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Teaching First Graders How to Use Function Machines to Determine an Unknown Number

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By the end of first grade, students should be able to determine an unknown whole number in an addition or subtraction equation relating three whole numbers. As students begin understanding addition as part plus part equals total and subtraction as total minus part equals part, they can begin to see patterns emerge in the relationships between numbers in equations.

While an explicit naming of inverse operations does not occur until later grades, at this stage students learn to see that using a subtraction fact to determine the missing number in an addition problem (and vice versa) is an effective problem-solving strategy.

Representing an Unknown Quantity

Even though it may seem early, algebraic thinking begins as students start to understand that an unknown quantity can be represented using a symbol. While variables and letters are more commonly used in more advanced math courses, first graders may use a question mark or even a picture to represent the number that they are trying to figure out.

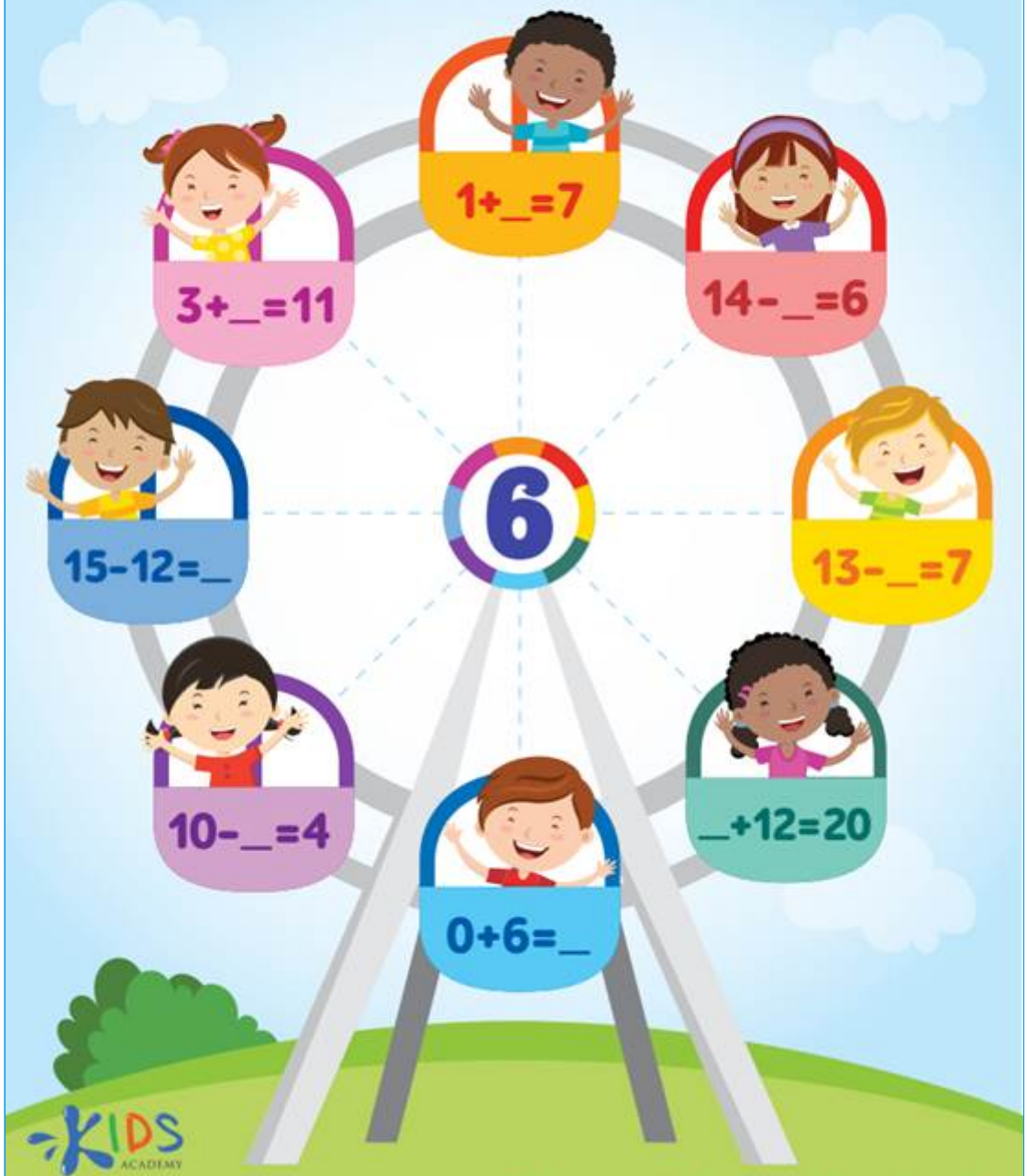
For example, rather than asking, “What is 3 + 7?” a teacher may instead present this problem: “3 + 7 = ?” Solve for ?.” Students begin to see the unknown quantity as an individual part of a problem rather than simply an “answer.” As students become more comfortable, the unknown quantity may be shifted to a missing addend (3 + ? = 10) or a missing subtrahend (10 - ? = 3). As always, begin with concrete examples that use math manipulatives or small items to represent quantities before moving to drawings or eventually abstract notation with numbers and symbols.

Flexible thinking is crucial for students’ math development, and practice is key! Consider using the following worksheets to provide additional practice and/or check for students’ understanding:

(click on the preview to complete the worksheets online or download pdf)

Ferris Wheel Math

Which of the equations have 6 as the missing number?
Trace on the dotted line for the correct answers.



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Missing 12

Which of the equations have 12 as the missing number?
Trace on the dotted lines for the correct answers.

___ - 6= 5

12+___=24

4+___=14

15-___=4

12

15-___=4

2+___=16

___+10=22

26-___=14

Function Tables: Recognizing Patterns

Often referred to as a “function machine,” a function table in early grades is a simple table that shows how a rule changes a number. There are typically two main sections: an input column/row and an output column/row. The purpose of the table is to examine the relationship between the input number and output number.

To determine the rule, several inputs and outputs need to be shown so that students can recognize patterns. For example, a table might have the number 3 as the first input and the number 6 as the first output. At this point, it is impossible to determine if the rule is adding 3 or doubling. As more numbers are included and the rule is followed, students can narrow down exactly what is happening. If the following inputs è outputs are 4 ⇒ 7, 5 ⇒ 8, and 6 ⇒ 9, it can be concluded that the rule is add 3.

Being able to recognize the pattern is the first step in student understanding. A great resource for practice or a check for understanding is either of these worksheets:

(click on the preview to complete the worksheets online or download pdf)

Addition Robot Sorter

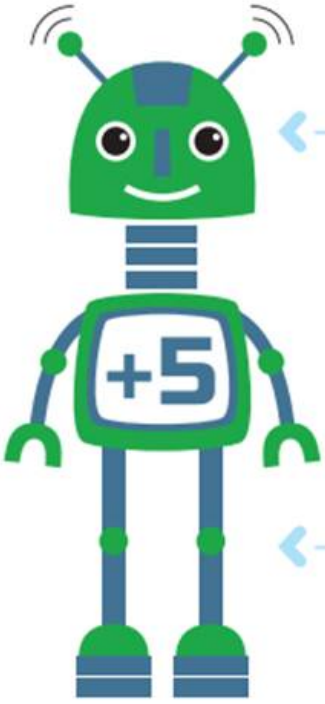
Find the rule in each table, +5 or +8?
Trace on the dotted line to the correct rule.

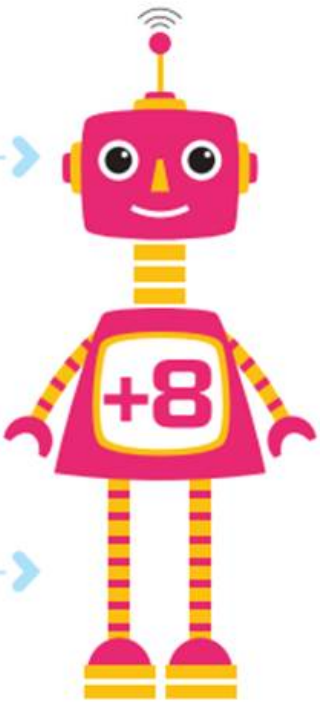
Input	Output
3	8
1	6
11	16

Input	Output
2	10
3	11
7	15

Input	Output
2	7
4	9
8	13

Input	Output
1	9
4	12
6	14





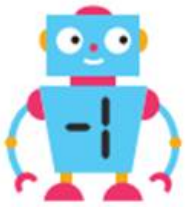
What's the Rule ?

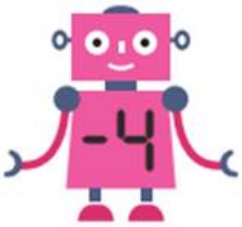
What rule does each function machine use?
Circle the correct answers.

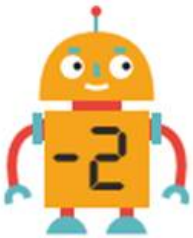
Input	Output
4	7
11	14
17	20

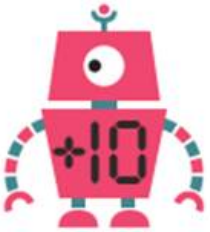
Input	Output
2	0
8	6
14	12

Input	Output
12	3
14	5
19	10







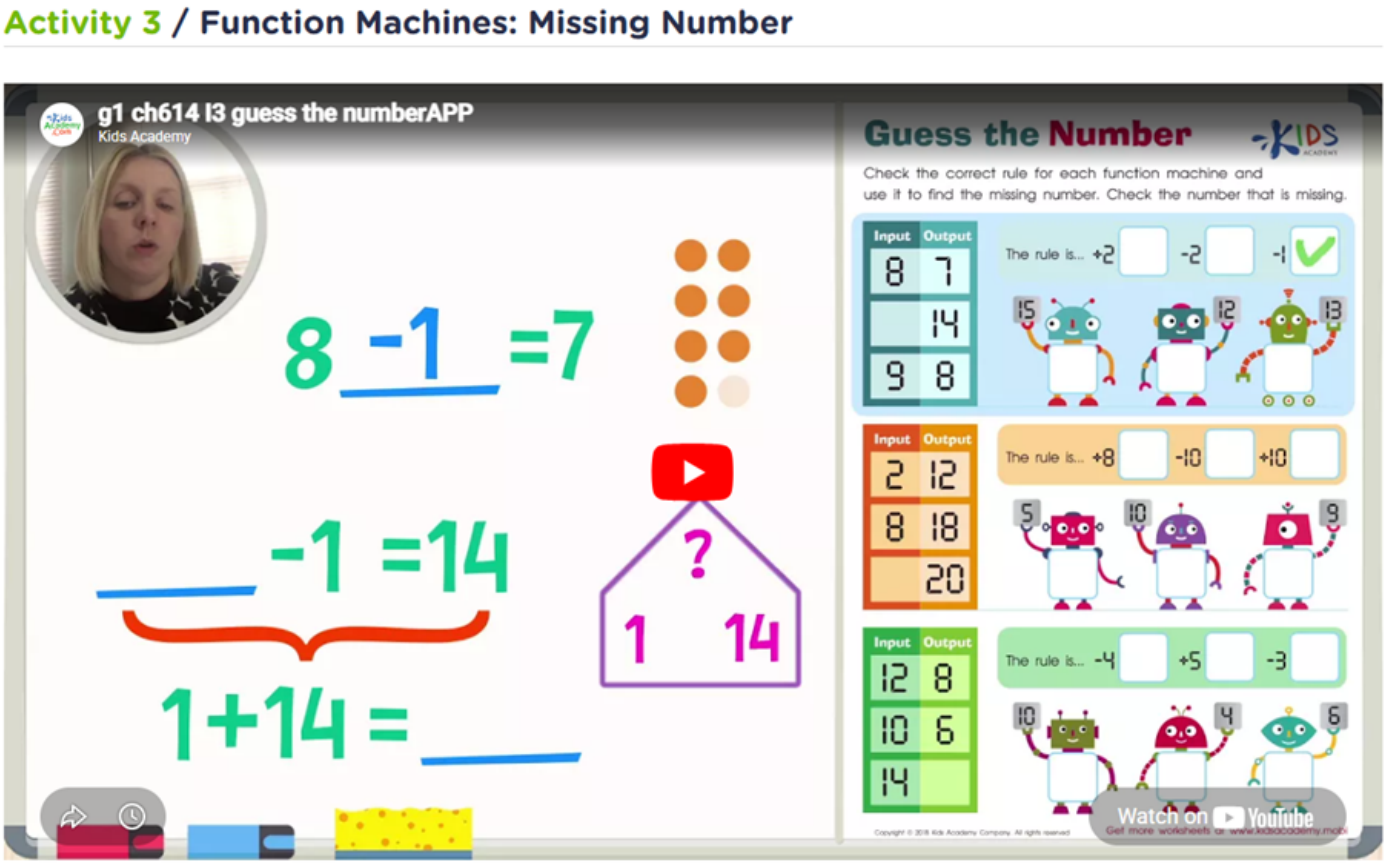


Function Tables: Applying Rules

Once students can recognize patterns and rules in function tables, they can begin to make generalizations and apply the rules to new numbers. Begin by having students determine unknown outputs once the rule is established. For example, if the rule is subtract 5, give students several new input numbers that would result in positive integer outputs (e.g. 7 ⇒ 2, 9 ⇒ 4).

To extend student thinking, have students determine input numbers when given output numbers. This next step requires a basic understanding of inverse operations – if the rule is add 1 and the output is 6, then the student must subtract 1 to determine the input number. Again, always begin with concrete materials such as math manipulatives to demonstrate this thinking before moving to drawings and eventually math notation.

Use this video to reinforce the concept and then follow up with the worksheet below:



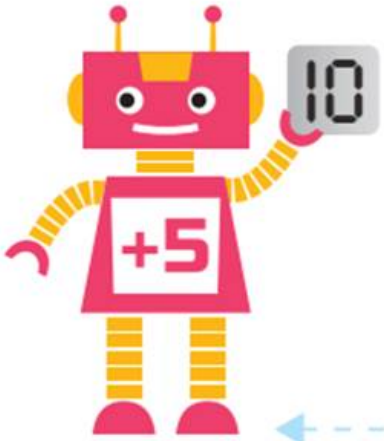
(click on the preview to complete the worksheet online or download pdf)

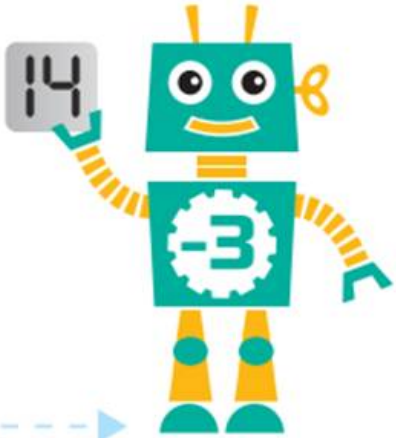
Missing Numbers

Figure out the rule in each function machine and use it to find the missing number. Trace the dotted line to the robot with the correct rule and number.

Input	Output
8	5
17	
12	9

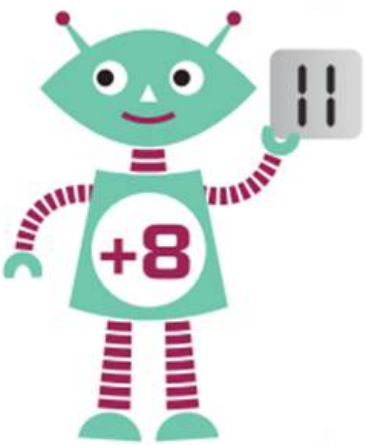
Input	Output
4	9
11	16
	15

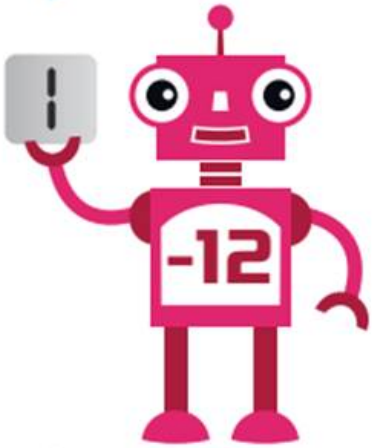




Input	Output
9	17
10	18
3	

Input	Output
18	6
13	
19	7





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Reinforcing Algebraic Thinking

Focusing on these basic function machines as well as helping students learn to determine unknown quantities based on patterns lays the groundwork for more advanced math concepts later on. Linear algebra cannot be learned without first gaining this basic understanding of relationships between numbers. These foundational skills are imperative to your students' understanding!