Square Roots Learning Strategies

What should students be able to do?

Students should be able to create a set of perfect squares and calculate their square roots, as well as estimate the square roots of non-perfect squares.

Common mistakes made by students:

Students may:

- Create an incorrect square area.
- Forget that the side length of the square is the square root of the area.
- Think that $\sqrt{9} = 9 \div 2 = 4.5$.
- Think that $\sqrt{9} = 9^2 = 9 \times 9 = 81$
- May estimate all roots to be “half-way between”. By knowing $\sqrt{9} = 3$ and $\sqrt{16} = 4$, the student may incorrectly write $\sqrt{10} = 3.5$.

Curriculum Connections:

- Please note all of the following correlations match outcomes in the new Mathematics Kindergarten to Grade 9 Program of Studies (2007).

Grade 8 Number SO1: Demonstrate an understanding of perfect squares and square roots, concretely, pictorially and symbolically (limited to whole numbers).

Grade 8 Number SO2: Determine the approximate square root of numbers that are not perfect squares (limited to whole numbers).

Grade 9 Number SO5: Determine the square root of positive rational numbers that are perfect squares.

Grade 9 Number SO6: Determine an approximate square root of positive rational numbers that are non-perfect squares.

Assessment notes:

*Note: The Print Activity is not intended to be an assessment piece

In the print activity, it is recommended that students use the “Explore It” mode to check their solutions. Students will be asked to continue creating the set of perfect squares and to calculate their square roots, as well as estimating the square roots of non-perfect squares. If only a portion of the print activity is sought for assessment purposes or you want to manipulate the questions, open the activity in Word format instead of PDF and make the changes yourself.
Solutions to the Print Activity:

1. a. 4 units

   b. 
   
   c. 4

   d. 4 is the side length of a square containing 16 squares. And since $4^2 = 16$, $\sqrt{16} = 4$. So 4 is called the square root of 16. Therefore, the answers to parts (a) and (c) are the same.

2. |
<table>
<thead>
<tr>
<th>Perfect Square</th>
<th>Square Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>16</td>
<td>4</td>
</tr>
<tr>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td>36</td>
<td>6</td>
</tr>
<tr>
<td>49</td>
<td>7</td>
</tr>
<tr>
<td>64</td>
<td>8</td>
</tr>
<tr>
<td>81</td>
<td>9</td>
</tr>
<tr>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>121</td>
<td>11</td>
</tr>
<tr>
<td>144</td>
<td>12</td>
</tr>
<tr>
<td>169</td>
<td>13</td>
</tr>
</tbody>
</table>

3. a. 64 units$^2$

   b. 8 units
c. The area of the checkerboard determined in part (a) is 64 units². The side length of the checkerboard determined in part (b) is 8 units.

Since $8^2 = 64$, 8 is the number whose square is 64. So, 8 is called the square root of 64.

Therefore, by knowing the side length is equal to the square root of the area, the square root of 64 can be easily determined. So $\sqrt{64} = 8$.

4. 

a. | Lower Perfect Square | Square Root |
<table>
<thead>
<tr>
<th></th>
<th></th>
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<tbody>
<tr>
<td>64</td>
<td>8</td>
</tr>
</tbody>
</table>

   Area = 75 units²

b. Upper Perfect Square.

c. 8.7 (acceptable answers = 8.6, 8.7, 8.8)

d. No. The value of 89 does not fall in the range of 64 and 81. (To estimate the value of $\sqrt{89}$, the lower perfect square to be used is 81 and the upper lower square to be used is 100.)

5. 

a. Area = 108 units²

<table>
<thead>
<tr>
<th>Lower Perfect Square</th>
<th>Square Root</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>10</td>
</tr>
</tbody>
</table>

Area = 108 units²

$\sqrt{108} = \boxed{10.4}$ (nearest tenth)

(Other acceptable answers = 10.3, 10.4, 10.5)
b. \( \text{Area} = 12 \text{ units}^2 \)

\[
\begin{array}{c|c}
\text{Lower Perfect Square} & \text{Square Root} \\
9 & 3 \\
\end{array}
\]

\( \sqrt{12} = 3.5 \) (Other acceptable answers = 3.4, 3.5, 3.6)

\[
\begin{array}{c|c}
\text{Upper Perfect Square} & \text{Square Root} \\
16 & 4 \\
\end{array}
\]

c. \( \text{Area} = 126.8 \text{ units}^2 \)

\[
\begin{array}{c|c}
\text{Lower Perfect Square} & \text{Square Root} \\
121 & 11 \\
\end{array}
\]

\( \sqrt{126.8} = 11.3 \) (Other acceptable answers = 11.2, 11.3, 11.4)

\[
\begin{array}{c|c}
\text{Upper Perfect Square} & \text{Square Root} \\
144 & 12 \\
\end{array}
\]
d. \[ \text{Area} = 46.2 \text{ units}^2 \]

<table>
<thead>
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<tbody>
<tr>
<td>36</td>
<td>6</td>
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</table>

\[ \sqrt{46.2} = \boxed{6.8} \] (Other acceptable answers = 6.7, 6.8, 6.9)

<table>
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</tr>
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<tbody>
<tr>
<td>49</td>
<td>7</td>
</tr>
</tbody>
</table>

6. \[ \sqrt{56} \quad E \]

\[ \sqrt{10} \quad C \]

\[ \sqrt{39} \quad A \]

\[ \sqrt{7} \quad D \]

\[ \sqrt{32} \quad F \]

\[ \sqrt{98} \quad B \]

7. a. 11

b. -11

c. 11 units

d. Length can only be a positive value. Therefore, the side length of the square can only be the principal square root of 121, which is 11 units.