

## Ohio Standards Connections

### Patterns, Functions and Algebra

#### Benchmark E

Solve open sentences and explain strategies.  
(Grades Pre-Kindergarten - 2)

#### Indicator 5

Understand equivalence and extend the concept to situations involving symbols; e.g.,  $4 + 5 = 9$  and  $9 = 4 + 5$ , and  $4 + 5 = 3 + 6 = \triangle + \square$



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(Grade 2)

#### Benchmark F

Represent an unknown quantity as a variable using a symbol, such as



(Grades Pre-Kindergarten - 2)

#### Indicator 6

Use symbols to represent unknown quantities and identify values for symbols in an expression or equation using addition and subtraction; e.g.,  $\square + \bigcirc = 10$ ,  $\triangle -$



$2 = 4$ .

(Grade 2)

### Mathematical Processes Standard

#### Benchmark A

Use a variety of strategies to understand problem situations; e.g., discussing with peers, stating problems in own words, modeling problems with diagrams or physical materials, identifying a pattern.  
(Grades Pre-Kindergarten - 2)

#### Benchmark H

Recognize the mathematical meaning of common words and phrases, and relate everyday language to mathematical language and symbols.  
(Grades Pre-Kindergarten - 2)

#### Benchmark I

Communicate mathematical thinking by using everyday language and appropriate mathematical language.  
(Grades Pre-Kindergarten - 2)

### Lesson Summary:

*Students will use symbols to represent unknown quantities.*

*Estimated Duration: 45 – 90 minutes of class time over 2-3 days*

### Pre-Assessment:

The lesson involves a preliminary discussion to assess the students' understanding of solving equations when there are unknown quantities. This discussion will provide useful information about the students' readiness to think beyond a concrete level. The students will need to be able to represent quantities with a symbol.

### Post-Assessment:

Administer a short paper and pencil assessment using problems similar to the ones introduced in this lesson.

### Scoring Guidelines:

The students' responses will demonstrate their level of understanding of algebraic representation and equivalence

3 = The student understands that unknown quantities can be represented by symbols and can solve simple and complex problems involving variables. The student is able to identify variables to complete equivalent equations and explain choices demonstrating an understanding of equivalence.

2 = The student is able to identify numbers to complete simple and complex equations. The student is able to identify variables to complete equivalent equations.

1 = The student is able to identify some numbers to complete simple and complex equations.

0 = The student is able to identify some numbers for simple equations.

### Instructional Procedures:

1. Present the following problem situation to the students: John had some marbles. Danny gave him three marbles. John now has eight marbles. How many marbles did John have before Danny gave him the three marbles?
2. Encourage the students to write an open sentence for the problem situation using a symbol to represent the unknown part.
3. Walk around the room to observe the students' sentences.
4. Solicit responses from several students. Record the sentences on the overhead or board. Facilitate a discussion about the students' responses.

### Instructional Tip:

The students may write an addition or subtraction sentence.

**Commentary:**

Modeling problem situations using words, objects or number phrases or sentences are activities that have been explored in previous grades. Students have prior knowledge of using variables to represent missing addends in addition sentences. Gradually help students move from placing numbers in boxes to satisfy certain equalities to representing those quantities with symbols that behave as variables.

5. Engage the students in a discussion focused on identifying "unknown quantities." Present the following problem situation:  
In this mystery bag, I have 10 candies. Some are cherry and some are strawberry. How many of each could I have?
6. Solicit and record the students' responses in chart form. Facilitate a discussion about the various responses.
7. Write the following open sentence on the board or overhead. Explain to the students that the circle and the triangle represent the unknown values, called variables, which represent different quantities.

$$\bigcirc + \triangle = 10$$

8. Ask the students to use the mystery bag problem to find the unknown quantities

**Commentary:**

It is important for the students to understand that each time they write a new equation, the value of the symbol should change. They need to understand that the symbol does not have a set value; i.e., the circle or triangle will not be the same number every time they see one in a problem.

9. Solicit and record the students' responses in chart form.

○	+	△	= 10
	+		= 10
	+		= 10
	+		= 10
	+		= 10

10. Ask the students to explain if the numbers 5 and 5 would work for this equation.

**Commentary:**

The students may be confused by two different symbols with the same quantity. Explain to them that sometimes the same number may be used.

11. Repeat this process with several other problem situations. Have the students write equations using various symbols.
12. Allow the students to share their equations with the class.
13. Present the following problem situation to the students:  
Mary had eight cookies. She gave three to Alexis. How many cookies does Mary have now?

$$8 - \bigcirc = \triangle$$

14. Ask the students to determine the identity of the circle and the triangle in this equation. Solicit the students' responses and record them on the board.
15. Repeat this process with several other problem situations asking the students to write equations using various symbols.
16. Instruct the students to write a problem situation involving subtraction.
17. Collect the problems and have another student write an equation and determine the solution.
18. Engage the students in a discussion about equivalence. Present the following problem situation:  
Chauncey and Elon shared nine crayons, four for Chauncey and five for Elon. How could Channel and Elise share their nine crayons differently?
19. Ask them to identify numbers that would complete the following equation:

$$4 + 5 = \triangle + \square$$

20. Repeat this problem using different numbers. Stress both equivalence and the concept of representing unknown quantities with symbols.
21. The next activity increases the level of challenge. Depending upon the students' understanding, you may want to postpone introducing this activity

until they have developed an understanding of both algebraic representation and equivalence.

$$4 + \text{hexagon} = 6 + \text{circle}$$

22. In this problem, you want the students to identify all the possible values for the hexagon and the circle. Begin by asking the students to think of each side equal to 7. Ask the students to identify the values for the hexagon and the circle. Repeat this problem having the value of each side equal to the numbers 7 through 19.
23. Substitute other numbers in the place of 4 and 6 and repeat the process.
24. Ask the students to generate equivalent equations with variables represented by symbols.

**Differentiated Instructional Support:**

- Some students may need to solve equations where only one unknown appears in the addend or subtrahend.
- Once the students seem to understand the concepts of equivalence and algebraic representation, ask them to generate equivalent equations using symbols.

**Extension:**

These are ideas for all students to continue learning on this topic – in the classroom or outside of the classroom.

- Provide each child with a collection of pattern blocks, blank paper, and crayons or markers. Ask the children to design a pattern for a quilt using a repeating and/or building pattern. Ask the students to describe the pattern on another sheet of paper.
- Any lesson on patterns can be extended throughout the year and in many other subject areas. For example, ask the students to identify and describe patterns in these areas: identifying patterns in nature and predictable events, hearing patterns in words, poetry, and music, etc.

**Materials/Resources Needed:**

*For the teacher:* Overhead transparency, chalkboard, flannel board (optional).

*For the students:* Sheet of blank paper, set of interlocking cubes, mathematics journal and pencil.