end{array}$	$\begin{array}{r} 5 \\ \times 5 \\ \hline 25 \end{array}$
$\begin{array}{r} 5 \\ \times 6 \\ \hline 30 \end{array}$	$\begin{array}{r} 5 \\ \times 7 \\ \hline 35 \end{array}$	$\begin{array}{r} 5 \\ \times 8 \\ \hline 40 \end{array}$	$\begin{array}{r} 5 \\ \times 9 \\ \hline 45 \end{array}$	$\begin{array}{r} 5 \\ \times 10 \\ \hline 50 \end{array}$	

### Building Times Tables Worksheet 9

BUILDING TIMES TABLES

I am building the 6 times table.

$$= \boxed{6 \times 0} = \boxed{0}$$

$$\text{|||||} = \boxed{6 \times 1} = \boxed{6}$$

$$\text{|||||} + \text{|||||} = \boxed{6 \times 2} = \boxed{12}$$

$$\text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 3} = \boxed{18}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 4} = \boxed{24}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 5} = \boxed{30}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 6} = \boxed{36}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 7} = \boxed{42}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 8} = \boxed{48}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 9} = \boxed{54}$$

$$\text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} + \text{|||||} = \boxed{6 \times 10} = \boxed{60}$$

Write each problem in the table here.

$\begin{array}{r} 6 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 6 \\ \times 1 \\ \hline 6 \end{array}$	$\begin{array}{r} 6 \\ \times 2 \\ \hline 12 \end{array}$	$\begin{array}{r} 6 \\ \times 3 \\ \hline 18 \end{array}$	$\begin{array}{r} 6 \\ \times 4 \\ \hline 24 \end{array}$	$\begin{array}{r} 6 \\ \times 5 \\ \hline 30 \end{array}$
$\begin{array}{r} 6 \\ \times 6 \\ \hline 36 \end{array}$	$\begin{array}{r} 6 \\ \times 7 \\ \hline 42 \end{array}$	$\begin{array}{r} 6 \\ \times 8 \\ \hline 48 \end{array}$	$\begin{array}{r} 6 \\ \times 9 \\ \hline 54 \end{array}$	$\begin{array}{r} 6 \\ \times 10 \\ \hline 60 \end{array}$	

### Building Times Tables Worksheet 8 Patterns in Tables

Find the answers.

Add the digits of the answers

Find as many patterns in the numbers as you can. Write the patterns you find below.

$5 \times 0 = 0$	$0$
$5 \times 1 = 5$	$5$
$5 \times 2 = 10$	$1$
$5 \times 3 = 15$	$6$
$5 \times 4 = 20$	$2$
$5 \times 5 = 25$	$7$
$5 \times 6 = 30$	$3$
$5 \times 7 = 35$	$8$
$5 \times 8 = 40$	$4$
$5 \times 9 = 45$	$9$
$5 \times 10 = 50$	$5$
$5 \times 11 = 55$	$10=1$
$5 \times 12 = 60$	$6$

Answers: The ones digits are 0,5,0,5... The tens digits get larger by one and the digits repeat twice, e.g., 1,1,2,2,3,3...  
Add digits: Every other number gets larger by one. After 5x0, the sum repeats the pattern, 5,1,6,2,7,3,8,4,9...

List all the problems in the 2 and 4 times table that have the same answers.

What pattern do you see?

$2 \times 2 = 4$	$4 \times 1 = 4$
$2 \times 4 = 8$	$4 \times 2 = 8$
$2 \times 6 = 12$	$4 \times 3 = 12$
$2 \times 8 = 16$	$4 \times 4 = 16$
$2 \times 10 = 20$	$4 \times 5 = 20$
$2 \times 12 = 24$	$4 \times 6 = 24$
$2 \times 14 = 28$	$4 \times 7 = 28$
$2 \times 16 = 32$	$4 \times 8 = 32$
$2 \times 18 = 36$	$4 \times 9 = 36$
$2 \times 20 = 40$	$4 \times 10 = 40$

Six 5s make 30 Four 5s make 30

Ten 5s make 50 Eleven 5s make 55

Nine 5s make 45 Eight 5s make 40

Two 5s make 10 Five 5s make 25

Seven 5s make 35 Twelve 5s make 60

Answers get larger by 4.

### Building Times Tables Worksheet 10 Patterns in Tables

Count by 6s from 0 to 66.

0 6 12 18 24 30 36 42 48 54 60

Find the answers.

Add the digits of the answers

What patterns do you see in the answers?

$6 \times 0 = 0$	$0$
$6 \times 1 = 6$	$6$
$6 \times 2 = 12$	$3$
$6 \times 3 = 18$	$9$
$6 \times 4 = 24$	$6$
$6 \times 5 = 30$	$3$
$6 \times 6 = 36$	$9$
$6 \times 7 = 42$	$6$
$6 \times 8 = 48$	$3$
$6 \times 9 = 54$	$9$
$6 \times 10 = 60$	$6$
$6 \times 11 = 66$	$3$
$6 \times 12 = 72$	$9$

0, 6, 2, 8, 4 repeats in the ones place

All answers are even numbers.

What patterns do you see when you add the digits?

6, 3, 9 repeats after zero

Fill in the missing numbers.

18 24 30 36 42 48 54 60 66 72

Make yourself a test on another piece of paper.

In mixed-up order, write all the problems of the 3, 4, and 5 times tables.

Then write in all of the answers.

Six 6s make 36 Four 6s make 24 Seven 6s make 42 Twelve 6s make 72

Ten 6s make 60 Three 6s make 18 Nine 6s make 54 Eight 6s make 48

Two 6s make 12 Five 6s make 30 Zero 6s make 0 Eleven 6s make 66

## Building Times Tables Worksheet 11

BUILDING TIMES TABLES

I am building the 7 times table.

$$= 7 \times 0 = 0$$

$$7 = 7 \times 1 = 7$$

$$7 + 7 = 7 \times 2 = 14$$

$$7 + 7 + 7 = 7 \times 3 = 21$$

$$7 + 7 + 7 + 7 = 7 \times 4 = 28$$

$$7 + 7 + 7 + 7 + 7 = 7 \times 5 = 35$$

$$7 + 7 + 7 + 7 + 7 + 7 = 7 \times 6 = 42$$

$$7 + 7 + 7 + 7 + 7 + 7 + 7 = 7 \times 7 = 49$$

$$7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 = 7 \times 8 = 56$$

$$7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 = 7 \times 9 = 63$$

$$7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 + 7 = 7 \times 10 = 70$$

Write each problem in the table here.

$\begin{array}{r} 7 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 7 \\ \times 1 \\ \hline 7 \end{array}$	$\begin{array}{r} 7 \\ \times 2 \\ \hline 14 \end{array}$	$\begin{array}{r} 7 \\ \times 3 \\ \hline 21 \end{array}$	$\begin{array}{r} 7 \\ \times 4 \\ \hline 28 \end{array}$	$\begin{array}{r} 7 \\ \times 5 \\ \hline 35 \end{array}$
$\begin{array}{r} 7 \\ \times 6 \\ \hline 42 \end{array}$	$\begin{array}{r} 7 \\ \times 7 \\ \hline 49 \end{array}$	$\begin{array}{r} 7 \\ \times 8 \\ \hline 56 \end{array}$	$\begin{array}{r} 7 \\ \times 9 \\ \hline 63 \end{array}$	$\begin{array}{r} 7 \\ \times 10 \\ \hline 70 \end{array}$	

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## Building Times Tables Worksheet 13

I am building the 8 times tables.

Skip jump by eight to build the eight times tables. Circle each multiple of eight.

0	1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20	
21	22	23	24	25	26	27	28	29	30	
31	32	33	34	35	36	37	38	39	40	
41	42	43	44	45	46	47	48	49	50	
51	52	53	54	55	56	57	58	59	60	
61	62	63	64	65	66	67	68	69	70	
71	72	73	74	75	76	77	78	79	80	
81	82	83	84	85	86	87	88	89	90	
91	92	93	94	95	96	97	98	99	100	

Write each problem in the table here.

$\begin{array}{r} 8 \\ \times 0 \\ \hline 0 \end{array}$	$\begin{array}{r} 8 \\ \times 1 \\ \hline 8 \end{array}$	$\begin{array}{r} 8 \\ \times 2 \\ \hline 16 \end{array}$	$\begin{array}{r} 8 \\ \times 3 \\ \hline 24 \end{array}$	$\begin{array}{r} 8 \\ \times 4 \\ \hline 32 \end{array}$	$\begin{array}{r} 8 \\ \times 5 \\ \hline 40 \end{array}$
$\begin{array}{r} 8 \\ \times 6 \\ \hline 48 \end{array}$	$\begin{array}{r} 8 \\ \times 7 \\ \hline 56 \end{array}$	$\begin{array}{r} 8 \\ \times 8 \\ \hline 64 \end{array}$	$\begin{array}{r} 8 \\ \times 9 \\ \hline 72 \end{array}$	$\begin{array}{r} 8 \\ \times 10 \\ \hline 80 \end{array}$	

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## Building Times Tables Worksheet 12

Patterns in Tables

Count by 7s from 0 to 77.

0 7 14 21 28 35 42 49 56 63 70 77

Find the answers.

$7 \times 0 = 0$	$7$
$7 \times 1 = 7$	$7$
$7 \times 2 = 14$	$5$
$7 \times 3 = 21$	$3$
$7 \times 4 = 28$	$10 \div 1$
$7 \times 5 = 35$	$8$
$7 \times 6 = 42$	$6$
$7 \times 7 = 49$	$13 \div 4$
$7 \times 8 = 56$	$11 \div 2$
$7 \times 9 = 63$	$9$
$7 \times 10 = 70$	$7$
$7 \times 11 = 77$	$14 \div 5$
$7 \times 12 = 84$	$12 \div 3$

Add the digits of the answers

Find as many patterns in the numbers as you can. Write the patterns you find below.

7, 5, 3, 1, 8, 6, 4, 2  
repeats in sums of digits after zero.

After zero the sums are 4 odd numbers, then 4 even numbers. All are decreasing by 2.

Fill in the missing numbers.

0 7 14 28 35 42 49 56 63 70

List all the problems in the 2, 3 and 6 times table that share the same answers.

See any patterns? Answers are all the six times tables.

Six 7s make 42 Four 7s make 28 Seven 7s make 49 Twelve 7s make 84  
 Ten 7s make 70 Three 7s make 21 Nine 7s make 63 Eight 7s make 56  
 Two 7s make 14 Five 7s make 35 Zero 7s make 0 Eleven 7s make 77  
 $2 \times 6 = 12$   $2 \times 3 = 6$   $2 \times 9 = 18$   $2 \times 12 = 24$   $2 \times 15 = 30$   $2 \times 18 = 36$   
 $3 \times 4 = 12$   $3 \times 2 = 6$   $3 \times 6 = 18$   $3 \times 8 = 24$   $3 \times 10 = 30$   $3 \times 12 = 36$   
 $6 \times 2 = 12$   $6 \times 1 = 6$   $6 \times 3 = 18$   $6 \times 4 = 24$   $6 \times 5 = 30$   $6 \times 6 = 36$

## Building Times Tables Worksheet 14

Patterns in Tables

Count by 8s from 0 to 88.

0 8 16 24 32 40 48 56 64 72 80 88

Find the answers.

$8 \times 0 = 0$	$0$
$8 \times 1 = 8$	$8$
$8 \times 2 = 16$	$7$
$8 \times 3 = 24$	$6$
$8 \times 4 = 32$	$5$
$8 \times 5 = 40$	$4$
$8 \times 6 = 48$	$3$
$8 \times 7 = 56$	$2$
$8 \times 8 = 64$	$1$
$8 \times 9 = 72$	$4$
$8 \times 10 = 80$	$8$
$8 \times 11 = 88$	$7$
$8 \times 12 = 96$	$6$

Add the digits of the answers

Find as many patterns in the numbers as you can. Write the patterns you find below.

Answers: In the ones place 0, 8, 6, 4, 2 repeats. In the tens place 1, 2, 3, 4, 4 then 5, 6, 7, 8, 8. Numbers go up by one then the 4<sup>th</sup> digit is repeated.

Sum of the digits decrease by one.

Fill in the missing numbers.

96 88 80 72 64 56 48 40 32 24

Write two multiplication word problems that use number sentences from the seven times table. AWV

Six 8s make 48 Four 8s make 32 Seven 8s make 56 Twelve 8s make 96  
 Ten 8s make 80 Three 8s make 24 Nine 8s make 72 Eight 8s make 64  
 Two 8s make 16 Five 8s make 40 Zero 8s make 0 Eleven 8s make 88

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## Building Times Tables Worksheet 15

BUILDING TIMES TABLES

I am building the 9 times table.

$$\begin{aligned}
 &= \boxed{9} \times \boxed{0} = \boxed{0} \\
 \boxed{9} &= \boxed{9} \times \boxed{1} = \boxed{9} \\
 \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{2} = \boxed{18} \\
 \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{3} = \boxed{27} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{4} = \boxed{36} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{5} = \boxed{45} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{6} = \boxed{54} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{7} = \boxed{63} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{8} = \boxed{72} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{9} = \boxed{81} \\
 \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} + \boxed{9} &= \boxed{9} \times \boxed{10} = \boxed{90}
 \end{aligned}$$

Write each problem in the table here.

$\begin{array}{r} \boxed{9} \\ \times \boxed{0} \\ \hline \boxed{0} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{1} \\ \hline \boxed{9} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{2} \\ \hline \boxed{18} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{3} \\ \hline \boxed{27} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{4} \\ \hline \boxed{36} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{5} \\ \hline \boxed{45} \end{array}$
$\begin{array}{r} \boxed{9} \\ \times \boxed{6} \\ \hline \boxed{54} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{7} \\ \hline \boxed{63} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{8} \\ \hline \boxed{72} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{9} \\ \hline \boxed{81} \end{array}$	$\begin{array}{r} \boxed{9} \\ \times \boxed{10} \\ \hline \boxed{90} \end{array}$	

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## Building Times Tables Worksheet 17

BUILDING TIMES TABLES

I am building the 10 times table.

$$\begin{aligned}
 &= \boxed{10} \times \boxed{0} = \boxed{0} \\
 \boxed{10} &= \boxed{10} \times \boxed{1} = \boxed{10} \\
 \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{2} = \boxed{20} \\
 \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{3} = \boxed{30} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{4} = \boxed{40} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{5} = \boxed{50} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{6} = \boxed{60} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{7} = \boxed{70} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{8} = \boxed{80} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{9} = \boxed{90} \\
 \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} + \boxed{10} &= \boxed{10} \times \boxed{10} = \boxed{100}
 \end{aligned}$$

Write each problem in the table here.

$\begin{array}{r} \boxed{10} \\ \times \boxed{0} \\ \hline \boxed{0} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{1} \\ \hline \boxed{10} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{2} \\ \hline \boxed{20} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{3} \\ \hline \boxed{30} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{4} \\ \hline \boxed{40} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{5} \\ \hline \boxed{50} \end{array}$
$\begin{array}{r} \boxed{10} \\ \times \boxed{6} \\ \hline \boxed{60} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{7} \\ \hline \boxed{70} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{8} \\ \hline \boxed{80} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{9} \\ \hline \boxed{90} \end{array}$	$\begin{array}{r} \boxed{10} \\ \times \boxed{10} \\ \hline \boxed{100} \end{array}$	

32

## Building Times Tables Worksheet 16

Patterns in Tables

Count by 9s from 0 to 99.

0 9 18 27 36 45 54 63 72 81 90 99

Find the answers.

$9 \times 0 =$	<u>0</u>
$9 \times 1 =$	<u>9</u>
$9 \times 2 =$	<u>18</u>
$9 \times 3 =$	<u>27</u>
$9 \times 4 =$	<u>36</u>
$9 \times 5 =$	<u>45</u>
$9 \times 6 =$	<u>54</u>
$9 \times 7 =$	<u>63</u>
$9 \times 8 =$	<u>72</u>
$9 \times 9 =$	<u>81</u>
$9 \times 10 =$	<u>90</u>
$9 \times 11 =$	<u>99</u>
$9 \times 12 =$	<u>108</u>

Add the digits of the answers

<u>0</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>
<u>9</u>

What patterns do you see in the answers?  
Factors added together equal nine.  
Tens digits is one less than the factor except if the factor is not a nine.

What patterns do you see when you the digits?  
All answers equal nine.

Fill in the missing numbers.

9 18 27 36 45 54 63 72 81 90

Make a list of all the problems in the 2, 4 and 8 times tables that share the same answers.

Describe the pattern. Answers are the 8 times tables.

Six 9s make <u>54</u>	Four 9s make <u>36</u>	Seven 9s make <u>63</u>	Twelve 9s make <u>108</u>
Ten 9s make <u>90</u>	Three 9s make <u>27</u>	Nine 9s make <u>81</u>	Eight 9s make <u>72</u>
Two 9s make <u>18</u>	Five 9s make <u>45</u>	Zero 9s make <u>0</u>	Eleven 9s make <u>99</u>

$2 \times 4 = 8$	$2 \times 8 = 16$	$2 \times 12 = 24$	$2 \times 16 = 32$
$4 \times 2 = 8$	$4 \times 4 = 16$	$4 \times 6 = 24$	$4 \times 8 = 32$
$8 \times 1 = 8$	$8 \times 2 = 16$	$8 \times 3 = 24$	$8 \times 4 = 32$

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## Building Times Tables Worksheet 18

Patterns in Tables

Find the answers.

$10 \times 0 =$	<u>0</u>
$10 \times 1 =$	<u>10</u>
$10 \times 2 =$	<u>20</u>
$10 \times 3 =$	<u>30</u>
$10 \times 4 =$	<u>40</u>
$10 \times 5 =$	<u>50</u>
$10 \times 6 =$	<u>60</u>
$10 \times 7 =$	<u>70</u>
$10 \times 8 =$	<u>80</u>
$10 \times 9 =$	<u>90</u>
$10 \times 10 =$	<u>100</u>
$10 \times 11 =$	<u>110</u>
$10 \times 12 =$	<u>120</u>
$10 \times 13 =$	<u>130</u>
$10 \times 14 =$	<u>140</u>
$10 \times 15 =$	<u>150</u>
$10 \times 16 =$	<u>160</u>
$10 \times 17 =$	<u>170</u>
$10 \times 18 =$	<u>180</u>
$10 \times 19 =$	<u>190</u>
$10 \times 20 =$	<u>200</u>
$10 \times 21 =$	<u>210</u>
$10 \times 22 =$	<u>220</u>
$10 \times 23 =$	<u>230</u>
$10 \times 24 =$	<u>240</u>

Add the digits of the answers

<u>0</u>
<u>1</u>
<u>2</u>
<u>3</u>
<u>4</u>
<u>5</u>
<u>6</u>
<u>7</u>
<u>8</u>
<u>9</u>
<u>1</u>
<u>2</u>
<u>3</u>
<u>4</u>
<u>5</u>
<u>6</u>
<u>7</u>
<u>8</u>
<u>9</u>
<u>1</u>
<u>2</u>
<u>3</u>
<u>4</u>
<u>5</u>
<u>6</u>

Find as many patterns in the numbers as you can.  
 Write the patterns you find below.

All answers end in zero.  
1, 2, 3, 4, 5, 6, 7, 8, 9, 0 is repeated in tens place.  
Add digits: 1, 2, 3, 4, 5, 6, 7, 8, 9 is repeated.  
Tens digits increase by one.

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### Finding Patterns in Tables - Worksheet 1

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

34

### Properties of Multiplication - Worksheet 1

Find the products or factors. Look for a pattern.

$$0 \times 7 = 0$$

$$1 \times 0 = 0$$

$$4 \times 0 = 0$$

$$0 \times 1 = 0$$

$$9 \times 0 = 0$$

$$2 \times 0 = 0$$

Make your own. **AWV**

$$0 \times 3 = 0$$

$$\bigcirc \times \bigcirc = 0$$

Write a sentence about something you discovered

All answers are zero. Zero times any number is zero.

Find the products or factors. Look for a pattern.

$$1 \times 8 = 8$$

$$1 \times 1 = 1$$

$$3 \times 1 = 3$$

$$1 \times 12 = 12$$

$$9 \times 1 = 9$$

$$2 \times 1 = 2$$

$$1 \times 2 = 2$$

$$13 \times 1 = 13$$

Write a sentence about something you discovered

Any number multiplied by one equals that number.

38

### Finding Patterns in Tables - Worksheet 2

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

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### Properties of Multiplication - Worksheet 2

Fill in the blanks to make the number sentences correct.

Product

18

$$3 \times 6 = 6 \times 3$$

14

$$2 \times 7 = 7 \times 2$$

12

$$4 \times 3 = 3 \times 4$$

36

$$4 \times 9 = 9 \times 4$$

32

$$8 \times 4 = 4 \times 8$$

Write a sentence about something you found out.

Changing the order doesn't change the answer when two numbers are multiplied together.

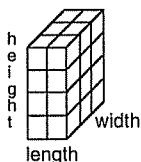
40



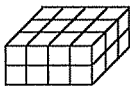
### Associative Property - Worksheet 1

Take out a set of linking blocks.  
Build a figure that is two blocks long, three blocks wide and four blocks high. It will look something like this:

This figure is called a rectangular solid. It's a three dimensional or 3D rectangle. In these lessons the size of the sides are always listed in this order: length, width, height. This solid would be called 2 by 3 by 4.



How many blocks did you use to build this rectangular solid? 24



Now build this solid.

This one is a 4 by 3 by 2.

How many blocks will this solid take?

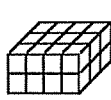
guess AWV actual 24

Compare the number of blocks you used for the first solid to the number of blocks you used in the second solid. What did you find out?

Arrange the solid another way. Draw a picture of your model. It could be     by     by    . AWV



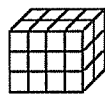
$2 \times 4 \times 3$



$4 \times 3 \times 2$



$3 \times 4 \times 2$



$4 \times 2 \times 3$

What changes when you change the arrangement of the numbers?

The shape of the rectangular solid.

What does not change? The total number of blocks.

41

### Associative Property - Worksheet 3

Fill in the blanks to make the number sentences correct.

Product

24      $(3) \times (2) \times (4) = (2) \times (4) \times (3)$

16      $(2) \times (4) \times (2) = (4) \times (2) \times (2)$

12      $(1) \times (2) \times (6) = (2) \times (1) \times (6)$

36      $(2) \times (9) \times (2) = (2) \times (2) \times (9)$

32      $(8) \times (1) \times (4) = (1) \times (4) \times (8)$

Write a sentence about something you found out.

The order can change with three numbers but the answer stays the same.

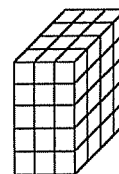
43

### Associative Property - Worksheet 2

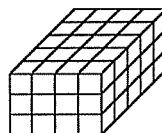
Build another rectangular solid like this: length 3 by 4 by 5 width 4 height 5

How many blocks will it take to build this new solid?

guess AWV actual 60



Now build this solid.



This one is a 4 by 5 by 3.

How many blocks will this solid take?

guess     actual 60

length 4 width 5 height 3

Arrange the solid another way. Draw a picture of your model.

It could be 5 by 4 by 3.

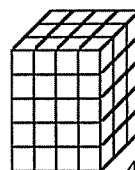
Drawing not shown.

length     width     height    

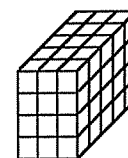
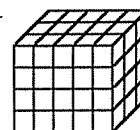
How many blocks will this one take?

guess     actual 60

$5 \times 3 \times 4$



$4 \times 3 \times 5$



$3 \times 5 \times 4$

42

### Associative Property - Worksheet 4

In math language, mathematicians often use parentheses ( ) to show what numbers to solve first.

$(2 \times 4) \times 5 = 40$

$(2 \times 3) \times 4 =$  means multiply 2 x 3 first to get 6.

6 x 4 = now multiply the 6 times the 4 to get 24.

Do these.  $(3 \times 4) \times 2 = 24$       $(4 \times 2) \times 3 = 24$

Find all three ways of associating these three numbers. 3, 4, 5  
The first one is done for you.

$(3 \times 4) \times 5 = 60$       $(5 \times 3) \times 4 = 60$

$(4 \times 5) \times 3 = 60$

Let's do it again with different numbers.  $2 \times 4 \times 5 = 40$

$(2 \times 4) \times 5 = 40$      Again.      $(2 \times 5) \times 4 = 40$   
 $2 \times 4 = 8$       $2 \times 5 = 10$   
 $8 \times 5 = 40$       $10 \times 4 = 40$

Solve it again. These are in a different order:

$(4 \times 5) \times 2 = 40$   
 $4 \times 5 = 20$   
 $20 \times 2 = 40$

What do you notice about the answers? They are all the same.

44

## Associative Property - Worksheet 5

Solve these problems. Remember do what is in the parentheses ( ) first.  
Now you will do it like this:

$$(6 \times 4) \times 2 = \underline{\quad}$$

$$24 \times 2 = 48$$

Solve these.

$$(2 \times 4) \times 6 = \underline{\quad} \quad (2 \times 6) \times 4 = \underline{\quad}$$

$$\underline{8} \times 6 = \underline{48} \quad \underline{12} \times 4 = \underline{48}$$

Again, what pattern do you see in the answers? They are the same.

Sometimes one order is easier than another, Pay attention to which order is easiest for you. You may need to use addition to get some answers.

$$(3 \times 6) \times 2 = \underline{\quad}$$

$$\underline{18} \times 2 = \underline{36}$$

$$(2 \times 3) \times 6 = \underline{\quad} \quad (2 \times 6) \times 3 = \underline{\quad}$$

$$\underline{6} \times 6 = \underline{36} \quad \underline{12} \times 3 = \underline{36}$$

Circle the one which was the easiest for you. AWV

Set 1

$$(5 \times 6) \times 2 = \underline{\quad}$$

$$\underline{30} \times 2 = \underline{60}$$

$$(2 \times 6) \times 5 = \underline{\quad}$$

$$\underline{12} \times 5 = \underline{60}$$

$$(2 \times 5) \times 6 = \underline{\quad}$$

$$\underline{10} \times 6 = \underline{60}$$

Set 2

$$(3 \times 7) \times 2 = \underline{\quad}$$

$$\underline{21} \times 2 = \underline{42}$$

$$(2 \times 7) \times 3 = \underline{\quad}$$

$$\underline{14} \times 3 = \underline{42}$$

$$(3 \times 2) \times 7 = \underline{\quad}$$

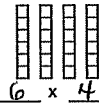
$$\underline{6} \times 7 = \underline{42}$$

Circle the one which was the easiest for you in each set. AWV

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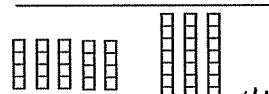
## Uneven Stacks

Write the multiplication problem and solve it.

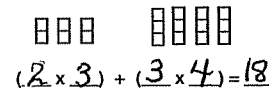


$$6 + 6 + 6 + 6 = \underline{24}$$

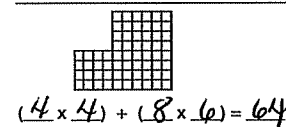
$$\underline{6} \times \underline{4} = \underline{24}$$



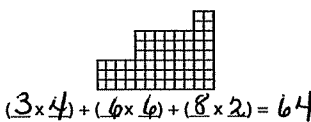
$$(4 \times 5) + (7 \times 3) = \underline{41}$$



$$(2 \times 3) + (3 \times 4) = \underline{18}$$



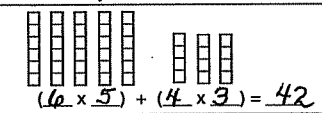
$$(4 \times 4) + (8 \times 6) = \underline{64}$$



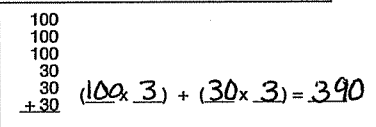
$$(3 \times 4) + (6 \times 6) + (8 \times 2) = \underline{64}$$

$$5 + 5 + 5 + 5 + 8 + 8 + 8 + 8 + 8 = \underline{60}$$

$$(5 \times 4) + (8 \times 5) = \underline{60}$$



$$(6 \times 5) + (4 \times 3) = \underline{42}$$



$$(100 \times 3) + (30 \times 3) = \underline{390}$$


↓ Draw  $(2 \times 4) + (7 \times 3) = \underline{29}$



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## Factoring: Manipulative - Worksheet 1

You will need tiles and a pencil.

Start with nine tiles. Make a  $3 \times 3$  array with the tiles 

Record the same size array on the grid. Label the array.

Use the tiles to build all the different arrays with nine tiles. All the rows have to be even. Record and label each array on the grid.

Make more arrays with ten, eleven, twelve, eighteen, twenty, and twenty-four tiles.

Choose three numbers to make your own arrays.

**9 tiles**

**10 tiles**

**11 tiles**

**12 tiles**

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## Factoring: Manipulative - Worksheet 2

**18 tiles**

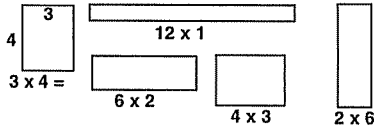
**20 tiles**

**24 tiles**

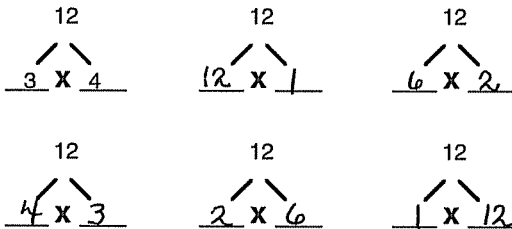
48

### Factoring: Recording - Worksheet 1

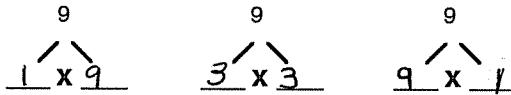
Build all the possible arrays using twelve tiles. Record the arrays on the grid paper. Write the multiplication number sentence for each array.



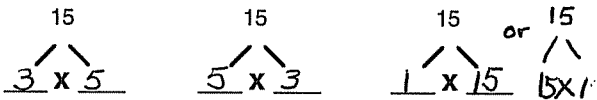
Write all the factors for twelve.



Write the factors for nine.



Write the factors for fifteen.



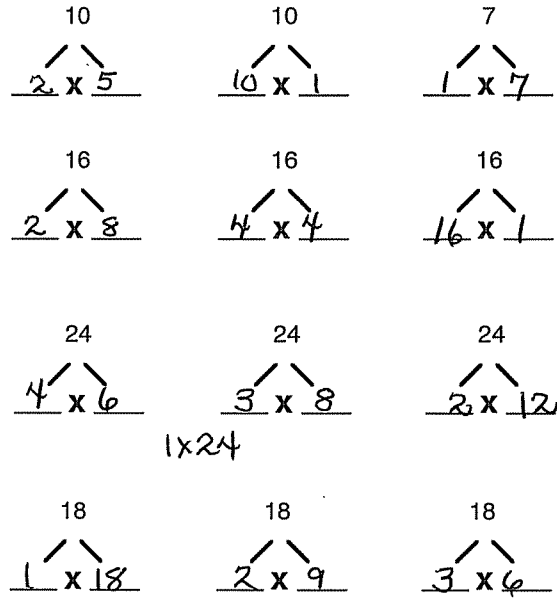
### Multiplication by Addition

Solve by addition.

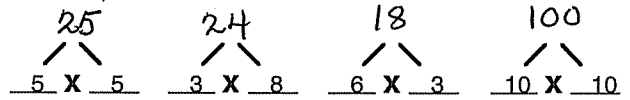
$\begin{array}{r} 23 \\ \times 4 \\ \hline 92 \end{array}$	$\begin{array}{r} 48 \\ \times 7 \\ \hline 336 \end{array}$	$\begin{array}{r} 146 \\ \times 7 \\ \hline 1,022 \end{array}$
$\begin{array}{r} 63 \\ \times 5 \\ \hline 315 \end{array}$	$\begin{array}{r} 70 \\ \times 6 \\ \hline 420 \end{array}$	$\begin{array}{r} 162 \\ \times 8 \\ \hline 1,296 \end{array}$
$\begin{array}{r} 27 \\ \times 5 \\ \hline 135 \end{array}$	$\begin{array}{r} 28 \\ \times 3 \\ \hline 84 \end{array}$	$\begin{array}{r} 175 \\ \times 5 \\ \hline 875 \end{array}$
$\begin{array}{r} 58 \\ \times 6 \\ \hline 348 \end{array}$	$\begin{array}{r} 34 \\ \times 8 \\ \hline 272 \end{array}$	$\begin{array}{r} 1,253 \\ \times 5 \\ \hline 6,265 \end{array}$

### Factoring: Recording - Worksheet 2

Factor these numbers.



Write the products of these numbers.



### Pre-Assessment - Part 1 and 2 and Post-Assessment

1. Solve. a.  $4 + 5 + 6 = 15$  b.  $4 + 4 + 4 + 4 + 4 = 20$  c.  $13 + 13 + 13 = 39$

Pre-Assessment - Part 2

1. What multiplication problem is shown in each picture?  
 a.  $4 \times 5 = 20$   
 b.  $5 \times 3 = 15$

2. a. Draw a picture of  $3 \times 4$ . b. Show  $3 \times 4$  as an addition problem.  
 $3 + 3 + 3 + 3 = 12$

3. Solve these problems.  
a.  $3 \times 2 = 6$  b.  $6 \times 4 = 24$  c.  $7 \times 3 = 21$  d.  $2 \times 3 \times 4 = 24$   
e.  $5 \times 7 \times 0 = 0$

4. Use addition to solve.  
a.  $14 \times 5 = 70$  b.  $25 \times 4 = 100$  c.  $32 \times 6 = 192$

5. Write a word problem that uses the problem  $6 \times 3 = 18$ .  
Answer will be unique.

6. Factor these numbers.

a.  $15 = 3 \times 5 = 15 \times 1$

b.  $24 = 4 \times 6 = 3 \times 8 = 2 \times 12 = 24 \times 1$

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ISBN 978-1-935559-88-7

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