Unit 7: Radical Expressions

Unit 7: Radical Expressions

Unit Table of Contents

Unit 7

Lesson 1

Topic 1, Presentation - 5.5 minutes
Topic 1, Worked Example 1 – 2.4 minutes
Topic 1, Worked Example 2 – 3.9 minutes
Topic 1, Worked Example 3 – 4.8 minutes

Topic 2, Presentation – 4.6 minutes
Topic 2, Worked Example 1 – 5.5 minutes
Topic 2, Worked Example 2 – 3.9 minutes
Topic 2, Worked Example 3 – 6.3 minutes

Topic 3, Presentation – 4.9 minutes
Topic 3, Worked Example 1 – 2 minutes
Topic 3, Worked Example 2 – 3.5 minutes
Topic 3, Worked Example 3 – 2.5 minutes

Lesson 2

Topic 1, Presentation – 4 minutes
Topic 1, Worked Example 1 – 4.5 minutes
Topic 1, Worked Example 2 – 4.2 minutes

Lesson 3

Topic 1, Presentation – 4.8 minutes
Topic 1, Worked Example 1 – 2.6 minutes
Topic 1, Worked Example 2 – 2.8 minutes
Topic 1, Worked Example 3 – 3.1 minutes

Topic 2, Presentation – 3 minutes
Topic 2, Worked Example 1 – 2.2 minutes
Topic 2, Worked Example 2 – 3.5 minutes
Topic 2, Worked Example 3 – 4.3 minutes

Topic 3, Presentation – 3.2 minutes
Topic 3, Worked Example 1 – 5.4 minutes
Topic 3, Worked Example 2 – 6.9 minutes
Topic 3, Worked Example 3 – 3.3 minutes

Topic 4, Presentation – 4.8 minutes
Topic 4, Worked Example 1 – 2 minutes
Topic 4, Worked Example 2 – 7.5 minutes

Unit 7: Radical Expressions

Instructor Notes

The Mathematics of Exponents and Radical Expressions

To a large degree this unit is transitional–rather than introducing entirely new ideas, it extends known concepts. Students will expand their knowledge of exponents and roots into more complex notation and procedures that they'll need in order to tackle problems later in the course.

Once they complete this unit, students will be able to simplify algebraic expressions with exponents (necessary for working with polynomials in Unit 8 and rational functions in Unit 11.) They'll also know how to simplify radical expressions (needed to solve quadratic equations in Unit 10). Students will also understand how to apply the Pythagorean Theorem to real world problems, learn to read and write scientific notation, and gain experience solving radical equations. (These last skills are useful, but not fundamental to the rest of the course. Depending on your state's testing requirements, it may be possible to reduce the importance of this material to devote more teaching time to the critical concepts.)

Teaching Tips: Algorithmic Challenges and Approaches

Simplifying radical expressions is a common stumbling block in this unit, but it's a skill students have to master to succeed in the course. The combination of radicals and exponents looks daunting and can require multiple skills to solve. Make sure students understand the fundamentals, start simply, insist that students write down every step at first, and question them about the goal of each one. Give them lots and lots of practice. In order to simplify radicals effectively, students need to be comfortable factoring numbers. While this skill was likely covered in earlier courses, you may find that students need to brush up before they can begin the real work of Unit 7.

Once the fundamentals are in place, start by simplifying expressions such as $\sqrt{x^3}$. It will make sense to students that since x^3 is equivalent to $x^2 \cdot x$, $\sqrt{x^3}$ is the same as finding $\sqrt{x^2 \cdot x}$. This is easy to simplify to $\sqrt{x^2}\sqrt{x}$ and finally to $x\sqrt{x}$. Once students understand that their first goal is to find and isolate all the square terms under the radicand, you can introduce more difficult problems. The key is to have students practice this technique with problem sets that gradually increase in complexity.

We recommend that you follow the example used in the topic texts, presentations, and worked problems –show every step and explain how each advances the goal of pulling out and simplifying the squares.

It is important that when students work on their own, they also write out all the steps, at least initially. While the course materials do clearly explain that the square root of a product is equal to the product of the square roots, this may be easily misunderstood at first. Informally question students as they work, until they can explain each of the steps as shown in this example:

$\sqrt{75x^5y^3z^7}$	Simplify
$\sqrt{3\cdot 25\cdot x\cdot x^4 y\cdot y^2\cdot z\cdot z^6}$	Split each term into a square and the remaining factor
$\sqrt{25x^4y^2z^6}\sqrt{3xyz}$	Because the square root of a product is the product of the square roots, we can collect all the square numbers under one square root, and all the remaining numbers under another
$\sqrt{25}\sqrt{x^4}\sqrt{y^2}\sqrt{z^6}\sqrt{3xyz}$	We can now take the square root of each term individually
$5x^2yz^3\sqrt{3xyz}$	Using the exponent rules we can simplify to this expression

Additional Resources

For students who need to refresh their factoring skills, an applet like this may help:
http://www.mathgoodies.com/factors/prime_factors.html

As with most algebra, once the concepts are understood, the best way to really learn new skills is repetition. This course includes sample problems, but many more are available online at math sites such as the following:

- http://www.kutasoftware.com/FreeWorksheets/Alg1Worksheets/Simplifying%20Radicals.pdf

Summary

This unit teaches ideas and techniques for simplifying radical expressions and expressions with exponents that are critical to the successful completion of this course and subsequent courses such as Algebra 2 and Geometry. Students can master this material if they are reminded of their existing knowledge of factoring, radicals, and exponents, and if they are taken through the new procedures step by step, with a gradual increase in complexity.

Unit 7: Radical Expressions

Instructor Overview
Tutor Simulation: Calculating Miles

Purpose

This simulation is designed to challenge a student's understanding of exponents and square roots. Students will be asked to apply what they have learned to solve a real world problem by demonstrating understanding of the following areas:

- Visualizing a Problem
- Applying Formulas to Solve a Problem
- Exponents
- Square Roots
- Pythagorean Theorem
- Simplifying Radical Expressions

Problem

Students are given the following problem:

> Antonio rides his bike everywhere. Every Saturday he rides from his house to the basketball court at the park, then to the swimming pool, then back home. Your challenge will be to help Antonio figure out how far he rides every Saturday.

Recommendations

Tutor simulations are designed to give students a chance to assess their understanding of unit material in a personal, risk-free situation. Before directing students to the simulation,

- make sure they have completed all other unit material.
- explain the mechanics of tutor simulations
  - Students will be given a problem and then guided through its solution by a video tutor;
  - After each answer is chosen, students should wait for tutor feedback before continuing;
  - After the simulation is completed, students will be given an assessment of their efforts. If areas of concern are found, the students should review unit materials or seek help from their instructor.
- emphasize that this is an exploration, not an exam.

Unit 7: Radical Expressions

Instructor Overview
Puzzle: Pythagoras' Proof

Objective

Pythagoras' Proof is a puzzle designed to show students the reasoning behind the Pythagorean Theorem of $a^2 + b^2 = c^2$. According to the theorem, the sum of the squares of the two legs of a right triangle equals the square of the hypotenuse. A simple and elegant proof of this is to make each side of the triangle one side of a square. If the theorem is correct, the combined areas of the two smallest squares will be the same as the area of the largest square.

In this puzzle, students will see that this proof holds, and the theorem is indeed true.

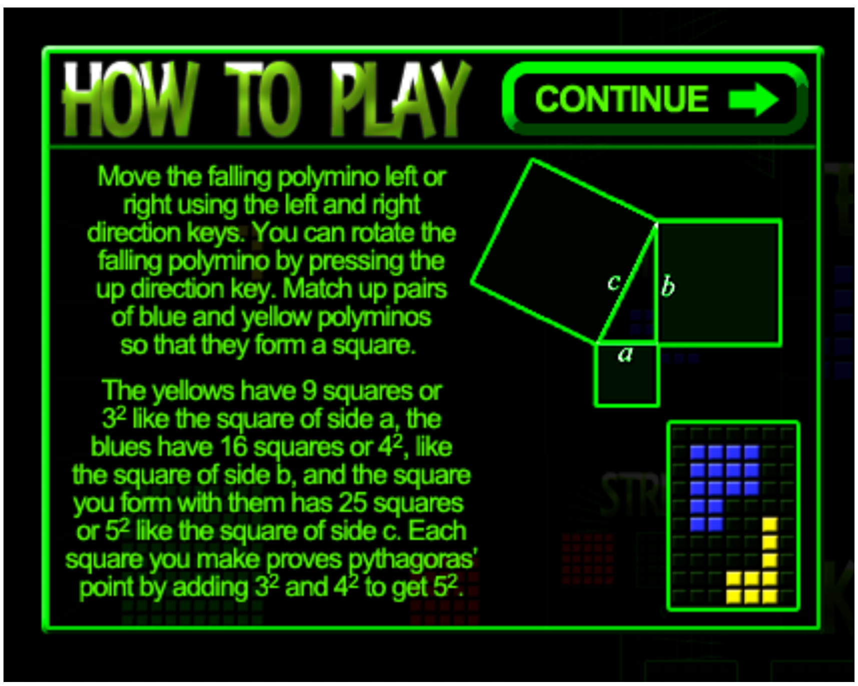

Figure 1. *Pythagoras' Proof reinforces students' grasp of the Pythagorean Theorem by turning* a^2 and b^2 *into shapes that they combine to form* c^2.

Description

This puzzle is a Tetris-style game that asks players to combine two irregular shapes to form a square. Each pair consists of a yellow shape made up of 9 small squares, and a blue shape formed from 16 squares. The yellow shape represents the a^2 in the Pythagorean Theorem, and the blue shape the b^2. When these two shapes are lined up correctly, they form a green square composed of 25 small squares—this square represents the c^2. After sufficient play, students will see that no matter how the squares are oriented relative to one another, a^2 and b^2 can always combine to equal c^2.

To play the game, players rotate dropping polyominoes so that they fit together. If the arrangement creates a square, the polyominoes turn green. If it doesn't, the pieces turn red. Players earn points for every square they put together and strikes for every mistake. Game play continues until three strikes occur.

Pythagoras' Proof is suitable for individual play, but it could also be used in a classroom situation to introduce the simple but profound theorem that it illustrates.

At the easy level there are three kinds of objects (apples, oranges, and cherries) grouped into two arrangements. The medium level also presents a two equation system, but the three objects (opals, emeralds, and rubies) are grouped in a more complicated way. At the hard level, there are four objects (rockets, spaceships, ray guns, and asteroids) arranged into a system of three equations.

Players score points for solving the puzzles and the points accumulate across puzzles. The ten puzzles at each level are scripted, but they are sufficiently difficult to solve visually that there is opportunity for replay. *Apples and Oranges* is suitable for both individual play and group learning in a classroom setting.

Unit 7: Radical Expressions

Instructor Overview
Project: Have Ruler...Will Travel

Student Instructions

Introduction
Humans have been using standard units to measure length for thousands of years. Over time, the units have evolved and the accuracy of measurement has increased. Land surveyors now have precise lasers and GPS systems to measure distances accurately. Although as students, we are limited in our access to lasers and GPS, we will compare distance measured with a tape measure to a new technology available for free to the public. Using satellite images and aerial photography, Google Earth offers a remarkably accurate way for us to measure distances.

Task
Working together with your group, you will select three rectangular locations to measure. After measuring the length and width of each location, you will use the Pythagorean Theorem to calculate the length of the diagonal. Then you will measure the actual distance of the diagonal. When you have completed all of your measurements, you will check your work for accuracy by using Google Earth to measure the distances. Finally, you will create a Google Earth Tour of your chosen locations.

Instructions
Solve each problem in order. Save your work along the way as you will create a presentation at the conclusion of the project.

1. First problem:
   - With your group, choose three, large, local rectangles or squares to measure. You will need to pick locations where it is possible to measure the length, width, and diagonal. Ideal locations include: football field, baseball diamond, soccer field, etc. Be creative. Try to pick locations that are individual to your team.

     Hint: (A city block would not be appropriate, as you would not be able to measure the diagonal with a measuring tape. Most people tend not to like students climbing through their back yards.)

2. Second problem:
   - Once your group is happy with the three locations chosen, you will begin measuring. First, measure the length and width of the location by either using a measuring tape or pacing off the length, if necessary. You may measure in customary or metric units, depending on your tape measure. The measuring tape will give you the most accurate reading, but for some very large locations, you may need to pace off the lengths. Record the length and width of the location in the table below.

- Follow the link below to increase your accuracy at pacing.
  http://www.ehow.com/how_4497078_estimate-distance-using-pace-count.html

3 Third Problem:

- Using the length and width of the location, imagine drawing in the diagonal. The diagonal would split the rectangle into two congruent, right triangles. We could consider the length to be side *a* and the width to be side *b*. Using the Pythagorean Theorem, substitute sides *a* and *b* into the formula to find side *c*. Show your work in the table below.

- Give your answer for side *c* in simplified radical form and record it in the table.

  Hint: (Are there any perfect squares that can be factored out of the radical?)

- Now, evaluate your answer to the nearest tenth using a calculator and record.

  Hint: (Although the answer in simplified radical form is exact, the answer to the nearest tenth is more meaningful for measuring distance.)

- Finally, measure or pace off the diagonal and record the measurement in the table.

  Hint: (Now move on to your next location. To make the best use of your time, complete all of the above steps at one location, before moving on to the next.)

Location	Measurement Length, side *a*	Measurement Width, side *b*	Given *a* & *b*, use the Pythagorean Theorem to solve for *c*. Give your answer in simplified radical form and rounded to the tenth. Remember: $a^2 + b^2 = c^2$	Measurement Diagonal, side *c*
1				
2				
3				

4 Fourth problem:

- Now that you have the table filled out with your measurements, we will use Google Earth to check for accuracy. Google Earth is a free download: http://earth.google.com/download-earth.html

- Open Google Earth and type your city and state into the "Fly to" textbox on the top left. Then hit enter. You should now see an aerial view of your city. Tools for zooming in and out and panning in all directions are located at the top right of the map. Use the tools to find your first location and zoom in as close as possible.

- Notice the toolbar with small buttons at the top of the map. Select the "Show Ruler" button, that looks like a ruler. Being as precise as possible, click on the map to drop your start and stop points. The ruler is set to measure in miles as the default but can be changed to measure in feet or meters. Measure the lengths of sides *a*, *b*, and *c*. Record your results in the table below. Repeat for the next two locations.

  Hint: (While zoomed in on each location, it would be helpful to mark the place by selecting the "Add Placemark" button, that looks like a thumbtack. Then change the name of the location and click ok. We will use the places to create a Google Earth Tour later.)

Location	Google Earth Measurement Length, side *a*	Google Earth Measurement Width, side *b*	Google Earth Measurement Diagonal, side *c*
1			
2			
3			

Collaboration
Get together with another group to discuss the accuracy of your results. Discuss the following:

- How will you determine accuracy?
- Which group had more accurate results? How do you know?
- Did the accuracy vary from location to location? Why?

Conclusions
Your project will be a Google Earth Tour and a presentation of your results. You may choose to represent your results on a poster or by making a multimedia presentation.

Please make sure that both tables are neatly presented as well as the step-by-step algebra to solve for *c* using the Pythagorean Theorem. Also, include a discussion of your accuracy, using the questions above for guidance.

In order to make the Google Earth Tour, you need to have a place marker at each location. See the hint for problem four if you have not already marked the places. Now select Tour under the Add Menu at the top of the screen. You will begin recording when you press the red record button on the lower left. Move from place to place and hit the record button to stop. Your tour will then play. If you are happy with it, save the tour by selecting the save file button to the right of the playback bar.

Hint: (You can then save the tour under File, Save, Save Place As. It can be saved on the desktop or to a flash drive. The file saves as a .kmz file and is not easily imported into Power Point. For this reason, it would be best to play your tour separately from the rest of your presentation.)

Instructor Notes

Assignment Procedures

Problem 1
Large, rectangular locations may not be available on the school grounds. If possible, allow students to conduct the majority of this project outside of class. This would allow a greater variety of locations and encourage the students to explore their community.

Problem 4
Find out if students are familiar with Google Earth, and explain how to use it to individuals or the class as needed. Google Earth is a very user-friendly program that should be picked up quite quickly by the students.

Collaboration
The collaboration offers a great opportunity to discuss the concept of percent error. Consider the following:

Group 1		Group 2	
Google Earth	Student Measurement	Google Earth	Student Measurement
230 ft.	256 ft.	110 ft.	126 ft.
Error! Objects cannot be created from editing field codes.		**Error! Objects cannot be created from editing field codes.**	

Many students would consider Group 2 to be more accurate than Group 1 because their measurement was closer. After the students have discussed accuracy for a while, bring up the idea of percent error, and then have them re-evaluate their conclusions about accuracy.

Recommendations:

- have students work in teams to encourage brainstorming and cooperative learning.
- assign a specific timeline for completion of the project that includes milestone dates.
- provide students feedback as they complete each milestone.
- ensure that each member of student groups has a specific job.

Technology Integration

This project provides abundant opportunities for technology integration, and gives students the chance to research and collaborate using online technology.

The following are examples of free internet resources that can be used to support this project:

http://earth.google.com/download-earth.html
Google Earth lets students explore overhead views of objects in their own communities, and to measure them accurately.

http://www.moodle.org
An Open Source Course Management System (CMS), also known as a Learning Management System (LMS) or a Virtual Learning Environment (VLE). Moodle has become very popular among educators around the world as a tool for creating online dynamic websites for their students.

http://www.wikispaces.com/site/for/teachers or http://pbworks.com/content/edu+overview
Lets you create a secure online Wiki workspace in about 60 seconds. Encourage classroom participation with interactive Wiki pages that students can view and edit from any computer. Share class resources and completed student work with parents.

http://www.docs.google.com
Allows students to collaborate in real-time from any computer. Google Docs provides free access and storage for word processing, spreadsheets, presentations, and surveys. This is ideal for group projects.

http://why.openoffice.org/
The leading open-source office software suite for word processing, spreadsheets, presentations, graphics, databases and more. It can read and write files from other common office software packages like Microsoft Word or Excel and MacWorks. It can be downloaded and used completely free of charge for any purpose.

Rubric

Score	**Content**	**Presentation**
4	Your project appropriately answers each of the problems. Tables are included and are complete. The step-by-step solution to each Pythagorean	Your project contains information presented in a logical and interesting sequence that is easy to follow. Your project is professional looking with

	problem is given. Your project is mathematically correct as it approaches the accuracy of the measurements and comments on any sources of error.	graphics and attractive use of color.
3	Your project answers each of the problems. Tables are included and are complete. The step-by-step solution to each Pythagorean problem is given. Minor errors may be noted. Your project approaches the accuracy of the measurements and comments on any sources of error. Minor errors may be noted.	Your project contains information presented in a logical sequence that is easy to follow. Your project is neat with graphics and attractive use of color.
2	Your project attempts to answer each of the problems. Tables are included and are mostly complete. The step-by-step solution to each Pythagorean problem is missing and/or major errors are noted. Your project attempts to address accuracy of the measurements, but major mathematical errors are noted. Your project contains little discussion of the sources of error.	Your project is hard to follow because the material is presented in a manner that jumps around between unconnected topics. Your project contains low quality graphics and colors that do not add interest to the project.
1	Your project attempts to answer some of the problems. Some tables are included and are mostly incomplete. Step-by-step solutions to each Pythagorean problem are missing and major errors are noted. Your project makes little attempt to address accuracy or sources of error.	Your project is difficult to understand because there is no sequence of information. Your project is missing graphics and uses little to no color.

Unit 7: Algebra - Radical Expressions

Glossary

base	the value that is raised to a power when a number is written in exponential notation. In the term 5^3, 5 is the base and 3 is the exponent.
exponent	the value that indicates the number of times another value is multiplied by itself in exponential notation. The exponent, also called the power, is written in superscript. In the term 5^3, 5 is the base and 3 is the exponent.
exponential notation	a condensed way of expressing repeated multiplication of a value by itself. Exponential notation consists of a base and an exponent. In the exponential term 5^3, 5 is the base and 3 is the exponent. This is a shorthand way of writing 5 • 5 • 5. Also called exponential form.
factor	for any number x, the numbers that can be evenly divided into x are called factors of x. For example, the number 20 has the factors 1, 2, 4, 5, 10, and 20.
hypotenuse	the side opposite the right angle in any right triangle—the hypotenuse is the longest side in a right triangle
leg	in a right triangle, one of the two sides creating the right angle
perfect square	any of the squares of the integers. Since 12 = 1, 22 = 4, 32 = 9, etc., 1, 4, and 9 are perfect squares
power	a way of describing the exponent in exponential notation. We can say the base is raised to the power of the exponent. For example we read x5 as “x raised to the 5th power.”
power of a power	raising a value written in exponential notation to a power as in (x2)3
product of powers	multiplication of two or more values in exponential form that have the same base—the base stays the same and the exponents are added
Pythagoras	a Greek philosopher and mathematician who lived in the 6th Century BC
Pythagorean Theorem	the formula used to relate the lengths of the sides in any right triangle $a^2+b^2=c^2$
quotient of powers	division of two or more values in exponential form that have the same base—the base stays the same and the exponent in the denominator is subtracted from the exponent in the numerator

radical	the math symbol $\sqrt{}$, used to denote the process of taking a root of a quantity
radical equation	an equation that contains a variable within a radical term
radical expression	a quantity that contains a term with a radical, as in $2\sqrt{3}\ or\ \sqrt[3]{8a^3bc^6}$
radicand	the number under the radical symbol
raised to a power	a way of describing the exponent in exponential notation. We can say the base is “raised to the power” of the exponent. For example we read x5 as “x raised to the 5th power.”
right triangle	a triangle with one right angle
root	any number x multiplied by itself a specific number of times to produce another number, such that inxn = y, x is the nth root of y – for example, because 23 = 8, 2 is the 3rd (or cube) root of 8
scientific notation	a convention for writing very large and very small numbers in which a number is expressed as the product of a power of 10 and a number that is greater than or equal to 1 and less than 10 as in 3.2 • 104

NROC Algebra 1--An Open Course
Unit 7: Radical Expressions
Mapped to Common Core State Standards, Mathematics

Unit 7, Lesson 1, Topic 1: Rules of Exponents

Grade: 8 - Adopted 2010

STRAND / DOMAIN	CC.8.EE.	Expressions and Equations
CATEGORY / CLUSTER		Work with radicals and integer exponents.
STANDARD	8.EE.1.	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27.

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.N.	Number and Quantity
CATEGORY / CLUSTER	N-RN.	The Real Number System
STANDARD		Extend the properties of exponents to rational exponents.
EXPECTATION	N-RN.2.	Rewrite expressions involving radicals and rational exponents using the properties of exponents.

Unit 7, Lesson 1, Topic 2: Scientific Notation

Grade: 8 - Adopted 2010

STRAND / DOMAIN	CC.8.EE.	Expressions and Equations
CATEGORY / CLUSTER		Work with radicals and integer exponents.
STANDARD	8.EE.3.	Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times 10^8 and the population of the world as 7 times 10^9, and determine that the world population is more than 20 times larger.
STANDARD	8.EE.4.	Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities (e.g., use millimeters per year for seafloor spreading). Interpret scientific notation that has been generated by technology.

Unit 7, Lesson 1, Topic 3: Simplifying Expressions with Exponents

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.A.	Algebra
CATEGORY / CLUSTER	A-SSE.	Seeing Structure in Expressions

STANDARD		Interpret the structure of expressions.
EXPECTATION	A-SSE.2.	Use the structure of an expression to identify ways to rewrite it. For example, see x^4 - y^4 as (x^2)^2 - (y^2)^2, thus recognizing it as a difference of squares that can be factored as (x^2 - y^2)(x^2 + y^2).

Unit 7, Lesson 2, Topic 1: Applications of the Pythagorean Theorem

Grade: 8 - Adopted 2010

STRAND / DOMAIN	CC.8.G.	Geometry
CATEGORY / CLUSTER		Understand and apply the Pythagorean Theorem.
STANDARD	8.G.6.	Explain a proof of the Pythagorean Theorem and its converse.
STANDARD	8.G.7.	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.G.	Geometry
CATEGORY / CLUSTER	G-SRT.	Similarity, Right Triangles, and Trigonometry
STANDARD		Define trigonometric ratios and solve problems involving right triangles
EXPECTATION	G-SRT.8.	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Unit 7, Lesson 3, Topic 1: Simplifying Radical Expressions

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.A.	Algebra
CATEGORY / CLUSTER	A-SSE.	Seeing Structure in Expressions
STANDARD		Interpret the structure of expressions.
EXPECTATION	A-SSE.2.	Use the structure of an expression to identify ways to rewrite it. For example, see x^4 - y^4 as (x^2)^2 - (y^2)^2, thus recognizing it as a difference of squares that can be factored as (x^2 - y^2)(x^2 + y^2).

Unit 7, Lesson 3, Topic 2: Solving Radical Equations

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.A.	Algebra
CATEGORY / CLUSTER	A-REI.	Reasoning with Equations and Inequalities
STANDARD		Understand solving equations as a process of reasoning and explain the reasoning.
EXPECTATION	A-REI.1.	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.

EXPECTATION	A-REI.2.	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
STRAND / DOMAIN	CC.F.	Functions
CATEGORY / CLUSTER	F-BF.	Building Functions
STANDARD		Build new functions from existing functions.
EXPECTATION	F-BF.4.	Find inverse functions.
GRADE EXPECTATION	F-BF.4.a.	Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2 x^3 for x > 0 or f(x) = (x+1)/(x-1) for x not equal to 1.

Unit 7, Lesson 3, Topic 3: Applying Radical Equations

Grade: 8 - Adopted 2010

STRAND / DOMAIN	CC.8.G.	Geometry
CATEGORY / CLUSTER		Understand and apply the Pythagorean Theorem.
STANDARD	8.G.7.	Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	CC.A.	Algebra
CATEGORY / CLUSTER	A-REI.	Reasoning with Equations and Inequalities
STANDARD		Understand solving equations as a process of reasoning and explain the reasoning.
EXPECTATION	A-REI.1.	Explain each step in solving a simple equation as following from the equality of numbers asserted at the previous step, starting from the assumption that the original equation has a solution. Construct a viable argument to justify a solution method.
EXPECTATION	A-REI.2.	Solve simple rational and radical equations in one variable, and give examples showing how extraneous solutions may arise.
STRAND / DOMAIN	CC.F.	Functions
CATEGORY / CLUSTER	F-BF.	Building Functions
STANDARD		Build new functions from existing functions.
EXPECTATION	F-BF.4.	Find inverse functions.
GRADE EXPECTATION	F-BF.4.a.	Solve an equation of the form f(x) = c for a simple function f that has an inverse and write an expression for the inverse. For example, f(x) =2 x^3 for x > 0 or f(x) = (x+1)/(x-1) for x not equal to 1.
STRAND / DOMAIN	CC.G.	Geometry
CATEGORY / CLUSTER	G-SRT.	Similarity, Right Triangles, and Trigonometry
STANDARD		Define trigonometric ratios and solve problems involving right triangles
EXPECTATION	G-SRT.8.	Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems.

Unit 7, Lesson 3, Topic 4: Fractional Exponents

Grade: 8 - Adopted 2010

STRAND / DOMAIN	**CC.8.EE.**	Expressions and Equations
CATEGORY / CLUSTER		Work with radicals and integer exponents.
STANDARD	**8.EE.1.**	Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 3^2 x 3^-5 = 3^-3 = 1/3^3 = 1/27.

Grade: 9-12 - Adopted 2010

STRAND / DOMAIN	**CC.N.**	Number and Quantity
CATEGORY / CLUSTER	**N-RN.**	The Real Number System
STANDARD		Extend the properties of exponents to rational exponents.
EXPECTATION	**N-RN.1.**	Explain how the definition of the meaning of rational exponents follows from extending the properties of integer exponents to those values, allowing for a notation for radicals in terms of rational exponents. For example, we define 5^1/3 to be the cube root of 5 because we want (5^1/3)^3 = 5^(1/3)^3 to hold, so (5^1/3)^3 must equal 5.
EXPECTATION	**N-RN.2.**	Rewrite expressions involving radicals and rational exponents using the properties of exponents.