

Applet for Quadratic Functions

This applet was developed to address, in part, the high school algebra standard in West Virginia. In addition, the applet may be used in College Algebra or Pre-calculus courses as well as a course for pre-service teachers. The accompanying worksheet may be used to guide the applet, or the applets may be used in isolation.

Content Standards are meant to be broad descriptions of what students should know and be able to do in a content area. They describe what students' knowledge and skills should be at the end of a sequence of study. The Quadratic Functions applet was written taking into account standard 2 from the *West Virginia Content Standards and Objectives for Mathematics* (WVDE, 2004).

Standard 2: Students will:

- **demonstrate understanding of patterns, relations, and functions;**
- **represent and analyze mathematical situations and structures using algebraic symbols;**
- **uses mathematical models to represent and understand quantitative relationships; and**
- **analyze change in various contexts through communication, representation reasoning and proof, problem solving, and making connections within and beyond the field of mathematics.**

A content objective is an incremental step toward the accomplishment of content standards (WVDE, 2004). The activity may be used to explore the following objectives from Algebra I, Algebra II, and PreCalculus. These are found in the *West Virginia Content Standards and Objectives* document. The format of each standard identification is **course_abbreviation.standard_number.objective_number**. So **A1.2.5** is for Algebra I and addresses standard 2, algebra, and is objective number 5.

A1.2.5 analyze a given set of data for the existence of a pattern numerically algebraically and graphically; determine the domain and range; and determine if the relation is a function.

A1.2.16 solve quadratic equations by graphing, factoring and quadratic formula.

A1.2.18 collect, organize, interpret data and predict outcomes using the mean, mode, median and range.

A2.2.8 solve equations containing radicals and exponents.

A2.2.9 define a function; find the domain, range, zeros; find the inverse of a function; find the value of a function for a given element in its domain; and perform basic operations on functions including composition of functions.

A2.2.10 explore families of functions: **recognize** linear, **quadratic**, absolute value, step, and exponential **functions; and convert among graphs, tables, and equations.**

A2.2.17 **perform a quadratic regression and use the results to predict specific values of a variable. Identify the regression equation.**

PC.2.1 **investigate and sketch the graphs of polynomials** and rational functions **using the characteristics of zeros**, upper and lower bounds, **y-intercepts, symmetry**, asymptotes and end behavior, **maximum and minimum points and domain and range.**

Performance Descriptors describe in narrative form how students demonstrate achievement of the content standards. In West Virginia, five performance levels have been adopted. The descriptors are meant to give teachers more information about the level of their students and are also used to explain student performance on statewide assessment instruments (WVDE, 2004). The following performance descriptors are suggested for the Quadratic Functions applet.

■ **Distinguished**

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in Algebra II. The student develops equations to solve practical application problems giving solutions in a clear, concise manner. The student finds domain, range and zeros of functions converting forms among graphs, tables and equations. The student solves quadratic equations over the set of complex numbers using various techniques confirming solutions both numerically and graphically in a clear concise manner and performs quadratic regressions using the regression equation to predict values.

■ **Above Mastery**

The student demonstrates competent and proficient performance and shows a thorough and effective application of knowledge and skills that exceeds the standard in Algebra II. The student finds domain, range and zeros of quadratic functions using graphs, tables and equations. The student solves quadratic equations over the set of complex numbers using various techniques, confirming solutions either numerically or graphically and performs quadratic regressions giving the regression equation.

■ **Mastery**

The student demonstrates fundamental course or grade level knowledge and skills by showing consistent and accurate academic performance that meets the standard in Algebra II. The student finds domain, range and zeros of basic quadratic functions using graphs, tables and equations. The student solves quadratic equations over the set of complex numbers confirming solutions numerically or graphically.

■ **Partial Mastery**

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in Algebra II. Performance needs further

development. The student inconsistently finds the domain, range and zeros of simple quadratic functions and attempts to solve simple quadratic equations given a graph.

■ **Novice**

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in Algebra II. Performance needs considerable development. The student graphs parabolas given a table and attempts to solve simple quadratic equations.

Suggestions for Grading the Worksheets

The author sets the total value of each example worksheet as 100 points. Some of the responses, usually the written ones, are weighted more heavily than others. In addition, up to 10 points of the 100 are awarded for the ability of students to work in a group and communicate mathematically. Worksheets turned in from only one student do not receive the laboratory points assigned for mathematical communication.

It is suggested that a rubric be used to score the written responses in this applet. A rubric can be defined as a set of authoritative rules to give direction to the scoring of assessment tasks or activities (Key Curriculum, 1999). When holistic scoring is used, the item being evaluated is looked at as a whole. Points are not given for individual components. Also, when using this type of assessment, it is suggested that special qualities in one aspect of a response may override weaknesses elsewhere.

Suggested Rubric for Written Responses

Responses receiving full credit should have the correct answer written in a clear detailed manner. These responses use sentences when required and contain few or no communication errors. There should be no question of the student(s)' understanding of the content surrounding the question being asked. All details should be addressed, including correct usage of the units of measurement being used, symbols required for communication and the identification of special types of numbers if required.

Responses receiving 3/4 credit include full correct answers except for a few minor arithmetic, symbolic, or communication errors. They still have clear and correct responses and explanations.

Responses receiving ½ credit include partial correct answers communicated with clear explanations. In some cases, the response may contain a full correct answer; however, it is not communicated in a clear manner. This usually means that a student puts down everything possible and wants the grader to pull out the correct parts. These responses may also be those with a correct solution, but contain no justification of the answer if specifically required.

Responses receiving 1/4 credit attempt to respond by beginning to develop a correct response. The response does not contain a correct answer; however, an attempt is made to communicate in a clear manner.

Responses receiving no credit are either blank, simply restate the problem, or show no real understanding of the question.

Student Accountability

In addition to the content standards and objectives of the lesson, the disposition of students is fostered by expecting each student to be accountable for his/her own work and time management, even though team work is expected. Often, sections of the activities are completed as group home work assignments and the following rules are applied:

- **Labs must be turned in only to YOUR instructor and are due IN YOUR CLASS on the Wednesday following the lab day. As a courtesy to students, labs will be accepted on Friday IN YOUR CLASS with no penalty. After that, NO LATE LABS WILL BE ACCEPTED.**
- **Each student should complete his/her own copy of the laboratory sheets. Be prepared to turn in your copy of the lab if your partner is absent the day that it is due. Only one lab per team (2-3 students) will be graded; if more than one lab is turned in, only one will be graded and returned.**
- **Only labs turned in to your instructor during regularly scheduled class time will be accepted. Make plans to get your lab turned in if you must miss class.**

References

Key Curriculum Press. (1999). *It's All Write: A Writing Supplement for High School Mathematics (Years 1–4)*.

Mathematics Content Standards and Objectives for West Virginia schools. Retrieved March 1, 2004, from <http://wvde.state.wv.us/csos/>