Estimating Square Roots The calculator activity was adapted from a lesson idea written by Gary Tsuruda. "Determining $\sqrt{x}$ with Base Ten Blocks—Do the Block Lie?" *Mathematics Teacher*, January 1987, p 32-35. Author permission was received for this lesson adaptation.

Description	Instructor Notes	Slides/Handouts/Files
This activity examines one method for estimating square roots. Students are asked to compare the estimates to the decimal approximations from the square root function. It is a good example of changing windows to see trends more clearly.	This estimation method is based on building the larger squares from smaller squares of tiles, realizing that each square comes from the previous smaller square plus the "L-shaped piece." For non-squares, students consider what fractional part of the "L-piece" is present. That fraction is then used to estimate the decimal portion of irrational square root values. After a few examples, students generate lists to consider the estimated values from 1 to 64. By calculating the "error" between this new estimate and the calculator's usual decimal approximation (using the $\sqrt{\ }$ key), students view an interesting function. This method of estimating square roots is actually a collection of short segments (with different slopes) that lie just below the curve of the function f(x) = $\sqrt{x}$.	1) Student tile sheet 2) Calculator instructions for making the lists and viewing the results.

Participant Discussion

1. How is a square root of a perfect square connected to an actual square?
2. How can we make that connection to a square for numbers that do not have exact square roots?
3. Explain the connection to an actual square when the calculator reports that $\sqrt{90}\approx 9.486832981$?
4. Why does the fractional "L-piece" method always give an estimate that falls below the actual square root?
5. When compared to using the square root function button, this approximation method is not very efficient. Is it useful in any other way?
6. Is this method more accurate when finding square roots for values less than 50 or for values greater than 100? How do you know?
7. Can you find the concept of slope anywhere in this process?

Calculator Functions

This activity gives students concentrated practice with several TI-73 actions, including multiple lists with algebraic rules that involve the sequence function, the fraction key, the iPart function, and the square root function. When viewing the difference function that measures the "error" in the estimates, they will need to think carefully about the window parameters. It is helpful to view that graph in sections initially.