

## **LESSON PLAN (DAY 3)**

### **Key Content Standards:**

14.0 Students *solve a quadratic equation by factoring.*

23.0 Students *apply quadratic equations to physical problems, such as the motion of an object under the force of gravity.*

### **Common Core Standards for Mathematical Practice**

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Attend to precision.
4. Model with Mathematics.

### **Key ELD Standards:**

#### **Part 1: Interacting in Meaningful Ways**

##### **A. Collaborative:**

Expanding 1: Exchanging Information/Ideas – Contribute to class, group, and partner discussions by following turn-taking rules, asking relevant questions, affirming others, adding relevant information, and paraphrasing key ideas.

Bridging 1: Exchanging Information/Ideas – Contribute to class, group, and partner discussions by following turn-taking rules, asking relevant questions, affirming others, adding relevant information, and paraphrasing key ideas, building on responses and providing useful feedback.

##### **B. Interpretive:**

Expanding 5: Demonstrate active listening in oral presentation activities by asking and answering detailed questions with occasional prompting and moderate support.

Bridging 5: Demonstrate active listening in oral presentation activities by asking and answering detailed questions with minimal prompting and support.

### **Learning Objective:**

#### **A. Cognitive Task (use cognitive verbs):**

1. Students will *recall* how to factor polynomials.
2. Students will be able to *recognize* and *identify* a quadratic function or equation.
3. Students will *apply* the zero product property to find roots of quadratic functions.
4. Students will *draw conclusions* between the number of factors and the number of x-intercepts or solutions of a quadratic function.

5. Students will *apply concepts* to real-world applications.
6. Students will *summarize* what they have learned.
7. Students will *contribute* to class and partner discussions using proper academic language and mathematical vocabulary.

**B. Understanding or Skill to be Enhanced:**

*Procedural Fluency -*

1. Factoring quadratic functions.
2. Finding the solutions to a quadratic equation by factoring.

*Concept –*

1. Understanding the relationship that the number of factors of the quadratic polynomial, is equal to the number of x-intercepts of the graph of the quadratic function, and is in turn equal to the number of solutions of the quadratic equation.

*Mathematical Reasoning -*

1. Apply Mathematics to real-world (word) problems.
2. Explain the reasonableness of the solution (e.g.: time cannot be negative).

**Assessment(s):**

- Warm up problems at beginning of class.
- Randomly choose students to answer questions during class. Make sure to also check IEP, GATE, and ELLs.
- Class discussions.
- Walk around and monitor students working individually, or discussing amongst themselves during *think-pair-share*.
- Walk around and check students' notes while they are working individually, or together in *think-pair-share*.
- Monitor students' body language and facial expressions.
- Towards end of class, pose the following question for individual students to answer – “What did we learn today?”
- Check homework of a few students while they are correcting their homework and working on warm-up problems at beginning of class.
- Exit ticket.

**Prerequisite Skills and Knowledge:**

1. Identifying quadratic functions and equations.
2. Factoring 2<sup>nd</sup> degree polynomials.

**Lesson Resources/Materials:**

- a. Students –
  - i. Notes book
  - ii. Textbook
  - iii. Pencil, eraser, highlighter.
  - iv. Graph paper
  
- b. Teacher –
  - i. Laptop connected to document camera and overhead projector
  - ii. Printouts of slides with problems for students to solve
  - iii. Transparencies and markers

**Instructional Sequence (DAY 3)**

**Introduction (5 - 8 minutes):**

TEACHER	STUDENTS
<ul style="list-style-type: none"> <li>✓ Tell students to take out homework and start correcting.</li> <li>✓ Project Warm-Up problems on screen.</li> </ul> <p><i>Assess/Evaluate:</i></p> <ul style="list-style-type: none"> <li>✓ Check homework of some students and take attendance while students are working on warm-up problems.</li> </ul>	<p>Correct homework.</p> <p><i>(Recall, Reading, Writing)</i> Start on warm-up problems.</p>

***Body of the Lesson (55 – 60 minutes):*** Describe step-by-step what the teacher **and** the students will be doing during the lesson.

TEACHER	STUDENTS
<p><b><i>Essential Mathematical Vocabulary for today:</i></b> <i>factor, quadratic, trinomial, zero, roots, x-intercept</i></p> <p style="text-align: center;"><b><i>Connect to prior knowledge</i></b></p> <p><b><i>Assess/Evaluate:</i></b></p> <p><i>Ask students and discuss –</i></p> <ul style="list-style-type: none"> <li>✓ “What is a <u>quadratic trinomial</u>? Discuss with your partner.”</li> <li>✓ “What are some <u>methods of factoring</u> quadratic trinomials? Discuss with your partner.”</li> <li>✓ “How do you find the <u>roots</u> of a quadratic trinomial? Discuss with your partner.”</li> <li>✓ “What is the <u>zero of a function</u>? Discuss with your partner.”</li> </ul> <p>Call (choosing randomly with index cards) on individual students to check understanding, and also engage the entire class.</p>	<p><i>(Recall, Speaking, Listening)</i> Discuss in pairs.</p> <p><i>(Recall, Speaking, Listening)</i> Discuss in pairs.</p> <p><i>(Recall, Summarize, Speaking, Listening)</i> Discuss in pairs.</p> <p><i>(Recall, Speaking, Listening)</i> Discuss in pairs.</p> <p><i>(Speaking)</i> Student(s) called on answers Teacher’s questions in complete sentences</p>

- ✓ Make sure to call on IEP and ELLs - **Talk slower**, may aid with **Sentence Starters, Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**.

**Anticipate:** If students are having difficulty, ask GATE student the questions, and then ask another student to repeat what the GATE student said.

**Anticipate:** If GATE student is also having difficulty, then have students turn to their notes (or text book), and then explain in their own words.

### Introduce today's topic with Concept

Today we will learn how to find the roots (or zeros) of a quadratic equation by factoring the quadratic polynomial.

**Concept:** Discuss with your partner what are the roots and zeros of a function, and then determine how you can find the roots (zeros) by factoring.

*Answer* – values of  $x$  that result in a zero factor.

- ✓ Call (choosing randomly with index cards) students to check understanding.
- ✓ Make sure to call on IEP and ELLs – **talk slower**, may aid with **Sentence Starters, Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**.

**Anticipate:** Students cannot make the connection between zeros/roots and factors that are zero. Scaffold by asking questions as follows:

- ✓ "What can you say about the value of a function at a zero/root?" (value is zero)

using correct academic language and mathematical vocabulary such as *factor, quadratic, trinomial, zero*.

(*Listening*) Students not called on are listening.

(*Speaking, Listening*) Class discussion.

(*Reading, Speaking*) Students refer back to their notes, or text book, and explain in their own words.

(*Connect, Speaking, Listening*) Discuss in pairs.

(*Connect, Speaking, Listening*) Class discussion.

(*Speaking*) Student(s) called on answers Teacher's questions in complete sentences using correct academic language and mathematical vocabulary.

(*Listening*) Students not called on are listening.

- ✓ “So, for example, if a quadratic function is given by  $x^2 - 9$ , for which values of  $x$  will it be equal to zero?” ( $\pm 3$ )
- ✓ “How did you figure that out?”
- ✓ “Can you rewrite the function in another way?”  $(x + 3)(x - 3)$
- ✓ “Looking at the factored form, can you figure out what the roots are?”

**Anticipate:** Students are still unable to make the connection that at least one of the factors needs to be equal to zero.

- ✓ “If  $a \cdot b = 0$ , what can you say about  $a$  and/or  $b$ ?” (either one or both = 0)
- ✓ “So if  $(a + 3)(a - 3) = 0$ , what can you say about  $(a + 3)$ , and/or  $(a - 3)$ ?” (either factor or both = 0)
- ✓ “So can you find  $a$  if  $(a + 3) = 0$ ? How about if  $(a - 3) = 0$ ?”

### Examples with 0, 1 or 2 roots

- ✓ Go through several examples (as time permits).
- ✓ **Model** the first example (or more), **thinking-aloud**, so students understand my thinking.
- ✓ Choose different examples with 0, 1 or 2 real roots.
- ✓ For each example, have students work together and discuss the solution with their partner.
- ✓ Randomly call students to check understanding.
- ✓ Make sure to call on IEP and ELLs – **talk slower**, may aid with **Sentence Starters**, **Revoice** student’s explanation using **hand gestures**, along with **Pace and Emphasis**.

### Procedures with Connections

- ✓ For each example, have students also graph the quadratic function.

*(Connect, Speaking, Listening)* First discuss with partner.

*(Connect, Speaking, Listening)* Then class discussion.

*(Connect, Speaking, Listening)* First discuss with partner.

*(Connect, Speaking, Listening)* Then class discussion.

*(Reading, Listening, Writing)* Students reading my work on the overhead, listening to me speak, and writing in their notes.

*(Recognize, Identify, Draw Conclusions, Speaking, Listening, Reading, Writing)* Work in pairs. Students write answers in complete sentences. For example, “The roots are \_\_\_ and \_\_\_.” OR “The factors are \_\_\_ and \_\_\_.”

*(Speaking)* Student(s) called on answers Teacher’s questions in complete sentences using correct academic language and mathematical vocabulary.

*(Listening)* Students not called on are listening.

- ✓ Ask – “What is the connection between the x-intercepts and the factors that are zero?” (they are the same)

**Draw figures** – Especially to aid IEP, ELLs, and students who are more visual.

**Connect to real-world application  
(word problems)**

- ✓ Example: height of a diver
- ✓ Example: height of a rocket (optional – if time permits)

**Draw figures to understand the problem** – especially to aid IEP, ELLs, and students who are more visual.

**Anticipate:**

Identify possible problem words/phrases in the word problems – *diver, platform* – check to make sure class understands each word/phrase.

- ✓ Randomly call students to check understanding.
- ✓ Make sure to call on IEP and ELLs – **talk slower**, may aid with **Sentence Starters, Revoice** (teacher repetition) student’s explanation using **hand gestures**, along with **Pace and Emphasis**.

**Anticipate:** Students have difficulty with word problems. In that case, call on GATE student to explain how he will solve the problem.

**Anticipate:** If GATE student can’t explain, ask questions to the class:

1. “Can you draw a rough sketch of the diver’s trajectory?”
2. “What is the height of the diver when the diver hits the water?” (zero)
3. “How can you find out at what time the height is zero?” (factors are

*(Label, Graph, Multiple Representations, Connect, Writing, Speaking, Listening)*  
Discuss in pairs. Then class discussion.

*(Apply Concepts, Use Concept Cues, Reading, Speaking, Listening, Writing)* Work in pairs. Students write answers in complete sentences. For example, “The diver is in the air for \_\_\_\_ seconds.”

*(Speaking)* Student(s) called on answers Teacher’s questions in complete sentences using correct academic language and mathematical vocabulary.  
*(Listening)* Students not called on are listening.

*(Speaking)* GATE student explains.

*(Apply Concepts, Use Concept Cues, Speaking)* Answer the questions, discussing with their partner if needed.



<p style="text-align: center;">zero)</p> <p><b>Anticipate:</b> Students still having difficulty understanding.</p> <ul style="list-style-type: none"> <li>✓ Then <b>model</b> the first example, <b>thinking-aloud</b>, so students understand my thinking.</li> <li>✓ If time permits, students can work in pairs on another similar example.</li> </ul>	<p>(<i>Reading, Listening, Writing</i>) Students reading my work on the overhead, listening to me speak, and writing in their notes.</p> <p>(<i>Speaking, Listening, Writing</i>) Work in pairs.</p>
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**Closure (2 - 10 minutes):**

TEACHER	STUDENTS
<p><b>Assessment</b></p>	
<p>Ask Students – “What did we learn today?”</p> <ul style="list-style-type: none"> <li>✓ Individually check IEP and several ELLs. May need to <b>talk slower</b>, aid with <b>Sentence Starters, Revoice</b> (teacher repetition) student’s explanation using <b>hand gestures</b>, along with <b>Pace and Emphasis</b>.</li> </ul> <p>Open up to class.</p>	<p>(<i>Summarize, Speaking</i>) Student(s) called on answers Teacher’s questions in complete sentences using correct academic language and mathematical vocabulary.</p> <p>(<i>Listening</i>) Students not called on are listening.</p> <p>Whole class discussion.</p>
<p><b>Assign Homework</b></p>	
<p>Assign Homework problems. If time permits, students can work on homework.</p> <p>Lesson 9-5 Exercises, pgs. 579 - 581: 7 – 38 all, 48 – 52 all</p>	<p>(<i>Reading, Writing</i>) Start homework.</p>
<p><b>Assess/Evaluate:</b></p> <p>Walk around and monitor individual students. Ask questions to check for understanding.</p> <p>Help individual students.</p> <ul style="list-style-type: none"> <li>✓ Make sure to check on IEP and several ELLs –May need to <b>talk slower</b>, aid</li> </ul>	<p>(<i>Speaking, Listening</i>) Ask for help if needed.</p>



with **Sentence Starters, Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**.

**Exit Ticket Questions**

- ✓ Q1: What are the x-intercepts of the following quadratic equations?
- $y = (x + 7)(x - 3)$
  - $y = (x - 1)^2$

*(Connect, Reading, Writing)* Answer the questions.

## ACADEMIC LANGUAGE (DAY 3)

- Describe the cognitive task related to the content learning objective:
  - ✓ Students will recall how to factor polynomials.
  - ✓ Students will be able to recognize and identify a quadratic function or equation.
  - ✓ Students will apply the zero product property to find roots of quadratic functions.
  - ✓ Students will draw conclusions between the number of factors and the number of x-intercepts or solutions of a quadratic function.
  - ✓ Students will apply concepts to real-world applications.
  - ✓ Students will summarize what they have learned.
  - ✓ Students will contribute to class and partner discussions using proper academic language and mathematical vocabulary.
- Language Demands: How will students be communicating in relation to the content in the rich task?
  - Receptive – listening, reading, and viewing:
    - ✓ Listening, reading, and viewing.
  - Productive – speaking and writing:
    - ✓ Speaking and writing.
- What key language skill(s), related to a single language demand above, will you help the students develop during the lesson?
  - ✓ Speaking.
  - ✓ Reading
- Describe the genre of the chosen language demand.

### Speaking

- ✓ using precise language in *explaining* or *justifying* mathematical reasoning
- ✓ *describing* procedures
- ✓ *defining* and *relating* mathematical concepts (factors, roots, zeros, x-intercepts)
- ✓ *engaging* in collaborative and oral mathematical reasoning
- ✓ *distinguishing* mathematical uses of words used in everyday language (e.g.: factor, roots, zeros)

### Reading

- ✓ *representing* word problems mathematically
- ✓ *translating* words or sentences into symbols
- ✓ *distinguishing* mathematical uses of words used in everyday language (e.g.: roots, zeros)

- Describe the instructional strategies you will use to support the development of academic language skills (**related to the identified language demand above**). Include strategies you will use to meet the needs of individual or groups of students with varying language abilities.
  - ✓ I will reinforce explaining (*orally*, or *speaking*) the thought process students are following by asking them to use correct mathematical terminology in articulating their responses. The specific strategies are:
    - *Discussing* with their partner and *asking* questions
    - *Explaining* the reasoning behind selecting a particular procedure
    - *Modeling* (specifically for ELLs and IEP)
    - *Scaffolding* (specifically for ELLs and IEP)
    - *Providing* sentence starters (specifically for ELLs and IEP)
    - *Rephrasing* (specifically for ELLs and IEP)
    - Students speak and write answers in complete sentences. For example, “The x-intercepts are \_\_\_ and \_\_\_.”
  - ✓ The instructional strategies I will use for *reading* are:
    - *Identifying* words that may be problematic (especially for ELLs and IEP) and clarifying them. In today’s lesson these are words such as *diver*, and *platform*.
    - *Divide and conquer* – tackling each sentence in a word problem one at a time.
    - *Multiple representation* (especially for ELLs, IEP, and for those who are more visually inclined) – draw a picture/figure to understand the context of a word problem.