LESSON PLAN (DAY 2)

Key Content Standards:

21.0 Students graph quadratic functions and know that their roots are x-intercepts.
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 graph in the Cartesian coordinate system.
2. Students will be able to *recognize* and *identify* a quadratic function or equation.
3. Students will *graph* quadratic functions with 0, 1, and 2 x-intercepts (roots), and also be able to *identify* the number of roots (x-intercepts) given the graph of a quadratic function.

4. Students will *use context cues* in graphing quadratic functions.
5. Students will *connect* mathematical concepts (roots/zeros of a function and x-intercept of the graph of the function).
6. Students will *apply concepts* to real-world (word) problems.
7. .Students will *compare and contrast* linear and quadratic functions/equations.
8. 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. Graph quadratic functions in the Cartesian coordinate system.
2. Identify the x-intercept (roots, zeros).

Concept –

3. Understand that the roots of a quadratic function are the x-intercepts of the graph of the function.
4. Compare and contrast linear and quadratic functions/equations.

Mathematical Reasoning -

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

Assessment(s):

- Warm up problems at beginning of class.
- Check homework of a few students while they are correcting their homework and working on warm-up problems at beginning of class.
- At start of class, ask the following question – "What did we learn yesterday?"
- Randomly call individual students and ask questions during the above review.
- 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.
- Exit ticket.

Prerequisite Skills and Knowledge:

1. Graph quadratic functions in the Cartesian coordinate system.
2. Identify the x-intercept (roots, zeros).

Lesson Resources/Materials:

a. Students –
    i. Notes book
    ii. Textbook
    iii. Pencil, eraser, highlighter.
    iv. Graph paper
    v. Worksheet for Lesson 9.4.
    vi. Venn Diagram with two circles overlapping

b. Teacher –
    i. Laptop connected to document camera and overhead projector
    ii. Transparencies and markers
    iii. Graph paper
    iv. Worksheet for Lesson 9.4.

Instructional Sequence (Day 2)

Introduction (5 - 8 minutes):

TEACHER	STUDENTS
✓ Tell students to take out homework and start correcting. ✓ Project Warm-Up problems on screen. ***Assess/Evaluate:*** ✓ Check homework of some students and take attendance while students are working on warm-up problems.	Correct homework. (*Recall*, *Reading*, *Writing*) Start on warm-up problems.

Body of the Lesson (50 - 55 minutes)*: Describe step-by-step what the teacher* ***and*** *the students will be doing during the lesson.*

TEACHER	STUDENTS
Essential Mathematical Vocabulary for today: *Parabola, zero, roots, x-intercept, Venn diagram, leading coefficient* ***Connect to prior knowledge*** ***Assess/Evaluate:*** ✓ Review – What did we learn yesterday?	
Call (choosing randomly with index cards) on individual students to check understanding, and also engage the entire class. ✓ 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**.	(*Recall*, *Speaking*) Student(s) called on answers Teacher's questions in complete sentences using correct academic language and mathematical vocabulary such as *parabola, zero, roots, x-intercept*. (*Listening*) Students not called on are listening.
✓ For GATE student: Explain (in words) how to find the solution(s) to a quadratic equation by graphing the related function?	(*Summarize, Speaking*) GATE student answers using correct academic language and mathematical vocabulary.

✓ Check to make sure GATE student uses correct academic language and mathematical vocabulary.	(*Listening*) Students not called on are listening.
Assign 9.4 Worksheet with problems (including word problems)	
Practice A – in class, do problems 2, 3, 5 Practice C – in class, do problem 5 For each problem: ✓ Walk around and monitor student conversations, and their work.	(*Recognize, Identify, Calculate, Label, Graph, Use Context Cues, Writing, Speaking*) Students work in pairs to solve the problem. Students write answers in complete sentences. For example, "The roots are ___ and ___."
✓ ***Scaffold*** as necessary.	(*Speaking, Listening, Writing*) Discuss in pairs. Ask questions.
✓ Randomly call students (especially IEP, GATE, and ELLs) to check understanding by asking them how they solved the problem.	(*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 questions to class as a whole.	
✓ If necessary, ***model*** how to solve some problems, and/or provide appropriate ***scaffolding***.	(*Reading, Listening, Writing*) Students reading my work on the overhead, listening to me speak, and writing in their notes.
Connect to real-world applications	
✓ Example: Height of a ball. ✓ Example: Height of a rocket. ***Draw figures to understand the problem*** – especially to aid IEP, ELLs, and students who are more visual.	(*Apply Concepts, Use Concept Cues, Reading, Speaking, Listening, Writing)* Work in pairs. Students write answers in complete sentences. For example, "The ball is in the air for ____ seconds."
Anticipate: Identify possible problem words/phrases in the word problems – e.g.: *models, how long (refers to time, not length), launched, rocket* – check to make sure class understands each word/phrase.	

Critical Thinking Questions ✓ Does the ball (rocket) start from the ground? ✓ How can you tell from the equation? (there is no constant term, the y-intercept is zero) ✓ Is it possible for the height (or time) to be negative? Why or why not? ✓ Does the parabola open upwards or downwards? ✓ How can you tell from the equation? (leading coefficient is negative)	
Critical Thinking Questions ✓ Compare and contrast quadratic functions/equations with linear functions/equations on the Venn diagram – similarities and differences. Call (choosing randomly with index cards) on individual students to check understanding, and also engage the entire class. ✓ 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 completing the Venn Diagram, then ask the following questions to engage them in a class discussion: ✓ What is an equation? ✓ What is a linear equation? A quadratic equation? How can you tell the difference between them? ✓ How many variables are there in a linear equation? (two) Quadratic equation? (two) ✓ What are they usually called?	(*Compare and Contrast, Listening, Speaking, Reading, Writing*) Discuss with partner, and complete the Venn Diagram comparing and contrasting linear and quadratic equations. Students may refer to their notes book, and to the text book. (*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. (*Listening, Speaking*) Students participate in the discussion, speaking in complete sentences using correct academic language and mathematical vocabulary.

(dependent and independent variables, x & y) ✓ How many possible solutions can a linear equation have? A quadratic equation? ✓ What does the graph of a linear and quadratic function look like? ✓ Think about the slope of the linear and quadratic equation. ✓ Consider the domain and range of each. ✓ Individually check for understanding with IEP and several ELLs. May need to **repeat the question, write it down, talk slower**, aid with **Sentence Starters**, **Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**.	(*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.

Closure (9 – 17 minutes):

TEACHER	STUDENTS
Assign Homework Assign Homework- Students complete remaining problems from Worksheet as homework. If time permits, students can work on homework at end of class. ***Assess/Evaluate:*** Walk around and monitor individual students. Ask questions to check for understanding. Help individual students. ✓ Make sure to check on IEP and several ELLs –May need to **talk slower**, aid with **Sentence Starters**, **Revoice** (teacher repetition) student's explanation using **hand gestures**, along	(*Reading*, *Writing*) Work individually on homework. Ask for help if needed.

with **Pace and Emphasis**. ***Assess/Evaluate:*** **Exit Ticket Questions** ✓ (Q1) How many possible real roots (solutions) can a quadratic function have? (0, 1, or 2) ✓ (Q2) Draw rough graphs of the following: ✓ (i) A quadratic function with 1 root. Label the root on the graph. ✓ (ii) A quadratic function with 2 roots. Label the root on the graph. ✓ (iii) A quadratic function with 0 roots.	(*Reading*, *Writing*) Answer the questions on the Exit Ticket.

ACADEMIC LANGUAGE (DAY 2)

1. Describe the cognitive task related to the content learning objective:

   - ✓ Students will *recall* how to graph in the Cartesian coordinate system.
   - ✓ Students will be able to *recognize* and *identify* a quadratic function or equation.
   - ✓ Students will *graph* quadratic functions with 0, 1, and 2 x-intercepts (roots), and also be able to *identify* the number of roots (x-intercepts) given the graph of a quadratic function.
   - ✓ Students will *use context cues* in graphing quadratic functions.
   - ✓ Students will *connect* mathematical concepts (roots/zeros of a function and x-intercept of the graph of the function).
   - ✓ Students will *apply concepts* to real-world (word) problems.
   - ✓ .Students will *compare and contrast* linear and quadratic functions/equations.
   - ✓ Students will *contribute* to class and partner discussions using proper academic language and mathematical vocabulary.

2. Language Demands: How will students be communicating in relation to the content in the rich task?
   - Receptive – listening, reading, and viewing:
     - ✓ Listening and reading
   - Productive – speaking and writing:
     - ✓ Speaking and writing

3. What key language skill(s), related to a single language demand above, will you help the students develop during the lesson?

   - ✓ Speaking, Listening, and writing

4. 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 (roots, zeros, x-intercepts)
   - ✓ *engaging* in collaborative and oral mathematical reasoning
   - ✓ *distinguishing* mathematical uses of words used in everyday language (e.g.: roots, zeros)

   Listening
   - ✓ *listening* to each other when working together in pairs, while solving worksheet problems, and also while completing the Venn diagram
   - ✓ *listening* to me when I am modeling and thinking aloud while solving a problem

   Writing

- ✓ *writing* down all steps in solving a problem
- ✓ *writing* answers in complete sentences (for e.g.: "The x-intercepts are __ and __. "
- ✓ *representing* word problems mathematically
- ✓ *translating* words or sentences into symbols
- ✓ *drawing* a visual representation of the context of a word problem
- ✓ *comparing and contrasting* on a Venn diagram

5. 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 their answers in complete sentences. For example, "The x-intercepts are ___ and ___."

   - ✓ The instructional strategies I will use for *writing* are:

     - *Venn diagram* – students compare and contrast linear and quadratic functions/equations on a Venn diagram.
     - Students are to *write down all intermediate steps* in solving a problem.
     - Students write answers in *complete sentences*. For example, "The x-intercepts are ___ and ___."
     - *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.