Notes for the Teacher

Students explore multiplication as a scaling operation to learn and practice multiplication facts up to 10 × 10. Using groups of replicating bugs as visual models of multiplication helps students understand multiplication as the scaling of one number by another. As they progress, students develop strategies for finding products.

Objectives:

- Students will use a scaling model to explore multiplication.
- Students will develop strategies for computing up to 10 × 10.

Common Core Mathematical Practices: (1) Make sense of problems and persevere in solving them; (2) Reason abstractly and quantitatively; (3) Construct viable arguments and critique the reasoning of others; (5) Use appropriate tools strategically; (7) Look for and make use of structure.

Common Core State Content Standards: 3.OA1, 3, 5, 7; 4.OA1

Grade Range: Grades 3–4

Introduce:

Open **Bug Multiplication--Multiplication as Scaling.gsp,** and distribute the worksheet. Use a projector to show sketch page "Bugs." Ask, "How many bugs are there?" (10 bugs) Demonstrate how to use the **Arrow** tool to highlight 0 and use the keyboard to enter 10 in the edit box below the question *How many bugs at first?* Then click anywhere on the screen to see if the answer is correct. ("Yes!" will appear if the answer is correct; "Oops. Please count again." will appear if it is not correct.)

Now use the **Arrow** tool to press the *Multiply!* button. Each of the 10 bugs slowly splits into 5 bugs (This represents the *multiplier* shown in the upper-right corner of the sketch.) Ask students to describe in their own words what just happened. Then ask, "What number did the bugs multiply by?" (5) Show students how to enter this number in the edit box below the question and to click anywhere in the sketch to check the answer.

Continue by pressing the *Scatter!* button with the **Arrow** tool. All the bugs will "fly" randomly across the screen. Then ask, "What is the total number of bugs?" (50 bugs) Some students may realize that they are finding the answer to 10 × 5; others may need to see the bugs in groups of 5 again. To show this, use the **Arrow** tool to press the *Fly home!* button. All the bugs will return to their original grouping—10 groups of 5 bugs each. After all students agree on a total number of bugs (using strategies such as

multiplying, adding, skip counting, or counting individual bugs), enter the number in the edit box below the question *How many bugs do they make?* Click anywhere on the screen to check the answer. Then write 10 × 5 = 35 on the board, and say, "We can represent what happened with this equation. 10 bugs each multiplied 5 times produce a total of 50 bugs."

Explain that if students get any of the numbers in the edit boxes incorrect, they can enter a new number without penalty.

Once the problem is done, use the **Arrow** tool to press the *Next Problem* button. A new number of bugs appear. They automatically split into groups of 5 bugs each and then "fly" around the screen. Students don't need to press the *Multiply!* button this time. There are 10 random problems in all, ranging from 1 × 5 to 10 × 5. Each problem is worth 10 points. The points are awarded after the correct number of total bugs is entered.

Demonstrate how to make a new game that covers different sets of multiplication facts by changing the value of the multiplier in the top-right corner of the sketch and pressing the *New Game* button. [Note: If the multiplier is greater than 10, students may have difficulty counting the number of bugs in each group.]

Demonstrate how to answer several problems, or have volunteers come to the computer and answer the problems. Be sure students understand how to play the game before you send them off to the computers on their own.

Explore:

Assign students to partners and send them in pairs to the computers. Have students open **Bug Multiplication--Multiplication as Scaling.gsp** and go to page "Bugs." Ask students to play as many games as time allows. (You may wish to play the games over several days.) Students should record the results of each game and their total scores on their worksheet.

As you circulate, observe students as they work. What strategies do students use to answer the problems? Are students counting each bug to find the total? Do students skip count by the number of bugs in each group? Do students use repeated addition? Do students answer the problem using multiplication? Ask students to explain their thinking to gain insight into their understanding of numbers and multiplication.

Remind students who need more time to view the bugs in equal-size groups that they can press *Fly home!* to return the flying bugs to these groups.

Make sure students understand how to record the results of each game played and the total score for each game on the worksheet.

Discuss:

Call students together to discuss and summarize what they learned. Discuss the different strategies students used to find the total number of bugs. Here are some possible student strategies:

- *We added the number of bugs from each group. For example, for 3 groups of 7 bugs each, we added 7 + 7 + 7 = 21.*
- *We used an "adding on" strategy. For example, if there were 5 bugs that each multiplied 7 times for 35 bugs in all, then we knew that 6 bugs that each multiplied 7 times had 35 + 7 = 42 bugs total.*
- *We skip counted by the number of bugs per group to find the total.*
- *We also skip counted, but we skip counted by the number of groups if it was an easier number. For example, when there were 5 groups of 6 bugs each, we skipped counted by 5s six times to get 30 bugs.*
- *We looked for multiplication facts we knew. For example, for 6 bugs each multiplying 6 times, we knew 5 bugs each multiplying 6 times is 5 × 6 = 30, and then we added the 6 bugs in the last group to get 36.*
- *We broke apart each group into smaller groups. We found the total number of bugs in each smaller group and then added them together. For example, for 8 bugs each multiplying 6 times, we broke it into two smaller groups: 4 bugs each multiplying 6 times. Since 4 × 6 = 24, we added 24 twice to get 24 + 24 = 48.*
- *We thought of the related multiplication fact and solved it. For example, 9 bugs each multiplying 3 times is 9 × 3 = 27.*

Depending on the level of your students, you can extend the discussion by having students look at their worksheets and find problems that had the same total number of bugs. For example, ask, "How many different problems did you find with a total of 16 bugs?" Write all the results on the board in a table

Bugs at First	Bugs Multiplied by	Total Bugs
2	8	16
4	4	16
8	2	16

Discuss how these results show that 2, 4, and 8 are all factors of 16, and how it demonstrates the Commutative Property of Multiplication: 2 × 8 is the same as 8 × 2.

Related Activities:

- *Fill a Box with Chocolate—Skip Counting Techniques*
- *Construct a Building—Multiplication Array Model*
- *Multiplication Strategies—Multipliers 6 Through 12*
- *Bunny Times*

License (CC-BY-NC-SA 3.0)

Portions of this material are based upon work supported by the National Science Foundation under award number DRL-0918733. Any opinions, findings, and conclusions or recommendations expressed in this work are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.