**Unit # 4**

**EXPLORING WITH QUADRADICS**

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| **Literacy Strategies**  (Check all that apply.) | **Habits of Success**  (Check one per unit.) | **Multiple Intelligence Areas** |
| * Admit/Exit slips * Graphic organizer * Know/Want to Know/Learn chart (KWL) * Open-response questions * Double-entry/Two-column notes * Retelling * Reflection * Jigsaw reading * Anticipation guide * RAFT (Role/Audience/Format/Topic) * Interactive reading guide * Concept definition maps * Frayer model * Visual prediction guide * Other: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ | * Create relationships * Teamwork, responsibility, effective communication) * Study, manage time, organize * (Organization, time management, study skills) * Improve reading/writing skills * (Use reading and writing to learn strategies) * Improve mathematics skills * (Estimate, compute, solve, synthesize) * Set goals/plan * (Set goals, plan, monitor progress) * Access resources * (Research, analyze, utilize) * USE OF TECHNOLOGY | * Logical/Mathematical * Spatial * Musical * Bodily—Kinesthetic * Interpersonal * Intrapersonal * Naturalist * Linguistic |

**UNIT Assessments:**

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| --- |
| Pre-Assessment: |
| Daily/Weekly: (Included on daily activities plans) |
| Post-Assessment: |

State Standards and Benchmarks:

A.1.9 Solve quadratic equations in one variable,

A.2.10 Identify and describe symmetries of graphs,

A.3.2 Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors

Key Terms:

Term

Like terms

Polynomial

Descending Power

Degree of Term

Degree of a Polynomial

Monomial

Binomial

Trinomial

Exponential Expression

FOIL

Outer product

Inner product

Conjugate

Scientific notation

Factor

Factored form

Greatest common factor (GCF)

Prime polynomial

Perfect square trinomial

Quadratic equation

Standard form

Hypotenuse

Legs

Day 1

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Review combining like terms, Know the vocabulary for polynomials, Evaluate polynomials, Add and subtract polynomials

Assessment: Ticket out the door

Accommodations:

Tier 2:

Tier 3:

Materials: Student white boards

Dry erase markers

Mini-lecture 5.1 Adding and Subtracting Polynomials

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | KWL – “What do you know about quadratics” (Pull form from file) |
| Introduction/Engage |  | Review vocabulary for polynomials (class discussion)  Teachers pick a strategy for vocabulary practice and understanding |
| Explore/Review |  | Review combining like terms. Recall that **like terms** have exactly the same combination of variables with the same exponents on the variables. **Only the coefficients may differ.**  Put practice problems on the board for students to practice (Maybe through the use of small white boards and competition.)  Review **evaluation polynomials** and provide practice as above.  Review **adding and subtracting polynomials** and provide practice as above. |
| Assessment |  | Ticket out the door – Have students list 3 things they learned today and give examples of each. |
| Closure |  |  |

Reflection:

**Day 2**

Benchmark: : A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Students will learn and use the **Product Rule** and **Power Rule** for Exponents

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Student White Boards

Dry Erase Markers

Mathdude Video “Law of Exponents:

Mini-Lecture 5.2 The Product Rule and Power Rules of Exponents

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Teachers will provide a few practice problems for combining like terms and evaluating polynomials. |
| Introduction/Engage |  | Introduce Product Rule for Exponents **am an = am+n** (Keep the same base and add the exponents.)  Provide practice problems for students using white boards(or method of your choosing)  Introduce **Power Rule** for Exponents **(am)n = amn**  (ab)m = ambm , (a/b)m = am/bm  Provide practice problems for students using white boards(Or method of your choosing)  **AN ALTERNATIVE TO INTRODUCING THIS SUBJECT YOURSELF IS TO SHOW THE MATHDUDE EPISODE “The Law of Exponents”** |
| Explore/Review |  | Provide practice combining the Product Rule and Power Rule for Exponents. |
| Assessment |  | Ticket out the door – Have students write their understanding of the Power Rule and Product Rule and give examples. |
| Closure |  |  |

Reflection: **The bases must be the same** before applying the product rule for exponents.

**Caution:** Be sure the students understand the difference between adding and multiplying exponential expressions.

Power rule does not apply to sum.

**Day 3**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Multiply a monomial and a polynomial, multiply two polynomials, and multiply binomials by the FOIL method

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Student white boards

Dry-erase markers

Mathdude Video – “Multiplying Polynomials”

Mini-Lecture 5.3 – Multiplying Polynomials

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems (Adding and subtracting polynomials, Product and Power Rules) |
| Introduction/Engage |  | Show the Mathdude episode “Multiplying Polynomials” |
| Explore/Review |  | Provide practice problems for students to do on white boards (see Mini-Lecture 5.3 – “Multiplying Polynomisls” for samples)  Mini-Lecture 5.4 – “Special Products” provides examples of special products that should be introduced to the students. |
| Assessment |  | Ticket out the door – “Explain the difference in the treatment of exponents when you multiply polynomials and when you add or subtract polynomials.” |
| Closure |  |  |

Reflection: You might remind students that FOIL is simply providing them with an easy way to use the distributive property for multiplying 2 binomials together. They will need to remember how to use the distributive property for monomials with more than 2 terms.

**Day 4**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Students will learn to divide a polynomial by a monomial

Accommodations:

Tier 2:

Tier 3:

Materials: Mathdude episode “Dividing Monomials”

Mini-lecture 5.6 “Dividing a Polynomial by a Monomial”

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Provide review problems for multiplying polynomials.  Discuss answers and have students work on board and explain to the class members. |
| Introduction/Engage |  | Show Mathdude episode “Dividing Monomials”  Have students work sample problems on individual white boards. |
| Explore/Review |  | Using Mini-Lecture 5.6, walk the students through the process of dividing a polynomial by a monomial.  Practice problems on individual white boards. |
| Assessment |  | Do a KWL on the past 4 days of instruction.  Review and discuss the KWL responses as a review for a weekly assessment tomorrow. |
| Closure |  |  |

Reflection: Encourage students to write the intermediate step (a+b/c = a/b + b/c) when dividing by a monomial. Otherwise, some students cancel the denominator with the first term in the numerator and do not know what to do next.

**Day 5**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Students will learn to factor out the Greatest Common Factor (GCF) of a polynomial

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Individual White Boards

Dry- erase markers

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems from the past 4 days of instruction.  Review answers in preparation of the following test. |
| Introduction/Engage |  | Test on combining like terms, evaluating polynomials, adding and subtracting polynomials, product rule and power rule for exponents, and multiplying and dividing polynomials |
| Explore/Review |  | Explore process of finding the Greatest Common Factor (GCF).  See Mini-Lecture 6.1 for sample problems to work on individual white boards |
| Assessment |  | Rotate around classroom as students find GCF on white boards to insure the students understand the concept. |
| Closure |  |  |

Reflection: Encourage students to factor monomials in a step-by-step manner: first factor out the common number, then the common variable for each variable that exists.

Many students omit the 1 when factoring out the entire term. Encourage students to check their answers by multiplying to avoid this problem.

Most students find it difficult to factor common binomials. Remind them that they are still factoring a common factor, but the factor happens to be a binomial.

**Day 6**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Factor trinomials with a coefficient of 1 for the squared term. Factor trinomials after factoring out the Greatest Common Factor.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Students white boards

Dry-erase markers

Mathdude Video – “Factoring”

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | KWL on factoring trinomials  Review responses on KWL |
| Introduction/Engage |  | Introduce the process of factoring trinomials by showing the Mathdude Video – “Factoring”  Provide practice problems for student practice on white boards.  Mini-Lecture 6.2 provides examples problems. |
| Explore/Review |  | Explore factoring out the greatest common factor, then factor the remaining polynomial.  Provide practice problems for students to practice on individual whit boards. |
| Assessment |  | Walk around as students practice problems on individual white boards to insure accuracy. |
| Closure |  | Ticket out the door – Have students write the process for factoring trinomials in 20 words or less. |

Reflection: Remind students that when the last term is positive, the factor pairs they pick must have the same sign, while if the last term is negative, the factor pairs must have opposite signs.

**Day 7**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

Learning Objective: Factor trinomials by grouping when coefficient of the squared term is not 1.

Factor trinomials using FOIL.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Individual white boards

Dry-erase markers

Mini-lecture 6.3 Factoring Trinomials by Grouping

Mini-lecture 6.4 Factoring Trinomials Using FOIL

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice factoring trinomials  Have students explain the answers on the board |
| Introduction/Engage |  | Introduce students to factoring trinomials by grouping  Provide practice problems from Mini-lecture 6.3 for students to practice on individual white boards |
| Explore/Review |  | Explore different approaches to factoring trinomials, including using FOIL. Min-lecture 6.4 contains samples for students to practice on individual white boards |
| Assessment |  | Lots of practice on the individual white boards is the best method I have found to encourage students to become proficient with factoring. You can help individuals as you roam around, and you can have the students who catch on quickly pair up with students who are struggling. |
| Closure |  | You may want to have students make a journal entry about the process of factoring so they can understand it better. |

Reflection: Most students have trouble with signs when a negative must be factored out of the second grouping. Tell them that if the two binomials that remain after the first round of factoring have opposite signs, it means they should have pulled a negative sign out of the second grouping.

Many students are amazed that two different grouping approaches can lead to the same final answer. Encourage them to try different groupings so that they will start to see patterns of which grouping arrangements make the factoring easier.

Encourage students to use whichever method they prefer.

When the squared term has a coefficient other than 1, some students find it helpful to make a table listing all possible factor pairs for ac in the first column and their sums in the second column.

Remind students that when the last term is positive, the factor pairs they pick must have the same sign, while if the last term is negative, the factor pairs must have opposite signs.

Remind students to factor out the negative sign as a common factor, if the sign of the squared term is negative.

**Day 7**

Benchmark: A.1.9 Solving quadratic equations in one variable

Learning Objective: Factor a difference of 2 squares

Factor a perfect square trinomial

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Individual White Boards

Dry-erase markers

Mini-lecture 6.5 Special Factoring Techniques

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems on factoring trinomials |
| Introduction/Engage |  | Introduce students to recognizing special forms of a quadratic expression so they can use special forms of factoring to speed the process, as factoring trinomials can be very tedious.  Have students factor the difference of 2 squares examples from Mini-lecture 6.5. |
| Explore/Review |  | Explore the process of factoring a perfect-square trinomial.  Have students factor perfect-square trinomial examples from Mini-lecture 6.5. |
| Assessment |  | Roam around the room to insure students are getting it. Pair struggling students with those who get it quickly. |
| Closure |  | Have students write a paragraph explaining how recognizing special forms of quadratics will make factoring easier and quicker for them. |

Reflection: Some students understand the difference of 2 squared formula better is the are first done using trinomial factoring with 0X as the middle term.

Point out to students the importance of the phrase “perfect square” trinomial. Encourage them to always check if the first and last terms of a trinomial are perfect squares.

Encourage students to become proficient with special case factoring as it will be important for all future algebra topics such as completing the square. It will also be important in all advanced mathematics classes, such as trig and calculus.

**Day 8**

Benchmark: : A.1.9 Solving quadratic equations in one variable

A.3.2 Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors.

Learning Objective: Solve quadratic equations by factoring

Solve other equations by factoring

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Individual white boards

Dry-erase markers

Mathdude Video – Solving equations by factoring

Mini-lecture 6.6 Solving Quadratic Equations by Factoring

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems involving factoring special forms of quadratic expressions.  Discuss results and have students present answers of board. |
| Introduction/Engage |  | Mathdude Video – Solving equations by factoring will introduce the concept to the students.  Have students work practice problems on individual white boards using the zero product property (samples in Mini-lecture 6.6) |
| Explore/Review |  | Explore additional problems using zero product property, working up to harder problems requiring manipulation and simplifying before factoring. |
| Assessment |  | Ticket out the door – Have students solve a quadratic equation before departing classroom to check for understanding. |
| Closure |  |  |

Reflection: Remind the students to always put the equation in standard form before factoring.

Some students try to use the zero product property before the equation is in standard form.

**Day 9**

Benchmark: : A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

A.3.2 Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors.

Learning Objective: Solve problems about geometric figures

Solve problems about consecutive integers

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Mathdude video – “Solving Quadratic Equations”

Individual white boards

Dry-erase markers

Mini-lecture

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems involving solving quadratics by factoring and using the zero product property.  Discuss results |
| Introduction/Engage |  | Mathdude video – “Solving Quadratic Equations”  Give students practice problems from Mini-lecture 6.7 to work on individual white boards involving geometric figures. |
| Explore/Review |  | Give short lesson on solving consecutive integer problems with the following recommendations: If X = the lesser integer, then for any  Two consecutive integers, use X, X+1  Two consecutive even integers, use X, X+2  Two consecutive odd integers, use X, X+2 |
| Assessment |  | KWL on solving quadratic equations |
| Closure |  |  |

Reflection: Many students find these problems difficult. Provide students with the Solving an Applied Problem handout in the file.

Encourage students to make a diagram whenever possible.

Remind students to check whether their answers are reasonable for applied problems.

**Day 10**

Benchmark: A.1.9 Solving quadratic equations in one variable (Because students need to learn and practice skills associated with this benchmark, this benchmark will be carried over for several days.)

A.3.2 Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors.

Learning Objective: Solve problems using the Pythagorean formula

Solve problems using given quadratic models

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Mini-lecture 6.7 Applications of Quadratic Equations

Individual white boards

Dry-erase marker

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems involving geometric figures and consecutive integers.  Review results |
| Introduction/Engage |  | KWL on Pythagorean formula to find out if additional instruction is needed before solving problems involving Pythagorean formula. Provide necessary review.  Practice problems involving Pythagorean formula on individual white boards. |
| Explore/Review |  | Explore problems involving gravity, such as the one in Mini-lecture 6.7.  Additional Quadratic Equation Application Problems can be found in the file. |
| Assessment |  | Ticket out the door – Write a sample real-world application problem that can be solved using the Quadratic Equation. |
| Closure |  | A unit assessment can be crafted from the sample problems found in the Mini-lectures from 5.1 through 6.7. |

Reflection: Many students find the applied problems difficult and need to see more examples. Additional Quadratic Equation Application Problems can be found in the file to be assigned as homework.

**Day 11**

Benchmark: A.3.2 Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors

A.2.10 Identify and describe symmetries of graphs,

Learning Objective: Identify the values of a, b, and c in a quadratic equation

Use the quadratic formula to solve quadratic equations

Solve quadratic equations with only one solution

Solve quadratic equations with fractions

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Mini-lecture 9.3 Solving Quadratic Equations by the Quadratic Formula

Individual white boards

Dry-erase markers

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems modeling real-world applications  Discuss solutions  Compare optional methods of solving |
| Introduction/Engage |  | KWL on quadratic formula  Discuss results to determine the level of knowledge |
| Explore/Review |  | Explore quadratic formula use, a, b, c, discriminate, etc.  Practice problems from Mini-lecture 9.3 |
| Assessment |  | Ticket out the door – Students write a summary of what they know about the use of the quadratic formula. |
| Closure |  |  |

Reflection: Remind the students to put the equation in standard form before identifying a, b, and c.

Many students reduce final answers incorrectly.

Some students will always use the quadratic formula because it has no restrictions on when it can be used. Encourage them to also master the other methods, which are often quicker and easier to apply.

**Day 12**

Benchmark: Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors

A.2.10 Identify and describe symmetries of graphs,

Learning Objective: Graph quadratic equations

Find the vertex of a parabola

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Mathdude video – Graphing Parabolas

Graphing Paper for each student

Mini-lecture 9.4 Graphing Quadratic Equations

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| **Strategy** | **Time** | **Activity** |
| Bell work |  | Practice problems using the quadratic formula  Review and discuss the results to insure understanding |
| Introduction/Engage |  | Have students graph the parabolas Y = X2 and Y = -X2 and facilitate a discussion about the characteristics of the results (Mini-lecture 9.4)  Provide students with additional quadratic equations to graph. Have them find the vertex and the x-ntercepts. |
| Explore/Review |  | Have students find the vertex and discuss how to find the axes of symmetry. Give students the formula for the vertex X = -b/2a and have them practice finding the vertex. |
| Assessment |  | Have the students explain the process of graphing quadratic equations in 20 words or less. |
| Closure |  |  |

Reflection: Many students need to be told at first what x values to use when finding ordered pairs for the graph.

Remind students that they may need more ordered pairs if the vertex position is not apparent.

**Day 13-20**

Benchmark: Model real-world phenomena using quadratic equations, interpret resulting solutions, and use estimation to detect errors

A.2.10 Identify and describe symmetries of graphs,

Learning Objective: Practice and refine understanding of graphing quadratic equations through the use of the Instructional Pan Template below.

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials: Instructional Plan Template for “All that Grows Is Not Linear: A Study of Quadratic Functions”

This template includes 10 90-minute lesson plans

Teachers are encouraged to pick several of these lesson plans to finish out the instruction on quadratics.

The following are recommended:

#1 – This is an introductory activity involving hand graphing and graphing calculators and it emphasizes several important facets of graphing quadratics.

#2 – This activity involves factoring equations using algebra tiles. It also involves graphing on a graphing calculator and using the trace function to determine factors.

#3 – This activity involves finding the vertex and using that to determine maximum and minimum points on the graph. Includes emphasis on finding the x value of the vertex, zeros, and y-intercept.

#6 – Involves a bouncing ball activity using the CBL/CBR to collect and analyze ball bounce data with a motion detector. It also involves measuring tools.

#7 – Involves hands-on measuring of circle dimensions made by the light of a flashlight, and exploring how the area of the light beam on a flashlight changes as the distance between the wall and the flashlight increases or decreases. Involves groups and teamwork activities.

# 8 – Involves simulated experiences working retail or fundraising and profit, revenue, and cost.

# 10 – Centers around a story about Mr. Norm Parabola. Looks like a funny story and a fun activity, which should help the students remember the math and concepts involved.

Note: These culminating activities could serve as the assessment for the entire unit on quadratics.

Learning Objective:

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

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| **Strategy** | **Time** | **Activity** |
| Bell work |  |  |
| Introduction/Engage |  |  |
| Explore/Review |  |  |
| Assessment |  |  |
| Closure |  |  |

Reflection:

**Day 1**

Benchmark:

Learning Objective:

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

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| **Strategy** | **Time** | **Activity** |
| Bell work |  |  |
| Introduction/Engage |  |  |
| Explore/Review |  |  |
| Assessment |  |  |
| Closure |  |  |

Reflection:

**Day 1**

Benchmark:

Learning Objective:

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

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| --- | --- | --- |
| **Strategy** | **Time** | **Activity** |
| Bell work |  |  |
| Introduction/Engage |  |  |
| Explore/Review |  |  |
| Assessment |  |  |
| Closure |  |  |

Reflection:

**Day 1**

Benchmark:

Learning Objective:

Assessment:

Accommodations:

Tier 2:

Tier 3:

Materials:

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| --- | --- | --- |
| **Strategy** | **Time** | **Activity** |
| Bell work |  |  |
| Introduction/Engage |  |  |
| Explore/Review |  |  |
| Assessment |  |  |
| Closure |  |  |

Reflection: