Tier 2 Algebra 2 Unit Plan

Unit 4: Radical Functions and Rational Exponents

ORANGE PUBLIC SCHOOLS 2015 - 2016

OFFICE OF CURRICULUM AND INSTRUCTION

OFFICE OF MATHEMATICS

Contents

Unit Overview

Unit 4: Radical Functions and Rational Exponents
Essential Questions
➢ To simplify the nth root of an expression, what must be true about the expression? ➢ When you square each side of an equation, is the resulting equation equivalent to the original? ➢ How are a function and its inverse function related?
Enduring Understandings
➢ Corresponding to every power, there is a root. For example, just as there are squares (second powers), there are square roots. Just as there are cubes (third powers), there are cube roots, and so on. ➢ If $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a}\sqrt[n]{b} = \sqrt[n]{ab}$ ➢ You can combine like radicals using properties of real numbers. ➢ You can write a radical expression in an equivalent form using a fractional (rational) exponent instead of a radical sign. ➢ Solving a square root equation may require that you square each side of the equation. This can introduce extraneous solutions.
Common Core State Standards
➢ **A.CED.4**: Create equations that describe number or relationships. ➢ **A.SSE.2:** Use the structure of an expression to identify ways to rewrite it. ➢ **A.**SSE.3c: Use the properties of exponents to transform expressions for exponential functions. ➢ **A.REI.2:** Solve simple rational and radical equations in one variable, and give examples showing ➢ how extraneous solution may arise. ➢ F.BF.1.b: combine standard function types using arithmetic operations. ➢ **F.BF.4.a:** Find inverse functions. 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. ➢ **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 4 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5. ➢ **N.RN.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents. M : Major Content S: Supporting Content A : Additional Content

Algebra 2 Unit 4

Calendar (Honors)

March 2016						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
		3/1	3/2	3/3	3/4	3/5
3/6	3/7	3/8	3/9	3/10	3/11	3/12
3/13	3/14	3/15	3/16	3/17	3/18	3/19
3/20	3/21	3/22	3/23	3/24	3/25 School Closed	3/26
February 2015						
Sun	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**
3/27	3/28	3/29	3/30	3/31	4/1	4/2
4/3	4/4	4/5	4/6	4/7	4/8	4/9

Scope and Sequence

Overview		
Lesson	Topic	Suggesting Pacing and Dates
1	Roots and Radical Expressions	2 days
2	Multiplying and Dividing Radical Expressions	2 days
3	Binomial Radical Expressions	3days
4	Rational Exponents	2 days
5	Solving Square Root and Other Radical Equations	3 days
6	Function Operations	2 days
7	Inverse Relation and Functions	2 days

Assessment Framework

Assessment	CCSS	Estimated Time	Format	Graded
Diagnostic/Readiness Assessment (Beginning of Unit)		½ Block	Individual	No
Assessment Check Up 1 (After Lesson 3)	A.SSE.2, N.RN.1, N.RN.2	½ Block	Individual	Yes
Performance (Critical Area) Task Radical Equations	A.REI.2, A.CED.4	½ Block	Individual	Yes
Check up 2 (After Lesson 6)	N.RN.2, N.RN.1, A.REI.2, A.SSE.3c, A.CED.4, F.BF.4.a, F.BF.4.c	½ Block	Individual	Yes
Performance (Modeling)Task Who wins the Race?	A-REI.2,	1 Block	Individual	Yes
Unit 4 Assessment	A.SSE.2, N.RN.2, N.RN.1, A.REI.2, A.CED.4,F.BF.1b, F.BF.4.a,	1 Block	Individual	Yes
Others				

Lesson Analysis

Lesson 1: Roots and Radical Expressions

Objective
- Using the *n*th Roots of *n*th Powers Property, SWBAT find *n*th roots, ASB correctly answering _____ exit slip questions.

Focused Mathematical Practices
- MP1: Make sense of problems and persevere in solving them
- MP2: Reason abstractly and quantitatively
- MP3: Construct viable arguments and critique the reasoning of others
- MP7: Look for and make use of structure

Vocabulary: *n*th root, principal root, radicand, index, cube root, radical expression

Common Misconceptions:
- Determining roots corresponding to every real power – students may think that the root is always a real number. Students must understand that if the index is even, the root of a negative number is not a real number.
- When finding roots of variables, students may be confused by the placement of the absolute value signs. They are needed if and only if all of the following are true: the index is even, the power of the variable in the radicand is even, and the power of the variable in the root is odd.
- Determining principal root – student must remember that the principal root is only the *positive* root.

Most relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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 4 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5. **N.RN.2**: Rewrite expressions involving radicals and rational exponents using the properties of exponents. **A.SSE.2**: Use the structure of an	***Review*** • "root" represents a solution of an equation – refer to Unit 3 • Properties of exponents ***New*** • Corresponding to every power, there is a root • If $a^n = b$, with *a* and *b* real numbers and *n* is a positive integer, then *a* is an *n*th root of *b*. • If *n* is odd: there is one real *n*th root of *b*, denoted in radical form as $\sqrt[n]{b}$ • If *n* is even: **and *b* is positive** – there are two real *n*th roots of *b*. The positive root is the principal root, and its symbol is $\sqrt[n]{b}$. The negative root is its opposite, or $-\sqrt[n]{b}$. **and**	***Review*** • Simplifying and rewriting expressions using only positive exponents (using properties of exponents) ***New*** • Find the root of a fraction (numerator and denominator separately) • Finding all real roots • Simplifying radical expressions by using definition o roots or properties of exponents	Lesson 6.1 / online textbook resources	2 days	Lesson Check: pg. 364 (use as exit slip)

expression to identify ways to rewrite it	***b* is negative** – there are no real *n*th roots of *b*. • The only *n*th root of 0 is 0. • *n*th Roots of *n*th Powers Property				

Lesson 2: Multiplying and Dividing Radical Expressions

Objective

- Using product and quotient properties for combining radical expressions, SWBAT multiply and divide radical expressions, ASB correctly answering ____ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 3: Construct viable arguments and critique the reasoning of others

Vocabulary: simplest form of a radical, rationalize the denominator, reduce a radical, product, quotient

Common Misconceptions:

- Properties for multiplying and dividing radical expressions apply only to real numbers. Students may try to use these properties for complex numbers.
- Students may forget to write absolute value symbols when simplify roots with even-numbered indexes.
- Properties for multiplying and dividing radical expressions – students may try to multiply radical expressions with different indexes.
- Simplifying radical expressions – students may struggle with finding perfect square and cube factors to use when simplifying radicals.

Most Relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
N.RN.2: Rewrite expressions involving radicals and rational exponents using the properties of exponents **A.SSE.2**: Use structure of an expression to identify ways to rewrite it.	***Review*** • Perfect squares and perfect cubes • You can simplify the product of powers that have the same exponent ***New*** • You can simplify a radical expression when the exponent of one factor of the radicand is a multiple of the radical's index • You can simplify the product of radicals that have the same index • **if $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers, then $\sqrt[n]{a}\sqrt[n]{b} = \sqrt[n]{ab}$** • If the radicand of $\sqrt[n]{a}$ has a perfect *n*th power among its factors, you can reduce the radical • if $\sqrt[n]{a}$ and $\sqrt[n]{b}$ are real numbers and $b \neq 0$, then $\frac{\sqrt[n]{a}}{\sqrt[n]{b}} = \sqrt[n]{\frac{a}{b}}$	***Review*** • Simplifying expressions using properties of exponents ***New*** • Multiply radical expressions • Simplify radical expressions • Simplify a product of radicals • Divide radical expressions (not involved rationalizing the denominator)	Lesson 6.2 / online textbook resources Note: Skip rationalize the denominator	2 days	Lesson check: pg 370

Lesson 3: Binomial Radical Expressions

Objective

- Using sum and difference properties for combining radical expressions, SWBAT add and subtract radical expressions, ASB correctly answering ______ exit slip questions.
- Using FOIL method, SWBAT multiply binomials that have radical expressions, ASB correctly answering ______ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 3: Construct viable arguments and critique the reasoning of others

Vocabulary: like radicals, distributive property, conjugate, rationalize the denominator

Common Misconceptions:

- Students may operate with the radicands when combining like radicals. For example, saying that $10\sqrt{6} + 2\sqrt{6} = 12\sqrt{12}$
- Incorrectly using FOIL method
- Students often write the conjugate of an expression incorrectly. They may incorrectly change signs in front of both terms of the binomial, or not change either sign. They must understand that the conjugate differs only in the sign of the *second* term of the binomial.

Most relevant CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.SSE.2 Use the structure of an expression to identify ways to rewrite it.	***New*** •	***Review*** • Reducing / simplifying radicals • Multiplying polynomials with the FOIL method • Multiplying radical expressions • Multiplying complex numbers ***New*** • Use the Distributive Property to add or subtract like radicals • Simplifying before combining like radicals • Multiplying binomial radical expressions •	*Lesson 6.3 / online textbook resources **Note: Skip page 377 Problem 6 which involved rationalizing the denominator.**	3 days	Lesson Check pg. 378 Check Up #1: Covering sections 6.1 – 6.3

Lesson 4: Rational Exponents

Objective

- Using properties of rational exponents, SWBAT simplify and rewrite expression involving radicals and rational exponents by using exponent properties, ASB correctly answering ___ exit slip questions.

Focused Mathematical Practices

- MP1: Make sense of problems and persevere in solving them
- MP 3: Construct viable arguments and critique the reasoning of others.

Vocabulary: rational exponent

Common Misconceptions:

- Incorrectly converting between radical expressions and expressions with rational exponents.
- Because students learned in 6.2 that you can only simplify products or quotients involving radical expressions when they have the same index, they may not understand that you can combine radical expressions with different indexes if you convert them to expressions with rational exponents.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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 4 because we want $(5^{1/3})^3 = 5^{(1/3)3}$ to hold, so $(5^{1/3})^3$ must equal 5. **N.RN.2:** Rewrite expressions involving radicals and rational exponents using the properties of exponents **A.SSE.3c**: Use the properties of exponents to transform expressions for exponential functions.	***New*** • You can write a radical expression in an equivalent form using a fractional (rational) exponent instead of a radical sign • If the *n*th root of *a* is a real number, *m* is an integer, and m/n is in lowest terms, then $a^{\frac{1}{n}} = \sqrt[n]{a}$ and $a^{\frac{m}{n}} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$ If m is negative, *a* $\neq 0$	***Review*** • Simplifying using properties of exponents ***New*** • Convert between exponential and radical forms • Simplify expressions with rational exponents • Combine radical expressions • Simplify numbers with rational exponents • **Rewrite expressions involving radicals and rational exponents using the properties of exponents**	Lesson 6.4 / online textbook resources **(See question bank items)**	2 days	Lesson Check pg. 385

Lesson 5: Solving Square Root and Other Radical Equations

Objective

- Using variable isolation, SWBAT solve square root and other radical equations, ASB correctly answering ______ exit slip questions.
- Using inverse operations and zero product property, SWBAT determine and eliminate extraneous solutions, ASB correctly answering _____ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 3: Construct viable arguments and critique the reasoning of others

Vocabulary: radical equation, square root equation, extraneous solutions,

Common Misconceptions:

- Many students are not in the habit of checking their solutions, so they may not recognize extraneous solutions. They must check all solutions when solving square root and radical equations. Students may also solve by graphing, because graph will not show extraneous solutions.
- Students may think that all negative numbers are extraneous solutions for square root equations. Use Problem 4 to show that this is not always the case.
- Many students do not use inverse operations correctly when solving equations. Instead of using inverse operations, they use the same operation, therefore the number / term is not canceled out (for example, in solving a multistep equation: 4x – 5 = 10 → many students subtract 5 from both sides of the equation instead of adding 5.)
- Students may think they need to write “+/-“ but because they are squaring, not taking a square root, the “+/-“ is not applicable.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
A.REI.2: Solve simple rational and radical equations in one variable and **show how extraneous solutions may arise** **A.CED.4:** Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.	***Review*** • Domain of a function is all the possible x-values ***New*** • A radical equation is an equation that has a variable in a radicand or a variable with a rational exponent. If the radical has index 2, the equation is a square root equation. • Solving a square root equation may require that you square each side of the equation. This can introduce extraneous solutions.	***Review*** • Using inverse operations to solve a multi-step equation • Checking solutions ***New*** • Isolate the radical on one side of the equation, then raise each side to the power suggested by the index • To solve equations of the form $x^{\frac{m}{n}} = k$, raise each side of the equation to the power n/m, the reciprocal of m/n. If either *m* or *n* is even, then $\left(x^{\frac{m}{n}}\right)^{\frac{n}{m}} = \lvert x \rvert$ • **Check for extraneous solutions**	Lesson 6.5 / online textbook resources	3 days	Lesson check pg. 394

Lesson 6: Function Operations

Objective

- Using the concept of function operations, SWBAT combine standard function types using arithmetic operation, ASB correctly answering ______ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively

Vocabulary:

Common Difficulty:

- Consider domain of function after combining functions when one of the function is radical or rational function.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
F.BF.1.b: combine standard function types using arithmetic operations.	***Review*** • Domain of a function is all the possible x-values ***New*** • The domains of the sum, differences, product, and quotient functions consist of the x-values that are in the domains of both f and g. Also, the domain of the quotient function does not contain any x-value for which g(x) = 0 for $\frac{f(x)}{g(x)}$	***Review*** • Combine like terms • Factor polynomials • Divide polynomials • Use distributive property to combine like terms ***New***	Lesson 6.6 / online textbook resources (Just focus on Problem #1~2) Note: In this lesson only focus on combine functions using arithmetic operation **NO Composition of Function**	2 days	Lesson check pg. 401 Problem #9, 10, 12, 13

Lesson 7: Inverse Relations and Functions

Objective

- Using x and y switch and solving process, SWBAT find the inverse of a relation or function, ASB correctly answering _____ exit slip questions.

Focused Mathematical Practices

- MP 1: Make sense of problems and persevere in solving them
- MP 2: Reason abstractly and quantitatively
- MP 3: Construct viable arguments and critique the reasoning of others

Vocabulary: inverse relation, inverse function, one-to-one function, composition of inverse functions, $f^{-1}(x)$, identity function

Common Misconceptions:

- Students may think that the inverse of a function is *always* a function. The inverse of a function will only be a function if the function is one-to-one.
- When solving, students may only look for the same number of solutions as the original equation.
- Students may confuse *f* inverse with *f* to the negative one power. The notation for inverse is $f^{-1}(x)$, while *f* to the negative one is $f(x)^{-1}$.

CCSS	**Concepts** What students will know	**Skills** What students will be able to do	Material/ Resource	Suggested Pacing	Assessment Check Point
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.	***Review*** • For any function *f*, each x-value in the domain corresponds to exactly one y-value in the range. ***New*** • If a relation pairs element *a* of its domain to element *b* of its range, the inverse relation pairs *b* with *a*. • If both a relation and its inverse happen to be functions, they are inverse functions. • The inverse of a function may or may not be a function. • The range of a relation is the domain of its inverse. The domain of a relation is the range of its inverse. • The graphs of a relation and its inverse are the reflections of each other in the line y = x. • A one-to-one function means that each y-value in the range corresponds to exactly one x-value in the domain. The inverse	***Review*** • Using inverse operations to solve a multi-step equation • Substitution (helps students to understand "switching" x and y ***New*** • To find the inverse of a function, switch x and y, then solve for y. • Find the domain and range for the inverse of a function	Lesson 6.7 / online textbook resources Note: composing inverse functions is not in algebra 2 standards Graphing of inverse function will not be assessed in Alg 2 PARCC (But we can use the graph to explain the meaning of inverse function by inversing domain and range)	2 days	Lesson check pg. 409

	of a function is also a function if the original function is one-to-one. •				

Ideal Math Block

The following outline is the department approved ideal math block for grades 9-12.

1) Do Now (7-10 min)
    a. Serves as review from last class' or of prerequisite material
    b. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

2) Starter/Launch (5 min)
    a. Designed to introduce the lesson
    b. Uses concrete or pictorial examples
    c. Attempts to bridge the gap between grade level deficits and rigorous, on grade level content
    d. Provides multiple entry points so that it is accessible by all students and quickly scaffolds up

3) Mini-Lesson (15-20 min)
    a. Design varies based on content
    b. May include an investigative approach, direct instruction approach, whole class discussion led approach, etc.
    c. Includes CFU's
    d. Anticipates misconceptions and addresses common mistakes

4) Class Activity (25-30 min)
    a. Design varies based on content
    b. May include partner work, group work/project, experiments, investigations, game based activities, etc.

5) Independent Practice (7-10 min)
    a. Provides students an opportunity to work/think independently

6) Closure (5-10 min)
    a. Connects lesson/activities to big ideas
    b. Allows students to reflect and summarize what they have learned
    c. May occur after the activity or independent practice depending on the content and objective

7) DOL (5 min)
    a. Exit slip

Sample Lesson Plan

Lesson	5: Solving Square Root and Other Radical Equations (Day 1 of lesson) – Day One focus is on solving square root equations. Day Two should focus on solving other radical equations (6.5 Problem 2) and Checking for Extraneous Solutions (6.5 Problem 4). Day Three should focus on	**Days**	1 (of 3)

<table>
<tr><td></td><td>solving equations with two radicals (6.5 Problem 5).</td><td></td><td></td></tr>
<tr><td>Objective</td><td>Using variable isolation, SWBAT solve square root and other radical equations, ASB correctly answering _____ exit slip questions.
Using inverse operations and zero product property, SWBAT determine and eliminate extraneous solutions, ASB correctly answering _____ exit slip questions.</td><td>CCSS</td><td>A.REI.2: Solve simple rational and radical equations in one variable and show how extraneous solutions may arise
A.CED.4: Rearrange formulas to highlight a quantity of interest, using the same reasoning as in solving equations.</td></tr>
<tr><td>Learning activities/strategies</td><td colspan="3">
(10 min) Do Now + Do Now Review: Students work in pairs
Which of the following conclusions is true about the statement below?
$x^2 = \sqrt{x}$
<ol type="a">
The statement is always true
The statement is true when x is negative
The statement is true when x = 0
The statement is never true
Solve 2(3x + 5) + 6 = 10 using two different methods. Describe your steps in each method.
Review Do Now solutions
(c)
x = -1
(5 min) Launch: Discussion – Solving multi-step equations using balance method (there are many applets available online to visually represent the balance method: http://www.fi.uu.nl/toepassingen/02018/toepassing_wisweb.en.html is one example)
* Ask students what the inverse operation is for a square root
Mini Lesson:
(5 – 6 min) Define radical equation: show the table below to students and have them turn and talk with a partner to come up with a sentence that defines a radical equation. Give students 2 minutes to discuss, and 1 minute to write out sentence. Call on pairs of students to share their ideas before providing them with formal definition.
<table>
<tr><th>Examples of Radical Equations</th><th>Non-Examples of Radical Equations</th></tr>
<tr><td>$\sqrt{x}+5=11$
$\sqrt[3]{x-4}=7$
$4\sqrt{x-7}+12=28$
$\sqrt[5]{x}=225$</td><td>$\sqrt{5}+x^2=11$
$x-4=\sqrt[4]{16}$
$x\sqrt{10-7}+12=28$
$x^4=\sqrt[3]{27}$</td></tr>
</table>
Definition: A <u>radical equation</u> is an equation that has a variable in a radicand or a variable with a rational exponent. (students should already know what a “radicand” is, however may need a reminder)
(2 – 3 min) Discuss solving equations (refer back to Do Now #2 and Launch): Ask students “what do we know about solving equations?” (isolate the variable – manipulate the equation so the variable is alone on one side of the equation). Explain to students that when solving radical equations, we must isolate the radical on one side of the equation. Once we isolate the radical, we raise each side to the power suggested by the index (refer back to Launch – what is the inverse of square root?).
</td></tr>
</table>

(3 min) **Example One:**

$$\sqrt{x} + 5 = 11$$

Different solving methods

$\sqrt{x}+5=11$ $\sqrt{x}+5=6+5$ $\sqrt{x}+\cancel{5}=6+\cancel{5}$ $\sqrt{x}=6$ $\sqrt{x}=\sqrt{36}$ $x=36$ **Check!**	$\sqrt{x}+5=11$ $\sqrt{x}+5-5=11-5$ $\sqrt{x}=6$ $\left(\sqrt{x}\right)^2=(6)^2$ $x=36$ **Check!**	$\sqrt{x}+5=11$ $\sqrt{x}+5-5=11-5$ $\sqrt{x}=6$ $x^{\frac{1}{2}}=6$ $\left(x^{\frac{1}{2}}\right)^2=(6)^2$ $x=36$ **Check!**

(5 min) **Student Practice:**

$$\sqrt{x} - 4 = 7$$

solution: x = 121

* Ask students: "what is the difference between $\sqrt{x} - 4 = 7$ and $\sqrt{x-4} = 7$?
* The radicand in the first equation is x and the radicand in the second equation is x – 4

(5 min) **Example Two:** Solve $\sqrt{x-4} = 7$ and compare to answer from above

Different solving methods:

$\sqrt{x-4}=7$ $\sqrt{x-4}=\sqrt{49}$ $x-4=49$ $x-4=49+4-4$ $x-\cancel{4}=49+4-\cancel{4}$ $x=53$ **Check!**	$\sqrt{x-4}=7$ $\left(\sqrt{x-4}\right)^2=(7)^2$ $x-4=49$ $x-4+4=49+4$ $x=53$ **Check!**	$\sqrt{x-4}=7$ $\left[(x-4)^{\frac{1}{2}}\right]^2=(7)^2$ $x-4=49$ $x-4+4=49+4$ $x=53$ **Check!**

(5 – 6 min) **Student Practice:**

$$\sqrt{x+6} = 15$$

solution x = 219

(5 – 6 min) **Example Three:**

$$4\sqrt{x-7} + 12 = 28$$

* Ask students: "what is the radicand?" "what do we need to isolate?"

Different solving methods:

$4\sqrt{x-7}+12=28$ $4\sqrt{x-7}+12=16+12$ $4\sqrt{x-7}+\cancel{12}=16+\cancel{12}$ $4\sqrt{x-7}=16$ $4\cdot\sqrt{x-7}=4\cdot 4$ $\cancel{4}\cdot\sqrt{x-7}=4\cdot\cancel{4}$ $\sqrt{x-7}=4$ $\sqrt{x-7}=\sqrt{16}$ $x-7=16$ $x-7=16+7-7$ $x-\cancel{7}=16+7-\cancel{7}$ $x=23$ **Check!**	$4\sqrt{x-7}+12=28$ $4\sqrt{x-7}+12-12=28-12$ $4\sqrt{x-7}=16$ $\frac{\cancel{4}\sqrt{x-7}}{\cancel{4}}=\frac{16}{4}$ $\sqrt{x-7}=4$ $\left(\sqrt{x-7}\right)^2=(4)^2$ $x-7=16$ $x-7+7=16+7$ $x=23$ **Check!**	$4\sqrt{x-7}+12=28$ $\frac{4\sqrt{x-7}}{4}+\frac{12}{4}=\frac{28}{4}$ $\sqrt{x-7}+3=7$ $\sqrt{x-7}+3-3=7-3$ $\sqrt{x-7}=4$ $(x-7)^{\frac{1}{2}}=4$ $\left((x-7)^{\frac{1}{2}}\right)^2=4^2$ $x-7=16$ $x-7+7=16+7$ $x=23$ **Check!**

(6 – 7 min) **Student Practice:**

$$5\sqrt{x+3}-10=15$$

solution: x = 22

(15 min) Class Activity: Students work in pairs. Cut out pieces in advance (Steps and reasons are not in order except for the given equation and the check). Students put solution steps in order, as well as match the reason to each step. Depending on the level of students in the class, you

may want them to copy or glue the examples into their notebooks. During activity, circulate through classroom to make sure all pairs have correct matches.

Steps	Reasons
$\sqrt{2x-1}+5=8$	Given Equation
$2x-1=9$	Simplify
$\sqrt{2x-1}=3$	Square both sides to eliminate the square root.
$2x=10$	Division Property of Equality
$\sqrt{2x-1}+5-5=8-5$	Isolated square root
$\left(\sqrt{2x-1}\right)^2=(3)^2$	Addition Property of Equality
$x=5$	Subtraction Property of Equality
$\frac{2x}{2}=\frac{10}{2}$	Simplify
$2x-1+1=9+1$	Simplify
$\sqrt{2(5)-1}+5=8$ $\sqrt{10-1}+5=8$ $\sqrt{9}+5=8$ $3+5=8$	Check

Independent **Practice to complete activity (6.5 Problem 1, complete "Got it?" #1 if time allows for additional practice): Students may check work against solution in textbook once complete.**

$$3+\sqrt{2x-3}=8$$

(5 min) Closure: Have students summarize lesson in notebook. Ask a few students to share out.
(10 min) Exit Slip: Error Analysis (explain the error in your own words and correctly solve the radical equation)

$$\sqrt{2x-1}=3$$

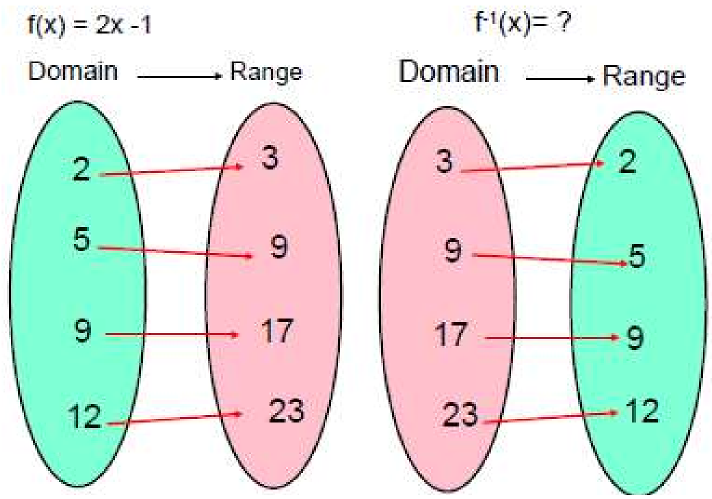
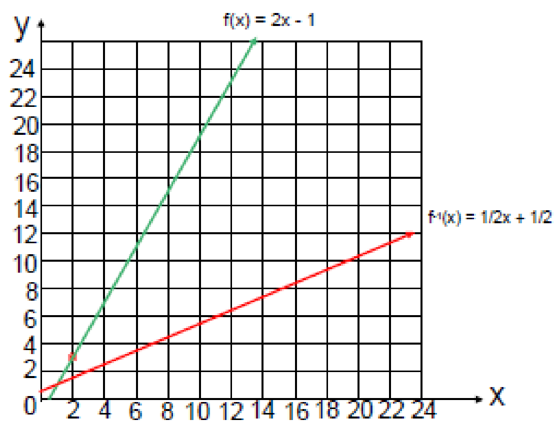
	$\sqrt{2x} = 4$ $2x = 16$ $x = 8$
Differentiation	***Possible differentiation strategies: (please design your own differentiation based on your students learning styles, academic level, strength and weakness,…..)*** * Heterogeneous pairing to allow for peer mentoring throughout investigation activity *Calculators will be provided * Higher performing students: only provide with steps during activity. Must come up with reasons on their own * Graphic organizer provided to lower performing students with given equations for all examples to keep them organized
Assessment	Formative: *circulating throughout class during lesson, *observe students when they are answering questions, discussing with their partner, working on class work…etc. *exit slip *homework – select problems from online textbook worksheet / textbook problems
Common Misconceptions/ Difficulty	1. Many students do not use inverse operations correctly when solving equations. Instead of using inverse operations, they use the same operation, therefore the number / term is not canceled out (for example, in solving a multistep equation: 4x – 5 = 10 → many students subtract 5 from both sides of the equation instead of adding 5.) 2. Students may think they need to write "+/-" but because they are squaring, not taking a square root, the "+/-" is not applicable.

Supplemental Material

CCSS	Dropbox Location and Filename	Link (Original Task)

A.CED.4, A.SSE.2, 3c A.REI.2, F.BF.1b F.BF.4a, N.RN.1, 2	Orange 9-12 Math > Curiculum Algebra 2 >Tire 1> Unit 4 > Question Bank	
A.REI.2	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 4 > Supplemental Material > Radical Equation	https://www.illustrativemathematics.org/illustrations/391
N.RN.1	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1 > Unit 4 > Supplemental Material > Evaluate Exponential Expression	https://www.illustrativemathematics.org/illustrations/1866
N.RN.2	Orange 9-12 Math > Curriculum Algebra 2 > Tier 1> Unit 4 > Supplemental Material > Rational or Irrational Number	https://www.illustrativemathematics.org/illustrations/608

Multiple Representations

Inverse Function	
Diagram	
Coordinate Graph	
Symbolic/Algebraically	**$f(x) = 2x - 1$** **$y = 2x - 1$** **$f^{-1}(x)$:** **$x = 2y - 1$** **$x + 1 = 2y$** **$f^{-1}(x) = 1/2\ x + 1/2$**

PARCC Sample Assessment (From PARCC practice test)

CCSS: A.REI.2 PARCC Item Type: Type I

What extraneous solution arises when the equation $\sqrt{x+3}$ = 2x is solved for x by first squaring both sides of the equation?

Enter your answer in the box.

CCSS: N.RN.2, N.RN.1 PARCC Item Type: Type I

Consider the equation $\frac{4^{x^2}}{2^x}$ = 2

Part A: Which equation is equivalent to the equation shown?

A. $2^{x^2} = 2$ B. $2^{x^2 - x} = 2$

C. $2^{2x} = 2$ D. $2^{x^2 - x} = 2$

Part B: Which values are solutions to the equation?

Select all that apply.

A. -2 B. -1 C. $-\frac{1}{2}$ D. $\frac{1}{2}$ E. 1 F. 2

Unit Authentic Assessment :(See OHS Dropbox file: Algebra 2 U4 Authentic Assessment)

Unit 4 Performance Assessment Task (Critical Area)

Who Wins the Race?

Alice and Briana each participate in a 5-kilometer race. Alice's distance covered, in kilometers, after t minutes can be modeled by the equation a(t) = $\frac{t}{4}$, Briana's progress is modeled by the equation b(t) =$\sqrt{2t-1}$

Part A: Who gets to the finish line first? Show your work or explain how you arrived your answer.

Part B: At what time(s) during the race are Alice and Briana side by side? Show your work or explain how you arrived your answer.

Unit 4 Performance Assessment Task (Critical Area)

Inverse Function

CCSS: F.BF.4a, F-LE.A2

Let f be the function that assigns to a temperature in degrees Celsius its equivalent in degrees Fahrenheit.

Part A: The freezing point of water in degree Celsius is 0 while in degrees Fahrenheit it is 32. The boiling point of water is 100 degrees Celsius and 212 degrees Fahrenheit. Given that the function f is linear, use this information to find an equation for f.

Part B: Find the inverse of the function f and explain its meaning in terms of temperature conversions.

Part C: Is there a temperature which is the same in degrees Celsius and in degree Fahrenheit? Explain how you know.

Unit Assessment Question Bank*:(See OHS Dropbox file: Algebra 2 U4 Question Bank)*

Additional Resources

From pearsonsuccessnet.org

- Find the errors
- Enrichment
- Re-teaching
- Activities, games, and puzzles
- Performance tasks
- Chapter project

Pearson Algebra 2 Common Core Teacher's Edition

Student Resources

From pearsonsuccessnet.org;

- Standardized test prep
- Homework tutors
- Think about a plan
- Student companions

Student workbook