

Name: LaRie Hillman

Grade Level/Subject: Pre-Algebra (higher as needed)

Topic: Grasping Squares, Square Roots, Cubes and Cube Roots

Objectives (P.A.S.S.): Algebra I Standard 1.2.a. Simplify and Evaluate Radical Expressions.

Introduction: The idea of squares and "square numbers" that you can take the square root of seems to present problems to some students even in Algebra II. Our Holt Pre-Algebra book introduced an idea of using small cubes to make larger cubes ahead of the lesson on cubing and cube roots and I took it down a level to graph paper for squares and square roots. These were not both actually done the same day, but were done close together. The squares problem was more of an introduction to square roots at the beginning of a lesson, while the cube problem was an all class period lesson to help them see the third dimension.

Materials needed: One sheet of graph paper per student with no axis, just fairly large squares works best for that lesson. You may also want them to use rulers to keep their lines straight. For the cubes, the book suggested "cm cubes" which can probably be ordered somewhere, but I have used "Alphabet cube beads" from Oriental Traders for a much more economical substitute. We used plastic ones with some success for a few years, but they are a little irregular. This summer I saw and ordered wooden ones (still alphabet beads) that seem to work much easier. I have also found that if you can some small three walled cubes to give them something to stack into, they keep at it with less discouragement. I simply used a stiff paper cut in squares that I taped as a bottom and two adjacent sides to create the corner to stack into.

Instructional process: For the graph paper assignment. Have students draw squares on their paper. You can give them the dimensions or ask them to draw specific ones. Then ask them to write inside each square what its dimensions are and how many grid squares are inside. Most don't take long to realize it is simply the length of the sides multiplied together. I then emphasize to them that when we talk about square numbers, it is simply numbers that can make up the inside of a square. Then we talk about taking a square root being the same as figuring out the length of a side of a square made with their given number of squares. Then that can lead into talking about those numbers that are not square numbers and how we take the square roots of them. I then ask them to make me a list of square numbers (usually up to 15 squared).

For the cubes, the students for instructions and a page in their book that is called a "Hands-On Lab". All you really need to do it without the book, is to first ask students to create cubes, such as one 2 cubes each of 3 dimensions, then 3 cubes each direction and then 4 cubes. It is usually best to have them work in pairs. As they make each cube, they need to record its dimensions and how many smaller cubes it took to make the larger cube. After those three are completed, then ask them to see if they can make a cube out

of 20 cubes, 36 cubes, and so on. Be sure to remind them that a cube must have the same dimensions all three ways. After they have tried this for various numbers, ask them to make a chart of numbers that can be used to make cubes. This will then lead back to talking about cube roots and what that means as well as what it means to cube a number.

Closure: Bringing it all back together at the end with their square and cubic number lists added to their notebooks and talking about that in relation to square roots and cube roots was the closure.

Assessment: Normally their number list and any worksheet or graph paper used along with their classroom response would be my main assessment; however, this time, I decided this would be a good lesson for the pre and post test, so that was another assessment available this year.

Modifications/Accommodations: This seems to be a lesson with little need for modification. Not moving into quite as large of numbers as we usually use would be the only modification I can think of for a very low achiever. If a student were unable to handle the small cubes because of physical limitations, they could be a coach or observer with another group.

Reflection: I think this lesson gives a little more concrete example to those struggling with radicals. Although it seems very simplistic, I couldn't help but wonder if I would have used at least a short version of this with the Algebra II students if it would have cut down on some of their errors as we learned to simplify radicals.