

Substitute Guide: Quadratic Functions — Graphs, Zeros, and the Vertex

Course: Algebra II (Grades 9–12) **Subject:** Mathematics **Time:** ~50 min standard · ~90 min block Math

Learning goal (plain language)

Students practice **quadratic functions** — reading a quadratic in **standard form** $y = ax^2 + bx + c$, finding its **vertex** (turning point) and **axis of symmetry**, finding its **zeros (roots)** by **factoring**, and **interpreting the vertex** as a maximum or minimum in a real story (a projectile's greatest height, a largest area). **You do not need a math background to run this.** Every formula and a worked example are printed in the student packet. Students **show their work**; you do not need to teach the method — the packet does the teaching. Your job is to hand it out, read the start script, keep the room on task, and collect the packets.

Standards alignment

Framework: 19 TAC §111.40 (Algebra II). Knowledge & skills for quadratic functions — graphing quadratics and identifying key attributes (vertex, axis of symmetry, zeros, y-intercept, maximum/minimum), solving quadratic equations by factoring, and interpreting these attributes in real-world contexts.

- **Provisional — graphing key attributes:** graph quadratic functions from standard form and identify the vertex, axis of symmetry, zeros/x-intercepts, y-intercept, and whether the vertex is a maximum or minimum.
- **Provisional — zeros by factoring:** solve quadratic equations of the form $ax^2 + bx + c = 0$ by factoring, using the Zero Product Property to find the roots.
- **Provisional — vertex in context:** interpret the vertex of a quadratic model as a maximum or minimum value (e.g., greatest height, maximum area) in a real-world situation.
- **Provisional — vertex form (block):** identify the vertex and axis of symmetry directly from vertex form $y = a(x - h)^2 + k$.

Provisional — pending educator verification against the current official TAC source.

(Standards are paraphrased here, not quoted. If unsure of exact section numbers, treat as 19 TAC Chapter 111 (Algebra II). Please confirm codes and wording against your official source. This packet is **not** claimed to be "aligned to the TEKS" until reviewed.)

Setup Before class (5 min)

- Count and hand out one **student packet** per student.
- Confirm each student has a **pencil**. A **graphing or scientific calculator is allowed but not required**; students who have one may use it.
- Write the date on the board and remind students to fill in the name line.
- Keep the **answer key** with you — it is a separate file and is **not** in the student packet.
- **Standard vs. block:** on a ~50-minute period, students do items 1–7, 9, and ACE (item 8 is optional). On a ~90-minute block, students also complete **item 8** — vertex form and the maximum-area modeling task.

Materials What's needed

- Printed student packet (5–7 pages) per student.
- Pencil per student; a graphing or scientific calculator is optional.
- This guide and the separate answer key (teacher only).
- No technology, no internet, no special supplies.

Timing Suggested pacing (standard ~50 min • block ~90 min)

Segment	Standard (~50 min)	Block (~90 min)	What students do
Start — Retrieval warm-up	6 min	8 min	Q1–Q2 (evaluate a quadratic; factor + Zero Product)
Build — Study the math	8–12 min	12–15 min	Read reference box, worked example, parabola graph; Q3
Apply — Use what you know	20–26 min	28–34 min	Q4–Q7 (read a graph, factor for roots, projectile context, error analysis)
Block — Extra applied task	optional	12–15 min	Q8 (vertex form; maximum-area modeling)
Explain — Justify (CER)	6–10 min	8–12 min	Q9 claim/evidence/reasoning
Close — ACE	5 min	5–7 min	Articulate / Connect / Extend
Continue — early finishers	optional	optional	Build your own quadratic from two roots

Script Read aloud to start

"Today's assignment is a paper math packet called *Quadratic Functions: Graphs, Zeros, and the Vertex*. You will work by yourself with a pencil. A graphing or scientific calculator is allowed if you have one, but you do not need one. The most important rule: **show your work** — write down the numbers and steps you use, not just a final answer. Everything you need is printed in the packet, including a worked example, a labeled parabola graph, and all the formulas. Start with the warm-up, then read the Build section before the Apply questions. If a question is tricky, skip it and come back. Put your name, class period, and date at the top now. You have about [50 / 90] minutes; raise your hand if you need help reading a question."

Support When students ask for help

- **Students show their work; you do not need to teach the method.** Point them back to the printed **reference box** and the **worked example** — the method is right there.
- **You may read any part aloud** to a student or the class.
- If a student is stuck, prompt with "What does the worked example do?" or "In $y = ax^2 + bx + c$, which sign of a tells you whether the vertex is a max or a min?" rather than giving the answer.
- For the vertex, remind them the packet shows $x = -b \div (2a)$, and that the axis of symmetry is that same vertical line.
- For zeros, remind them to **set the quadratic equal to 0, factor, then set each factor to 0** (Zero Product Property).
- Remind students that a **root is where $y = 0$** (on the x -axis) while the **vertex is the turning point**, halfway between the roots — they are not the same.
- It is fine if a student cannot finish the optional early-finisher challenge.

Access Accommodations & language support

- **Read-aloud** of any question is allowed for all students.
- Point students to the **worked example**, the **formulas** in the reference box, and the **sentence stems** for Q9 and ACE.
- A **calculator is allowed** for any student who wants one — this removes the arithmetic barrier so students can focus on the reasoning about vertex, axis, and roots.
- Extended time is fine; the core can stop after Q9 if time runs short.
- Students may show work with numbers and short phrases if writing full sentences is a barrier, as long as the reasoning is clear.
- The packet is grayscale-safe — the parabola uses black lines, labeled points, a dashed axis of symmetry, and text, so it prints and reads clearly in black and white.

Tools Allowed & not allowed

Allowed: pencil, the printed packet, a graphing or scientific calculator, quiet self-read-aloud. **Not needed / not allowed:** phones for messaging, internet, AI tools, or getting answers from another student.

Collect at the end: Collect every packet, whether finished or not, with names on them. Stack them for the teacher. Note on a sticky how far most students got and any questions that caused confusion.

Answer key: The **answer key is a separate file** (answerkey.html) and is for the teacher only. Please do not hand it to students.

Teacher follow-up (for the returning teacher)

The highest-value items to review next class are the **error analysis (Q7)** and the **justification (Q9)**, which reveal the **sign error in factoring** (opposite-sign factors when c is negative) and the **root-vs-vertex** confusion (the axis is the midpoint of the roots, not a root). Watch for students who assume the **vertex is always a minimum** (Q6 has $a < 0$, a maximum), who **stop after finding the vertex x** without substituting back for the height/area (Q6, Q8b), and who mishandle the sign in $x = -b \div (2a)$ or in vertex form (Q8a). The **read-a-graph** item (Q4) shows who can pull zeros, vertex, axis, and y-intercept from a table. The separate answer key lists worked steps, alternate strategies, misconceptions, and a 3-point rubric for Q9.

HS_ALG2_Quadratics_01 — Quadratic Functions: Graphs, Zeros, and the Vertex Substitute Guide