Making Lemonade

Mary wants to make a small glass of lemonade and a large glass of lemonade. Mary needs the juice of four lemons to make a small glass of lemonade. Mary needs the juice of eight lemons to make a large glass of lemonade. Mary has fourteen lemons. Does Mary have enough lemons to make the two glasses of lemonade? Show all your mathematical thinking.
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**Task**
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**Strategies for Addition and Subtraction Unit**

The Strategies for Addition and Subtraction Unit involves understanding the processes of addition and subtraction in order to solve problems and answer questions such as—

- If we know all of the parts, how can we find the whole?
- If we know the whole and one of the parts, how can we find the missing part?
- Given an equation, can you create an addition or subtraction situation to match it? How can you prove it matches the equation?

**Math Concepts and Skills:**
The student solves problems by developing and using strategies for addition and subtraction.

The student:

- finds the sum of a multiple of 10 and a one-digit number (up to 99) in problem situations.
- develops, applies and explains strategies used to add and subtract within 20, such as making 10 and decomposing a number leading to a 10.
- creates problem situations when given a number sentence involving addition or subtraction of numbers within 20; solves the problems created.
- represents word problems involving addition and subtraction of numbers up to 20.
- applies properties of operations to add and subtract two or three numbers—if 4 + 3 = 7 is known, then 3 + 4 = 7 is also known.

**Exemplars Task-Specific Evidence**
This task requires students to use part/whole reasoning: If I have two parts, I can put the parts together to find the whole. The students will also compare their whole with a given whole to determine whether Mary has enough lemons to make her glasses of lemonade.
Underlying Mathematical Concepts

- Counting on/Addition
- Number sense to 14
- Comparison

Possible Problem-Solving Strategies

- Model (manipulatives)
- Diagram/Key
- Table
- Tally table
- Number line

Possible Mathematical Vocabulary/Symbolic Representation

- Model
- Diagram/Key
- Table
- Tally table
- Number line
- Addend
- Amount
- Dozen
- Per
- More than (>)/Greater than (>)/Less than (<)
- Equivalent/Equal to
- Most/Least
- Halves, half of
- Odd/Even
- Pair

Possible Solutions

Original Version:
Yes, Mary has enough lemons to make the 2 glasses of lemonade.

Key

<table>
<thead>
<tr>
<th>Glass</th>
<th>Lemons</th>
<th>Total Lemons</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Large</td>
<td>8</td>
<td>12</td>
</tr>
</tbody>
</table>

4 + 8 = 12

12 < 14
14 > 12
Possible Connections
Below are some examples of mathematical connections. Your students may discover some that are not on this list.

- Mary only uses 12 lemons, which is an even number.
- 12 is a dozen.
- The small glass uses half of the lemons that the large glass uses.
- Mary has 2 lemons remaining.
- 2 lemons is a pair.
- Mary needs 2 more lemons to make another small glass of lemonade.
- The task is recreated to make enough small or large glasses of lemonade for a family, class, etc.
- Relate to a similar task and state a math link.
- Solve more than one way to verify the answer.
- You need 6 more lemons to equal a large glass.
- 2 small glasses equal 1 large glass.
## Novice Scoring Rationales

<table>
<thead>
<tr>
<th>Criteria and Performance Level</th>
<th>Assessment Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem Solving</strong>&lt;br&gt;Novice</td>
<td>The student’s strategy of using a diagram to represent four, eight, and fourteen lemons, and adding all the lemons, does not work to solve the task. The student’s answer, “26 lemons,” is not correct.</td>
</tr>
<tr>
<td><strong>Reasoning &amp; Proof</strong>&lt;br&gt;Apprentice</td>
<td>The student shows some correct reasoning of the underlying concepts of the task. The student demonstrates understanding of four lemons to one glass, eight lemons to one glass. The student does not understand that the sum of four and eight lemons should be compared to fourteen lemons.</td>
</tr>
<tr>
<td><strong>Communication</strong>&lt;br&gt;Apprentice</td>
<td>The student correctly uses the mathematical term <em>diagram</em>.</td>
</tr>
<tr>
<td><strong>Connections</strong>&lt;br&gt;Novice</td>
<td>The student does not make a mathematically relevant observation.</td>
</tr>
<tr>
<td><strong>Representation</strong>&lt;br&gt;Apprentice</td>
<td>The student’s diagram is appropriate to part of the problem but is not accurate. The student diagrams an additional fourteen lemons, which does not support a correct answer. The student defines the lemons in the scribing.</td>
</tr>
</tbody>
</table>
My diagram

4

26 lemons

“I made 4 lemons, 8 lemons, 14 lemons. I got 26 lemons. [Reread the task.] Yes, she can make lemonade. Mary, has 26 lemons”

AZ
# Apprentice Scoring Rationales

<table>
<thead>
<tr>
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<th>Assessment Rationales</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem Solving</strong>&lt;br&gt;Apprentice</td>
<td>The student’s strategy of using a diagram to record how many lemons are needed to make a small and a large glass of lemonade, finding a total of lemons and comparing that total to Mary’s fourteen lemons, would work to solve the task. But, the student diagrams an extra lemon in the large glass of lemonade. The student’s answer, “Yes,” is not correct because it is based on incorrect data.</td>
</tr>
<tr>
<td><strong>Reasoning &amp; Proof</strong>&lt;br&gt;Practitioner</td>
<td>The student shows correct reasoning of the underlying concepts of the task. The student demonstrates understanding of four lemons to one glass, eight lemons to one glass, finding the total number of lemons needed, and comparing that total to fourteen lemons. The student diagrams nine lemons in the large glass which leads to an incorrect total of thirteen lemons to compare to Mary’s total of fourteen lemons. This is considered a careless error and not a flaw in the student’s reasoning.</td>
</tr>
<tr>
<td><strong>Communication</strong>&lt;br&gt;Practitioner</td>
<td>The student correctly uses the mathematical terms <em>diagram</em> and <em>key</em>.</td>
</tr>
<tr>
<td><strong>Connections</strong>&lt;br&gt;Apprentice</td>
<td>The student attempts to make a mathematically relevant observation, but it is based on an incorrect diagram. The student states, “Mary has one extra lemon because fourteen comes after thirteen.” The correct connection is two extra lemons.</td>
</tr>
<tr>
<td><strong>Representation</strong>&lt;br&gt;Apprentice</td>
<td>The student's diagram is appropriate to the problem, but is not accurate. The student diagrams an extra lemon in the large glass. A key defines the lemons and glasses.</td>
</tr>
</tbody>
</table>
Is 14 lemons enough

make a diagram

13 lemons

Yes

“I counted all the lemons and
Mary is OK. She can make the
lemonade in the two glasses.
Mary has 1 extra lemon because
14 comes after 13.”

AZ
## Practitioner

<table>
<thead>
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</thead>
<tbody>
<tr>
<td><strong>Problem Solving</strong>&lt;br&gt;Practitioner</td>
<td>The student’s strategy of using a tally chart to record how many lemons are needed to make a small and large glass of lemonade, and comparing that total to Mary’s fourteen lemons works to solve the task. The student’s answer, “Yes,” is correct.</td>
</tr>
<tr>
<td><strong>Reasoning &amp; Proof</strong>&lt;br&gt;Practitioner</td>
<td>The student shows correct reasoning of the underlying concepts of the task. The student demonstrates understanding of four lemons to one glass, eight lemons to one glass, using addition to find the total number of lemons needed, and comparing that total to fourteen lemons.</td>
</tr>
<tr>
<td><strong>Communication</strong>&lt;br&gt;Practitioner</td>
<td>The student correctly uses the mathematical term <em>small</em> from the task. The student also correctly uses the terms <em>tally chart, dozen, tally mark</em>.</td>
</tr>
<tr>
<td><strong>Connections</strong>&lt;br&gt;Practitioner</td>
<td>The student makes the mathematically relevant observations, “12 is a dozen,” and, “2 lemons left.”</td>
</tr>
<tr>
<td><strong>Representation</strong>&lt;br&gt;Practitioner</td>
<td>The student’s tally chart is appropriate to the problem and accurate. All labels are provided and the data is correct. <strong>Note:</strong> A key is not necessary if a tally mark represents one.</td>
</tr>
</tbody>
</table>
Practitioner

I need to find how many lemons she needs. I will do a tally chart.

glass / lemons

small 1 1 1 1 1
big 1 1 1 1 1 1

5 + 5 + 10 + 2 = 12

“My connection chain.”
AZ

12 is a dozen
2 lemons left

“I put a tally with the 4 tally marks to make 5. Then I could add 5 and 5 for 10 and put on the last 2 tally marks 11, 12. She has enough lemons.”
AZ
# Expert Scoring Rationales

<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td><strong>Problem Solving</strong></td>
<td>The student’s strategy of using a diagram of four lemons for a small glass and eight lemons for a large glass to find a total of twelve lemons to compare to fourteen lemons works to solve the task. The student’s answer, “Yes,” is correct. The student verifies her/his answer by using more strategies. The student also brings the concept of half to the problem.</td>
</tr>
<tr>
<td><strong>Reasoning &amp; Proof</strong></td>
<td>The student shows correct reasoning of the underlying concepts of the task. The student demonstrates understanding of four lemons to one glass, eight lemons to one glass, finding the total number of lemons needed using addition, and comparing that total to fourteen lemons. The student uses conceptual understanding of subtraction and less than to verify her/his answer is correct.</td>
</tr>
<tr>
<td><strong>Communication</strong></td>
<td>The student correctly uses the mathematical terms <em>diagram</em>, <em>key</em>, <em>half</em>, <em>dozen</em>, <em>pair</em>, <em>more</em>, <em>less</em>, <em>number line</em>. The student correctly uses the mathematical notation “&lt;”.</td>
</tr>
<tr>
<td><strong>Connections</strong></td>
<td>The student makes the mathematically relevant Practitioner observations, “dozen is 12,” “pair is 2 [lemons],” “4-more,” “8-less,” and, “2 [lemons] left.” The student makes the Expert observations, “half 8 [lemons] is 4 [lemons],” and, “12 &lt; 14.” The student verifies her/his answer by using a second diagram to count back four and eight lemons, subtraction equations to show the two remaining lemons, a number line using an addition jump of four lemons and then eight individual lemons for a total of twelve lemons. The student states, “I found my answer lots of times. I got yes for enough lemons all the time.” The student writes, “I am right.”</td>
</tr>
<tr>
<td><strong>Representation</strong></td>
<td>The student’s first and second diagrams are appropriate to the problem and accurate. All labels are provided and a key defines the lemons. The student’s number line is also appropriate and accurate with all labels included. The student links the representation to verify that her is answer is correct.</td>
</tr>
</tbody>
</table>
Does Mary have enough lemons?

I will make a diagram.

Key:
- lemon

Glass:
- 4 less
- 8 more

4 + 8 = 12

14 - 2 = 12

12 - 2 = 10

10 - 8 = 2

Answer: Yes

Number line:

I am right. 12 and 14. Yes

"I found my answers lots of times. I got yes for enough lemons all the time. I love this problem."

AZ