## Ohio Standards Connection

**Number, Number Sense and Operations Standard**

**Benchmark K**
Analyze and solve multi-step problems involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem.

**Indicator 12**
Analyze and solve multi-step involving addition, subtraction, multiplication and division using an organized approach, and verify and interpret results with respect to the original problem.

**Mathematical Processes**

**Benchmark B**
Use an organized approach and appropriate strategies to solve multi-step word problems.

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### Lesson Summary:

In this lesson, students learn strategies for solving problem situations. First, students develop further understanding of each operation (addition, subtraction, multiplication and division) by thinking about the “action” of the operation (combining, separating or comparing). They use strategies such as act it out, mental images, making models and drawing pictures to represent the “actions” in problem situations. Then determine the operations needed to determine the solution, finally, the reasonableness of the solution is discussed in context of the problem situation.

### Estimated Duration: Three hours

### Commentary:
Young children often find word problems easier to solve than simple number sentences because word problems offer a context to help interpret the action required (NRC, 2001). This lesson focuses on helping students read problems to understand the context and then make use of the context to determine appropriate operations. Understanding the context of problems should not, however, be turned into identifying key words such as “is” and “of” as indicators of mathematical symbols. The identification of key words turns problem solving into an algorithmic approach and creates misconceptions for students. Instead, understanding a problem context should involve student restatements of problems in their own words, discussions of the action in a problem, and the use of manipulatives or concrete objects to model the action.

### Pre-Assessment:
This pre-assessment focuses on skills to solve one-step word problems.

- Have students determine the possible operations which can be used to solve the problem situations on *Strategies for Solving Problems*, Attachment A.
- Pair students to discuss and write responses.
- Select students to share their responses. Accept operations and strategies that are appropriate to determine the solution.

### Scoring Guidelines:
Assess students through observation and listening to their discussions. Collect the students’ work and determine the level at which they understand and apply the operations. To assist students, encourage the use of models and drawing pictures to help determine the operation. Having students model or act out the situation provides multiple pathways for assessing and learning.
Strategies for Solving Problems - Grade Four

Post-Assessment:
Distribute Strategies for Solving Problems, Attachment C.

Scoring Guidelines:
Assess students’ understanding of operations and strategies for solving problems. Use a rubric to determine the level of understanding and future instruction. Possible responses are provided on Strategies for Solving Problems Answer Guide, Attachment D.

<table>
<thead>
<tr>
<th>Score Point</th>
<th>Operations</th>
<th>Strategies</th>
<th>Computation</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>Uses appropriate operations to find solutions for problem situations. Understands relationships among the operations and can use operations flexibly.</td>
<td>Uses multiple strategies flexibly, appropriate for the operations, to represent and solve problem situations. Can interpret the results based on the context of the situation.</td>
<td>Provides accurate computation. Shows ability to compute for all operations.</td>
</tr>
<tr>
<td>2</td>
<td>Provides partial evidence of understanding operations. Uses appropriate operations for more than half the time.</td>
<td>Uses two to three strategies, appropriate to the operations, to represent and solve problem situations. Interprets the results based on the context of the situation with minor flaws.</td>
<td>Provides accurate, but limited range of computation for all operations. For example, consistently uses repeated addition for multiplication</td>
</tr>
<tr>
<td>1</td>
<td>Provides minimal evidence of understanding of the operations. Many flaws in understanding the context of the situation and relating that to combining, separating or comparing.</td>
<td>Uses one strategy or inappropriate strategies for the operation. Provides minimal evidence of interpreting results and comparing them to the context of the story.</td>
<td>Provides inaccurate calculations consistently. Limited use of operations.</td>
</tr>
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Instructional Procedures:
Part One
1. Discuss the problem situations in the pre-assessment activity. Have students share the strategies and operations used to determine the solutions to the problems. Ask students to share their reasoning and to create a model or picture to show the strategy is appropriate for the problem situation.
2. Create a graphic organizer, such as a concept map, to summarize the meaning of and connection among the operations. Use Operations Concept Map, Attachment E as a guide.
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a. Have pairs or small groups of students brainstorm a list of actions or words which describe each operation.
b. Ask students to draw a picture or build a model with appropriate tools for each operation. Make materials such as counters, base-ten blocks or measuring tapes (number lines) available for all students.

Instructional Tip:
Expect students to provide traditional keywords during the brainstorm session. Give students examples to show that the keywords do not always mean what they expect them to mean. For example:
There are 43 green and red peppers in the basket altogether. Seventeen are red peppers. How many are green? Altogether is typically related to addition. This situation uses subtraction.
There are 6 cookies in a package. Scot bought a package for three friends and himself. How many cookies did he buy altogether? This situation requires multiplication, otherwise students may just add 6 and 3 and 1.

3. Select students to share their ideas and strategies for each operation. Complete one operation at a time. Ask students for instances when they used the operation. Ask students who would use the operations in their jobs and why it is important to know them.

4. Have students brainstorm ways to think about and solve a problem. Allow them to share in small groups then select students to share with the class. Record the strategies on the board. Responses may include using mathematical tools or manipulatives, drawing pictures, acting the situation out, making mental images or lists, guess and check, and double-checking (Does the answer make sense?).

5. Pose a problem situation for students to identify operations and strategies to find a solution. The principal at Smithville Elementary was ordering buses for a field trip to the zoo. Six of the classrooms were going. What does the principal need to know to determine the number of buses to order? Which operations would be useful in finding a solution?
   a. Allow students to discuss their ideas in small groups.
   b. Ask the group recorders to write the ideas on a sheet of paper. Direct them to fold the sheet in half and label one side “What we need to know” and the other side “Useful operations”.
   c. Have the group reporters share the ideas and list on the board.
   d. Use a think-aloud strategy to describe the problem situation. Refer students to the ideas generated and actions of the situation. For example, combine the number of students and teachers in each class to find the total number of participants then separate the total number by the number of people who can ride each bus.

6. Have students additional information that they learned about the operations on the Operations Concept Map, Attachment E.

Part Two
7. Review the list of strategies that can be used to solve problem situations. Explain that the strategies will be used to solve problem situations throughout the lesson. Encourage students to use multiple strategies to interpret and determine the reasonableness of their solution. Make mathematical tools available (counters, craft sticks, base-ten blocks, tape measure).
8. Pose the following problem situation for students to apply different strategies.

_A florist is making bouquets having eight flowers. The florist buys flowers from the grower in bundles of 12. Determine the number of bouquets the florist can make with four bundles of flowers._

a. Allow students to work in pairs or small groups.
b. Ask students to solve the problem using two-three of the strategies listed on the chart. Observe students as they work and note the strategies they use.
c. Select students to share the strategies used at the board or overhead. Allow students who acted out the problem to demonstrate. Have students use the manipulatives and draw pictures on the overhead. Another strategy may use multiples of eight and 12. Try to present all of the strategies for the students to see.
d. Ask students to consider the reasonableness of six bouquets as the solution. It makes sense that there are more than four, because there are 12 flowers in the bundles and only eight in the bouquets, for every two bundles purchased there are eight additional flowers to make another bouquet.
e. Give the following scenario to have students evaluate the thinking of “another” student.

_Last year, one student solved the problem like this: Eight flowers and 12 flowers is 20. Twenty multiplied by four is 80. The florist made 80 bouquets. Does this make sense? (No, there are only 48 flowers in four bundles. The florist would need 640 flowers to make 80 bouquets._

9. Distribute one card to each student from _Problem-Solving Checklists_, Attachment F.

10. Pose additional problem situations. Have students select two to three strategies from the checklist on the card. Ask students to present the strategies to the class and determine the reasonableness of the strategy and solution. Encourage and accept diverse strategies that are useful in finding an accurate solution.

- _The teacher bought three bags of candy to give to the fifteen students in the class. Each student is to receive an equal number of pieces. The bags consist of 37 pieces, 50 pieces and 48 pieces. Determine the number of pieces of candy each student will receive._
- _The Salad Company makes 50 pounds of potato salad in one batch. The potato salad is packaged in three pound containers. The company makes two dollars per container. Determine the amount of money the company makes on two batches of potato salad._
- _Andy has a $10 bill and orders a small pizza with cheese, pepperoni, mushrooms and olives. A small cheese pizza costs $7.00 and additional toppings are 75 cents each. Determine the change Andy will receive._

11. Have students summarize what the learned about strategies and operations in a mathematics journal.

**Differentiated Instructional Support:**

Instruction is differentiated according to learner needs, to help all learners either meet the intent of the specified indicator(s) or, if the indicator is already met, to advance beyond the specified indicator(s).

- Limit the choices on the post-assessment to just two different operations.
- Limit the requirement for extra information in the post-assessment to just one or two problems.
- Extend the post-assessment by adding negative numbers, fractions, and decimals.
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- Read each problem and answer back to the student as they finish to make sure the student’s thoughts are properly represented.

**Extension:**
Have students write one problem that they can show all of the strategies that they have learned to solve this one problem.

**Home Connection:**
Ask students to create word problems with their parents based on family history. An example of this could be years of birth in the generations of the families.

**Materials and Resources:**
The inclusion of a specific resource in any lesson formulated by the Ohio Department of Education should not be interpreted as an endorsement of that particular resource, or any of its contents, by the Ohio Department of Education. The Ohio Department of Education does not endorse any particular resource. The Web addresses listed are for a given site's main page, therefore, it may be necessary to search within that site to find the specific information required for a given lesson. Please note that information published on the Internet changes over time, therefore the links provided may no longer contain the specific information related to a given lesson. Teachers are advised to preview all sites before using them with students.

*For the teacher:* Chalk or markers and chalkboard or markerboard

*For the student:* Pencil, paper, and note cards

**Vocabulary:**
- operation
- strategy

**Research Connections:**

**General Tips:**
Review of the words sum, difference, quotient, and product before the lesson begins.

**Attachments:**
Attachment A, *Strategies for Solving Problems Pre-Assessment*
Attachment B, *Strategies for Solving Problems Pre-Assessment Answer Guide*
Attachment C, *Strategies for Solving Problems Post-Assessment*
Attachment D, *Strategies for Solving Problems Post-Assessment Answer Guide*
Attachment E, *Operations Concept Map*
Attachment F, *Strategies for Problem Solving Checklist*
Attachment A
Strategies for Solving Problems Pre-Assessment

Directions: Read the situation. Determine which operation is needed to determine the answer and explain why.

1. Dan picked 54 apples at the apple orchard. Jennifer picked 39 apples. Which operation would you use to find the difference in the number of apples Dan and Jennifer picked?

   Explain why you would use this operation?

2. Betty planted eight rows of tulips. She placed five tulips in each row. Which operation would you use to find the number of tulips Betty planted?

   Explain why you would use this operation?

3. Amy and Nancy posted 134 campaign signs around the community on Monday. On Tuesday, they posted 388. Which operation would you use to find the number of campaign signs Amy and Nancy posted?

   Explain why you would use this operation?

4. Mr. Hall has 32 desks in his room. He placed the desks in four rows. Which operation would you use to determine the number of desks in a row?

   Explain why you would use this operation?
Accept all appropriate operations and a variety of strategies.

1. Dan picked 54 apples at the apple orchard. Jennifer picked 39 apples. Which operation would you use to find the difference in the number of apples Dan and Jennifer picked?
   **Subtraction or addition (adding up)**

   Explain why you would use this operation?
   
   *The situation compares two numbers. To find the difference, students must identify how far 39 is from 54. This can be done by subtracting 39 from 54 or adding on/counting up from 39 to 54.*

2. Betty planted eight rows of tulips. She placed five tulips in each row. Which operation would you use to find the number of tulips Betty planted?
   **Multiplication or addition**

   Explain why you would use this operation?
   
   *The situation combines equal groups. The number of tulips can be found by multiplying 8 and 5 or by adding, 5 + 5 + 5 + 5 + 5 + 5 + 5 + 5.*

3. Amy and Nancy posted 134 campaign signs around the community on Monday. On Tuesday, they posted 388. Which operation would you use to find the number of campaign signs Amy and Nancy posted?
   **Addition**

   Explain why you would use this operation?
   
   *The situation combines two groups.*

4. Mr. Hall has 32 desks in his room. He placed the desks in four rows. Which operation would you use to determine the number of desks in a row?
   **Division or subtraction**

   Explain why you would use this operation?
   
   *The situation separates a set of desks into equal parts. Responses may include dividing eight into 32 or subtracting eight from 32 four times.*
Name ________________________________________ Date ________________________

Directions: Read the situations and solve. Show your work. Use more than one strategy to determine the answer when you can.

1. In September, the school store had five boxes of erasers to sell, each containing 125 erasers. By the end of November, there were only 88 erasers left to sell. Determine the number of erasers sold at the school store.

2. Hattie was planning to bring a treat for the 27 students and teacher in her class. She wanted each person to get four cookies. The cookies come in packages of 16. Determine the number of packages of cookies she needs.

3. There are 325 students in Logan School altogether. For a field trip the principal ordered nine buses to take the students, teachers and other adults. Each bus will hold 40 people. Determine the total number of teachers and other adults that can ride the buses.

4. Frankie has a stamp collection of 235 stamps. He displays his stamps in albums. An album has 12 pages. He places 8 stamps on each page of the album. Determine how many more stamps Frankie can collect before starting another album.
Attachment D
Strategies for Solving Problems Post-Assessment Answer Guide

1. In September, the school store had five boxes of 125 erasers to sell. By the end of November, there were only 88 erasers left to sell. Determine the number of erasers sold at the school store.

   Five boxes of 125 erasers can be determined by using multiplication or repeated addition, \(5 \times 125 = 625\)

   To find the number sold, the difference of 625 and 88 should be found. Subtraction, benchmarking or adding-on are some strategies that may be used to find that 537 erasers were sold.

2. Hattie was planning to bring a treat for the 27 students and teacher in her class. She wanted each person to get four cookies. The cookies come in packages of 12. Determine the number of packages of cookies she needs.

   Use multiplication or repeated addition to find that Hattie needs 112 cookies (\(28 \times 4\)).

   Strategies such as dividing 112 by 12, listing multiples of 12, or multiplying by 10s can be used to find that Hattie needs 10 packages of cookies.

3. There are 325 students in Logan School altogether. For a field trip the principal ordered nine buses to take the students, teachers and other adults. Each bus will hold 40 people. Determine the number of teachers and other adults that can ride the bus.

   Uses multiplication or repeated additions to find that the nine buses hold 360 people.

   Subtraction, benchmarking or adding-on are some strategies that can be used to determine that 35 teachers and other adults can ride the buses.

4. Frankie has a stamp collection of 235 stamps. He displays his stamps in albums. An album has 12 pages. He places 8 stamps on each page of the album. Determine how many more stamps Frankie can collect before starting another album.

   Multiplication, listing multiples of 12 or 8 or repeated addition are strategies that can be used to determine that an album holds 96 stamps. Dividing 235 by 96, creating a list using multiples of 96 or repeated addition are some strategies that can be used to find that three albums hold 288 stamps. Strategies to find difference can be used to find that Frankie can collect 53 more stamps before buying another album.
Strategy for Solving Problems - Grade Four

Attachment E
Operations Concept Map

Addition
Multiplication

Subtraction
Subtraction

Mathematical Operations
## Strategies for Problem Solving Checklist

<table>
<thead>
<tr>
<th>Approaches</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Act it out</td>
<td>Am I combining, separating, or comparing?</td>
</tr>
<tr>
<td>Build a model</td>
<td></td>
</tr>
<tr>
<td>Draw a picture</td>
<td>Does the solution make sense?</td>
</tr>
<tr>
<td>Mental images</td>
<td></td>
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<tr>
<td>Make a list</td>
<td></td>
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<tr>
<td>Guess and Check</td>
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