



Teacher-to-Teacher

Video Series
for Secondary Educators

TITLE: Writing in the Math Classroom

PRIMARY SUBJECT AREAS: Algebra-Quadratic Equations and
Parabolas

GRADE LEVELS: 9-12

OVERVIEW: This lesson will begin with graphing parabolas from quadratic equations given in the form $y = ax^2 + bx + c$ and progress to writing the equation of a parabola, given data points. The lesson will consist of an investigation, a hands-on data collection activity, and several writing activities. The writing will include journals and portfolios and will be applicable to any math class.

APPROXIMATE DURATION: 2-3 fifty-minute class periods

LOUISIANA CONTENT STANDARDS:

<http://www/DOE/assessment/standards/MATH.pdf>

Algebra

A-1-H demonstrating the ability to translate real-world situations into algebraic expressions and equations

A-3-H using tables and graphs as tools to interpret algebraic expressions, equations, and inequalities

Data Analysis

D-2-H recognizing data that relate two variables as quadratic

Patterns, Relations, and Functions

P-3-H recognizing behavior of families of functions, using graphing technologies

GLEs Addressed

Grades 11/12

4. Translate and show the relationships among non-linear graphs, related tables of values, and algebraic symbolic representations (A-1-H)
6. Analyze functions based on zeros, asymptotes, and local and global characteristics of the function (A-3-H)
19. Correlate/match data sets or graphs and their representations and classify them as exponential, logarithmic, or polynomial functions (D-2-H)

27. Compare and contrast the properties of families of polynomial, rational, exponential, and logarithmic functions, with and without technology (P-3-H)

EDUCATIONAL TECHNOLOGY GUIDELINES:

<http://www/DOE/LCET/curric/k12stand.pdf>

Technology Productivity Tools

- Students use technology tools to enhance learning, increase productivity, and promote creativity.

Technology Research Tools

- Students use technology tools to process data and report results.

INTERDISCIPLINARY CONNECTIONS:

N/A

OBJECTIVES:

1. The student will find the vertex, y -intercept, and direction of a parabola, given an equation in the form $y = ax^2 + bx + c$.
2. The student will be able to write an explanation of how to graph a parabola.
3. The student will be able to collect and graph real world data and find the equation of a parabola to model the data, using a calculator.
4. The student will make conclusions about real world data.

LESSON MATERIALS AND RESOURCES:

Investigation worksheet, Water Fountain Parabola Project, Journals, Portfolios, Algebra textbook

TECHNOLOGY TOOLS AND MATERIALS:

Overhead calculator and calculator for each student

BACKGROUND INFORMATION:

Students should be able to use the graphing feature on the calculator. They should know that the graph of a quadratic equation is a parabola, and they should be familiar with the basic shape of a parabola. They should know the meaning of the terms vertex, y -intercept, and x -intercept.

LESSON PROCEDURES:

1. Vertex Investigation Worksheet – This investigation should be done in small groups. Students should use calculators to graph each parabola and find its vertex. The teacher should do one or two with the class first, as examples. Students should make conjectures about the vertex and test their guesses. They may need encouragement or suggestions for the numbers to check. The teacher should walk around the room as groups work to give help (and hints!) as needed. They might not need to graph every parabola given or they might need to make up their own equation in

- order to test their conjectures. The teacher should decide how much students need to write down on the lab worksheet and might decide to have students only sketch 4 or 5 graphs instead of all of them. The important idea here is for students to graph enough parabolas to reach a conclusion about the vertex.
2. Each student should write the conclusions requested at the end of the activity. They may talk to their groups about the conclusions, but it is best if each student write an individual conclusion. Students should complete the writing exercise in a journal or as written work to be graded.
 3. Water Fountain Project – Students should work in small groups to complete this project. Each group should choose a different water fountain around the school. After they trace the water, they should return to the classroom and complete the rest of the work. Each group should have a piece of colored paper (regular or heavier) and several colored pencils or markers. The finished projects can be posted by appropriate water fountains around the school so that all students can enjoy them!
 4. Students may be asked to write journal entries about parabolas and/or about the water fountain project.
 5. Students should be asked to include an entry on parabolas in a portfolio at the end of the semester. Both the vertex investigation and the water fountain project are items that involve parabolas.

ASSESSMENT PROCEDURES:

1. Teachers should check students' conclusions before students begin the writing exercise.
2. The writing exercise can be discussed in groups or with the whole class, and/or they can be evaluated by the teacher.
3. As students work on the Water Fountain Project, teachers should informally assess students' progress, giving guidance and suggestions where needed. To grade the project, the teacher might want to use a rubric. A suggested rubric is included. Students should be given the rubric when they are assigned the project; then they know exactly how they will be graded.
4. Have students write a journal entry about graphing parabolas and/or about the water fountain project. Or use the writing exercise as a journal entry. Journal entries may be graded or students may just receive credit for doing the writing. A journal entry is a good way for a student to express thoughts about a project or activity. After doing the water fountain project for the first time, a journal entry will give the teacher feedback, possibly with suggestions for ways to improve the project.
5. For portfolios to be done at the end of the semester, have students include an entry showing their understanding of parabolas. They may also be required to include an activity that was done in a group and/or a data collection activity. The portfolio evaluation sheet is a way for students to check themselves and serves as a guide for the student of what is expected. Students should have a peer (someone in the same course) evaluate their work and also have a parent read and comment on the work.

ACCOMMODATIONS/MODIFICATIONS:

N/A

REPRODUCIBLE MATERIALS:

Vertex Investigation Worksheet
Water Fountain Project
Journals in Math
Portfolio Assignment

EXPLORATION AND EXTENSION:

Students can find other examples of parabolas in the world around them. Writing about parabolas they find is a good journal entry. Students can discuss and/or write about the similarities and differences in the equations they found for different water fountain.

LESSON DEVELOPMENT RESOURCES:

N/A

REFLECTIONS:

Students can easily determine the effect that a and c have on the graph of the parabola, but more work is needed to determine the role of b and to arrive at the formula for the x -coordinate of the vertex. By listing the values of a and b next to the vertex on the chart, students will see the relationship after looking at several equations. This is a good activity to do in small groups, as students can help each other to find the solution.

The Water Fountain Parabola Project helps students understand where math occurs in everyday life. By making a sign about the parabola formed and by posting it next to the water fountain, students all over the school are exposed to math as they drink water. Students also enjoy having a chance to be creative in math and doing a hands-on activity helps them understand and remember how to work with graphs of parabolas.

Having students write in a journal is a way to assess students' understanding and also to get students' opinions and feedback on activities. Students are more involved in their learning when they know that their opinions matter to the teacher. Feedback on activities can help the teacher improve the activity as well as determine its success.

Portfolios are another way to get feedback from students. Students must write a paragraph about each item they include, so the portfolio is an excellent way to have students summarize their learning for a quarter, semester, or year. Students reflect on their work in the course, and the completed portfolio shows students what they have accomplished in the course. The Portfolio Evaluation forces students to share their work with a parent or guardian, so it is another way to involve parents.

CONTACT INFORMATION:

Kay Fenton

Parabola Vertex Investigation

Goal: To find the vertex of a parabola

For the investigation, you should graph each parabola and find the vertex by using 2nd calc, maximum or minimum. Your goal is to be able to state the vertex of a parabola by just looking at the equation of the parabola. You do not need to graph every parabola listed; graph enough so you can make conclusions. If you need to graph more, make up your own. You should complete the table entries for every parabola you do. At the end of the investigation, you need to write conclusions about graphing parabolas. Have your conclusions checked before you continue to the writing exercise.

HINT: Try to find the x -coordinate in terms of a and b . After you find the rule for finding the x -coordinate, then determine a method for finding the y -coordinate.

Graph each of the following and find the vertex (use maximum or minimum key on calculator)

function	sketch	vertex	a	b
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$$y = x^2 + 4x + 1$$

$$y = x^2 - 4x + 1$$

$$y = x^2 + 6x - 3$$

$$y = 2x^2 - 4x + 1$$

$$y = -2x^2 - 4x - 5$$

$$y = -x^2 + 3x + 4$$

$$y = -4x^2 + 2x - 3$$

$$y = 2x^2 + x - 8$$

$$y = 3x^2 - x - 1$$

$$y = -4x^2 + x + 4$$

Conclusions:

Given the quadratic equation: $y = ax^2 + bx + c$. Use your graphs to answer the following.

1. What does a , the coefficient of x^2 , do to the graph of the parabola?
2. What is the y -intercept of the parabola?
3. What is the x -coordinate of the vertex of the parabola?
4. How do you find the y -coordinate of the vertex of the parabola?

Writing Exercise:

Suppose your friend was absent the day your class learned how to graph a parabola when given a quadratic equation in the form $y = ax^2 + bx + c$. Write a note to your friend to tell him/her how to find the vertex and how to graph the parabola.

Water Fountain Parabola Project

1. Choose a water fountain somewhere on the school campus.
2. Make a sketch of the water parabola that forms when you turn on the water fountain.
3. Draw the parabola on graph paper. Choose points on the parabola and make a table of values for x, y .
4. Enter x and y values in 2 lists on your calculator. Make a scatter diagram. Find the equation of the parabola in the form $y = a(x - h)^2 + k$ (use guess and check).
5. Make a sign (use $\frac{1}{4}$ to $\frac{1}{2}$ poster board) to post by the fountain giving any information you want about the parabola formed. Include the equation, graph, and at least 2 other facts about the parabola. Title your poster (be creative...). On the back of your poster, write the location of your water fountain. Be specific.

COMPLETE and hand in:

1. Our water fountain is located: _____
2. Attach original sketch.
3. Give list of values in a table form. Attach graph (on graph paper).
4. The equation of our parabola is: _____
5. Include sign. Title your sign, using a clever math phrase....

You will be graded on accuracy and neatness. Creativity is good too!

Water Fountain Parabola Project Grade Sheet

Names_____

Location of Fountain_____

Sketch and graph (10)

Data Table (4)

Equation (8)

Facts on sign (10)

Sign (8)

(total – 40)

Journal Writing in Mathematics

A journal is a way for students to do writing on a daily (or several times a week) basis in math. Students can be given prompts at the beginning of class or at the end to review or summarize a lesson. The writing can be graded or just discussed in class. To make the journal, students can use folders or simply staple a few sheets of paper together, with a title page and/or a back coversheet.

Suggestions for journal entries:

- Question about a lesson just learned to test students' understanding
- Question about a previous lesson as a review
- Comments about a group activity or project
- Student opinion on a class activity
- Writing about math in the newspaper
- Evaluation of a class activity or project
- Self evaluation on a project or after a test

Portfolio Information

A portfolio is a collection of student work that shows student achievement. It should include items chosen by the student, with some teacher guidance. A completed portfolio is a record of a student's work in the course.

What does a portfolio show?

- Growth over time
- Evidence of mastery of a subject
- Achievement
- Strengths and Weaknesses

What are the uses of a portfolio?

- Measure growth
- Show mastery of outcomes – for class, department, school, or district
- Collection of student work
- Sample of best work for other purposes – college admission, employment
- Determination of placement in appropriate courses
- Student assessment tool
- Personal reflection tool
- Documentation for review of course
- Reliability and validity check on traditional assessment
- Use in parent, student, teacher conferences
- Program evaluation
- Communication with subsequent teachers

What are some types of portfolios?

- Working portfolios – measure growth during the year
- Cumulative portfolios – measure growth through the years

Algebra II Portfolio – 2nd Semester

The following items should be in your portfolio, numbered and in this order:

1. Favorite work of the semester
2. Least favorite work of the semester
3. One work that shows progress you made in Algebra II this year
4. One data project or experiment from this semester
5. One notebook quiz from the semester
6. One item involving parabolas
7. One example of a group activity
8. One example of work from another subject that relates to Algebra

Write at least a paragraph about why each work was included; put your paragraph, followed by the work, in your portfolio folder. Put your second semester portfolio items behind first semester, using a cover sheet for second semester to show where it starts.

Also include the following – ½ to 1 page each:

9. Letter to next year's Algebra II student – include advice, warnings, encouragement, etc.
10. Write an imaginary dialog between the teacher and one or both of your parents about your performance and your work in Algebra this year. Think about what he/she might say about your strengths and weaknesses and about the progress you have made. What would your parents' responses be?
11. Your feelings about this class. Please take a little time to think about it and include what you think would improve Algebra II for next year's students. Also include how you think the block schedule was handled for this class.

Portfolio Evaluation Sheet

This should have peer and parent comments and signatures as well as your own evaluation of your work. I will do the teacher evaluation. Please put this page first in the portfolio and do not attach it in the brads.

The portfolio for 2nd semester should be in your portfolio folder after the works from first semester. Your items should be numbered and put in the order listed above. Your paragraphs and final items should be typed or written neatly in ink.

The portfolio will be worth 40 points and will be graded on following directions, variety of work included, thoroughness of explanations, neatness.

Due: _____

I will return portfolios before exams. You will need to return portfolio, old tests, and spiral on the day of your exam.

Name _____

Portfolio Evaluation Sheet

Please evaluate the portfolio by checking each listed item. Write your comments at the end.

SELF PEER PARENT TEACHER

Prepared on time				
Complete				
Correctly organized				
Neat				
Written in sentences				
Correct grammar, spelling, punctuation				
Items numbered				
Variety of items included				
Growth in mathematical ability shown				
Growth in communication skills shown				

PEER Comments and signature:

PARENT Comments and signature:

TEACHER Comments and signature: