LESSON PLAN (DAY 1)

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

B. 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.

C. 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 *summarize* what they have learned.
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.

Mathematical Reasoning -

4. Apply Mathematics to real-world (word) problems.
5. 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. Graphing on the Cartesian coordinate system.
2. Calculating the coordinates of the vertex and axis of symmetry of a parabola, and determining the maximum and minimum values.

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
   iv. Graph paper

Instructional Sequence (DAY 1)

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 (55 - 60 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* ***Connect to prior knowledge*** **Assess/Evaluate:** *Ask students and discuss –* ✓ "Describe the shape of a parabola? Discuss with your partner." ✓ "What is the zero of a function? Discuss with your partner." ✓ "What are the roots of a function? Discuss with your partner." 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, Listening*) Discuss in pairs. (*Recall, Speaking, Listening*) Discuss in pairs. (*Recall, Speaking, Listening*) Discuss in pairs. (*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.

Anticipate: If students are having difficulty, ask GATE student the questions, and then ask another student to repeat what the GATE student said.	(*Speaking*) GATE student answers the question. (*Listening*) Students not called on are listening.
Anticipate: If GATE student is also having difficulty, then have students look at their notes (or text book), and then explain in their own words.	(*Reading*) Read their notes and/or textbook. (*Speaking*) Students explain in their own words.
Connect to students' experiences *Ask students and discuss –* ✓ "Where in real-life would you see a curve similar to that of a parabola? Discuss with your partner and write down at least 3 examples."	(*Connect, Speaking, Listening*) Discuss in pairs.
Anticipate: Possible student answers… ✓ Sports – volleyball, basketball, soccer, javelin throw ✓ Bridge over a river/stream ✓ Satellite dish ✓ Throw a stone in the air ✓ Shooting a cannonball ***Draw figures*** (if necessary) – especially to aid IEP, ELLs, and students who may be more visual.	(*Connect, Speaking, Listening, Writing*) Class discussion.
Anticipate: If no answer… ✓ Provide a clue… (draw shape of parabola) the trajectory looks like this. Where do you see objects following such a trajectory? ✓ How many of you play sports? (link to volleyball, basketball, soccer, javelin throw)	
Introduce today's topic with Concept Today we will learn how to find the roots (or zeros) of a quadratic equation by graphing.	
Concept: Discuss with your partner what are	

the roots (zeros) of a function, and then determine how you can find the roots (zeros) from the graph of a function. *Answer – same as the x-intercept.* ***Assess/Evaluate:*** ✓ 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 x-intercepts. ***Scaffold*** by asking questions as follows: ✓ "What can you say about the value of a function at a zero/root?" (value is zero) ✓ "Draw a graph of a quadratic function." ✓ "Looking at the graph, where is the value equal to zero?" (x-intercept) **Examples with 0, 1, or 2 real 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 first work individually, then discuss the solution with their partner. ***Draw figures*** – especially to aid IEP, ELLs, and students who are more visual. ***Assess/Evaluate:*** ✓ Randomly call students to check understanding. ✓ Make sure to call on IEP and ELLs –	(*Connect, Multiple Representations, Speaking, Listening*) Discuss in pairs. (*Connect, Multiple Representations, Speaking, Listening*) Class discussion. (*Connect, 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. (*Recognize, Identify, Calculate, Label, Graph, Writing*) Work individually. (*Speaking, Listening, Writing*) Work in pairs. Ask questions. Students write answers in complete sentences. For example, "The roots are ___ and ___."

talk slower, may aid with **Sentence Starters**, **Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**. **Connect to real-world application (word problems)** ✓ Example: height of a jumping frog ✓ Example: height of a dolphin jumping out of the water (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 –*** *straight up, model, dolphin, how long (refers to time, not length)* **– *check to make sure class understands each word/phrase.*** ***Assess/Evaluate:*** ✓ 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. Make sure GATE student uses correct mathematical vocabulary and explanations. ***Anticipate:*** If GATE student can't explain, ask questions to the class: 1. "What is the height of the frog when it is on the ground?" (zero)	(*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. (*Apply Concepts*, *Use Context Cues*, *Reading*, *Speaking, Listening, Writing*) Work in pairs. Students write answers in complete sentences. For example: "The frog is in the air for 0.75 seconds." Or "The dolphin is out of the water for 2 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. GATE student explains in complete sentences using correct academic language and mathematical vocabulary. (*Listening*) Students not called on are listening. (*Speaking, Listening*) Answer the questions,

2. "Can you draw a rough sketch of the frog's trajectory?" (graph of a parabola) 3. "At what point(s) on the graph is the frog on the ground?" (x-intercepts) 4. "So from the graph can you find out how long the frog stays in the air?" (difference between the x-intercepts). ***Anticipate:*** Students still having difficulty understanding and solving the problem. ✓ ***Model*** the first example, **thinking-aloud**, so students understand my thinking. ✓ If time permits, students can work in pairs on the second example (dolphin).	discussing with their partner if needed. (*Reading*, *Listening, Writing*) Students reading my work on the overhead, listening to me speak, and writing in their notes. (*Apply Concepts, Use Context Cues, Reading, Speaking, Listening, Writing*) Work in pairs.

Closure (5 – 10 minutes):

TEACHER	STUDENTS
Assessment ***Assess/Evaluate:*** Ask Students – "What did we learn today?" ✓ Individually check IEP and several ELLs. May need to **talk slower**, aid with **Sentence Starters**, **Revoice** (teacher repetition) student's explanation using **hand gestures**, along with **Pace and Emphasis**. ✓ Open up to class. **Exit Ticket Question** ***Assess/Evaluate:*** ✓ Draw a parabola with 2 x-intercepts. Label the vertex (max or min), y-intercept, axis of symmetry, and x-intercepts. ✓ (Q1) What point(s) on the graph of this parabola corresponds to the roots or	(*Summarize*, *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, Listening*) Whole class discussion. (*Connect, Reading, Writing*) Answer the question on the Exit Ticket.

zeros of the function? (x-intercept) **Assign Homework** Assign Homework problems. If time permits, students can work on homework. Lesson 9-4 Exercises, pgs. 571 - 573: 14 – 28 all (except #16), 41, 42, 47 – 57 all ***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 with **Pace and Emphasis**.	(*Reading*, *Writing*) Work individually on homework. (*Speaking*) Student(s) called on answers Teacher's questions in complete sentences using correct academic language and mathematical vocabulary.

ACADEMIC LANGUAGE (DAY 1)

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 *summarize* what they have learned.
   - ✓ 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, reading, and viewing.
   - 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.
   - ✓ Reading

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)

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

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 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 *straight up, model, dolphin, how long (*refers to *time,* not *length)*
   - *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.