6.RP Party Planning

Alignments to Content Standards:  6.RP.A.3

Task

Arianna is making origami swans for her friend’s birthday party. She wants to make 9 swans, one for each party guest. If Arianna takes 15 minutes to make each swan, will she be able to make 9 swans in 2 hours? Explain.

IM Commentary

The goal of this task is to provide a ratio problem which can be solved efficiently with a wide variety of techniques. While it could be used at many points in a ratio unit (with or without additional instructions on which technique to apply) one possible use of the task is as a summative assessment. Toward the end of a unit, the teacher can expect students to apply many different methods, including tape diagrams, ratio tables, double number lines, and unit rates. In addition to use as an assessment, the task can provide a solid basis for comparing the different solution techniques. Which method do students prefer? Which method makes the most sense to students?

The number 15 minutes in the task was chosen because it is equivalent to 1/4 of an hour. This gives students a chance to think about another aspect of ratios, unit conversions, regardless of whether or not their method of solution focuses on unit rates. This number can be changed if desired and then students will likely convert hours to minutes instead.

The choice of 15 minutes has a large impact on the level of difficulty of the different solutions. The ratio table, double number line, and unit rate methods will still apply with a more complex number such as 13 minutes or even $13\frac{1}{2}$ minutes. The arithmetic
will be more challenging but the methods work in essentially the same manner. The tape diagram becomes more complicated because time needed to make the swans can no longer be grouped nicely to make hours. Note also that if the number of swans were larger, 30 for example, then the double number line starts to become more difficult to draw because the number lines need to be extended much further. One great advantage to the double number line and tape diagram techniques is that they provide a geometric intuition for the size of the quantities involved. By comparison the ratio table and unit rate conversions are abstract. The abstract methods are particularly useful when numbers become more complex. Having a conversation with the students about the relative merits of the solutions is particularly important at the end of the unit and this task can help spark that conversation.

This task was written as part of a collaborative project between Illustrative Mathematics, the Smarter Balanced Digital Library, the Teaching Channel, and Desmos.

Solutions

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Solution: 1 Tape Diagram

There are 60 minutes per hour and 4 groups of 15 minutes are 60 minutes. So 4 groups of 15 minutes make an hour. Using this, we can make a tape diagram showing how long it takes for Arianna to make 9 swans:

![Tape Diagram](image)

Each blue square here represents 15 minutes and each green square represents one origami swan that Arianna makes in 15 minutes. The tape diagram shows that it will take Arianna 2 hours and 15 minutes to make 9 swans. She will not be able to finish the work in two hours at this rate.
Solution: 2 Ratio Table

We can make a ratio table:

<table>
<thead>
<tr>
<th>Number of swans</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>9</td>
<td>135</td>
</tr>
</tbody>
</table>

We have a little more work to do here as we need to decide if 135 minutes is more or less than 2 hours. There are 60 minutes per hour so in 2 hours there are $2 \text{ hours} \times 60 \frac{\text{minutes}}{\text{hour}} = 120$ minutes. Arianna will not finish making the 9 swans in 2 hours.

We could also make a ratio table with time in hours:

<table>
<thead>
<tr>
<th>Number of swans</th>
<th>Time (hours)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>$\frac{1}{4}$</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>$2 \frac{1}{4}$</td>
</tr>
</tbody>
</table>

It takes $2 \frac{1}{4}$ hours to make swans at this rate and so Arianna will not finish on time.

Solution: 3 Double Number Line

The information in the ratio table can also be shown using a double number line. This double number line uses the fact that 15 minutes is $\frac{1}{4}$ of 60 minutes (or one hour).
Here we see that it takes Arianna more than 2 hours to make 9 swans. Note that, as with the tape diagram and ratio table, there was a choice to be made for representing the units of time and we could also make a double number line with minutes instead of hours.

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**Solution: 4 Using a unit rate**

It takes Arianna 15 minutes to make each swan. We can represent this as a rate \( \frac{15 \text{ minutes}}{\text{swan}} \). To make 9 swans we have

\[
9 \text{ swans} \times \frac{15 \text{ minutes}}{\text{swan}} = 9 \times 15 \text{ minutes}.
\]

We have \( 9 \times 15 = 135 \) so it takes Arianna 135 minutes to make 9 swans. There are 60 minutes per hour and so 2 hours is 120 minutes. It will take Arianna more than 2 hours to make the 9 swans.

Alternatively, Arianna can make \( \frac{1}{15} \) swans per minute. So in 2 hours or 120 minutes she can make

\[
120 \text{ minutes} \times \frac{1 \text{ swans}}{15 \text{ minute}} = \frac{120}{15} \text{ swans}.
\]

Since \( \frac{120}{8} = 15 \), Arianna can only make 8 swans, not 9, in 2 hours.