Teacher Guide: Critter Count

Learning Objectives

Students will…

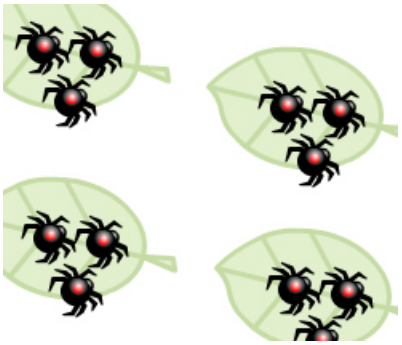
- Understand what is meant by a multiplication expression, such as 2 × 3.
- Model a multiplication expression using groups or an array.
  - State the multiplication expression that matches an array or diagram of equal groups.
- Model a multiplication expression as repeated addition: 4 × 3 = 3 + 3 + 3 + 3.
- Show that the commutative property applies to all multiplication problems.

Vocabulary

array, commutative property, factor, multiple, multiplication, product

Lesson Overview

The *Critter Count* Gizmo™ allows the student to see what multiplication means. A multiplication expression is modeled as repeated groups (bugs on leaves) or as an array. A counting animation shows students that a multiplication expression actually represents repeated addition.



4 groups of 3 spiders (4 × 3)

The Student Exploration sheet contains two activities:

- Activity A – Students model multiplication expressions by placing equal groups of critters on leaves.
- Activity B – Students model multiplication as an array and demonstrate the commutative property of multiplication.

Suggested Lesson Sequence

1. **Pre-Gizmo activity** (10 – 20 minutes)
   At lunchtime, bring your students to the school cafeteria. Ask your students to come up with different ways of counting how many students are eating in the cafeteria. Counting students one-by-one would probably be quite time consuming; is there a shortcut? There are many ideas that could work, but some ideas will probably involve counting the tables and estimating how many students are at each table. That solution is very similar to the scenario presented in the *Counting Critters* Gizmo.

2. **Prior to using the Gizmo** (10 – 15 minutes)
   Before students are at the computers, pass out the Student Exploration sheets and ask students to complete the Prior Knowledge Questions. Discuss student answers as a class. At this point, letting students share how they thought about the questions is more valuable than "going over" the correct answers. After the discussion, if possible, use a projector to introduce the Gizmo and demonstrate its basic operations.

3. **Gizmo activity** (15 – 20 minutes per activity)
   Assign students to computers. Students can work individually or in small groups. Have students work part of the Student Exploration sheet using the Gizmo. Alternatively, you can use a projector and do the Exploration as a teacher-led activity.

   It may be overwhelming for students to do all of the activities in the Student Exploration in one sitting. We recommend starting with the first page of the Student Exploration sheet (Prior Knowledge Questions and Gizmo Warm-up) plus one of the two activities. Extend the lesson if you want using the extensions below. Return to the Gizmo and the unused activities in future class periods to reinforce the concepts.

4. **Extending the Gizmo** (15 – 20 minutes each)
   Here are some suggestions for extending the activities in the Student Exploration sheet.

   Activity A Extension – Present the Gizmo to your class on a projector. Turn off the **Show multiplication** checkbox, and use the sliders to model a multiplication problem as a set of groups. Ask your students to identify the multiplication problem that is being modeled. Then turn off the **Show total** checkbox and press **Count**. Have your students count along as the critters are highlighted. (This is called **skip counting**.)

   Activity B Extension – Discuss how the array model relates to the commutative property. Compare an array that has 3 rows and 5 columns to one with 5 rows and 3 columns. Do the two arrays have the same number of bugs? Ask your students whether the commutative property applies to the other basic operations such as addition, subtraction, or division. (In fact, the commutative property applies to addition but not to subtraction or division – for example, 6 – 3 is not equal to 3 – 6, and 6 ÷ 3 is not equal to 3 ÷ 6.)

5. **Follow-up activity: Rectangles** (30 – 40 minutes)
   Displaying a multiplication problem as an array leads naturally to a discussion of the area of rectangles. Pass out sheets of graph paper, and ask students to mark off rectangles on the paper. Ask students to find the area of each rectangle by counting the squares. Then ask the students if there are easier ways of determining the area than counting squares. Students will discover that the area of the rectangle is equal to the length multiplied by the height. (This is a useful connection to make, as it will allow any multiplication problem to be envisioned as a rectangle, with the product being the rectangle's area.)

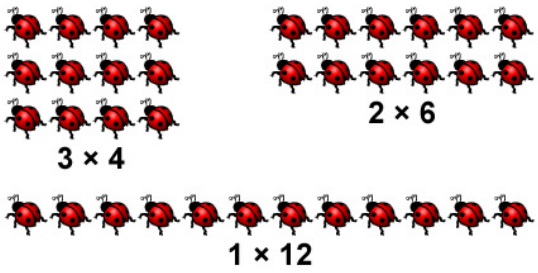
Mathematical Background

Learning the "times tables" is a task that every student must master to have success in math. But as students practice with flash cards, timed tests, songs, riddles, and other memorization techniques, it is important to emphasize what multiplication actually means. Multiplication is shorthand for repeated addition of a number. So the expression 4 × 3 means "four groups of three," or 3 + 3 + 3 + 3.

The *Counting Critters* Gizmo presents three equivalent ways of modeling a multiplication expression. The first shows critters grouped on leaves, so that 4 × 3 is represented by four leaves and three critters per leaf. The second is an array, so that 4 × 3 is modeled by four rows of three critters. The third is repeated addition, which is shown when the **Count** button is pressed. Each model will help students visualize what multiplication actually represents.

Modeling multiplication as an array leads to a variety of other topics, such as finding the area of a rectangle, finding the factors of a number, and modeling partial products.

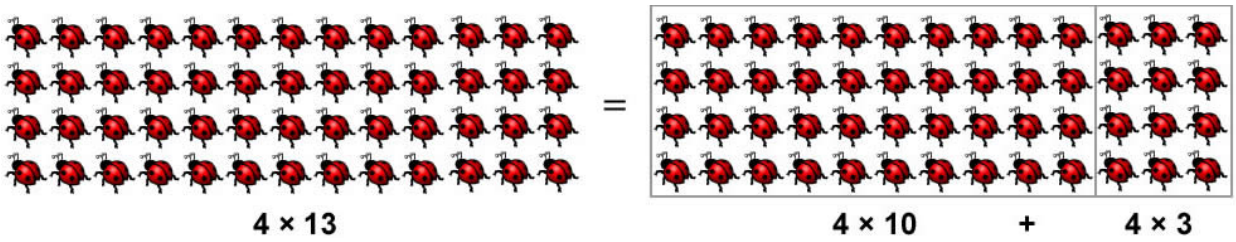
The **factors** of a number are all the numbers that divide into the number evenly (no remainder). You can use the *Critter Count* Gizmo to explore factors. For example, you can challenge students to create as many different arrays with 12 critters as they can find. As the arrays at right show, the factors of 12 are 1, 2, 3, 4, 6, and 12. (Note: It is not possible to model 1 × 12 in the Gizmo.)



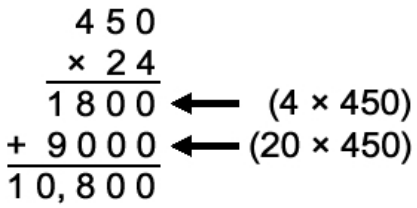
Array models can also illustrate partial products. The **distributive law** states that

$$a(b + c) = ab + ac$$

In this case, the two products "ab" and "ac" are the **partial products**. For example, consider 4 × 13, which is rewritten 4(10 + 3). By the distributive law, this is equal to (4 × 10) + (4 × 3), or 40 + 12 = 52. This can be illustrated with array models. The array on the left shows 4 × 13. This can be subdivided into the 4 × 10 and 4 × 3 arrays shown on the right.



The standard algorithm for two-digit multiplication, shown at right, is based on the concept of partial products. Consider the product of 450 × 24. To multiply 450 × 24 using the standard algorithm, first multiply 4 × 450 (1,800), and then multiply 20 × 450 (9,000). Add the two partial products to get the answer, 10,800.



Selected Web Resources

Multiplication games and activities: http://www.multiplication.com/
Teaching multiplication: http://www.mathcats.com/grownupcats/ideabankmultiplication.html
Teaching tips: http://curriculalessons.suite101.com/article.cfm/teaching_multiplication
More teaching tips: http://teachersmentor.com/math/math_facts.html
Partial products:
http://www.phila.k12.pa.us/offices/curriculum/supports/2007/math/partial_products.ppt