

Java Applet for the Lemonade Stand

This applet was developed to address, in part, the high school algebra standard in West Virginia. In addition, the applet may be used in a course for pre-service teachers or as in introductory laboratory in College Algebra to familiarize the students with the grapher. The accompanying worksheets may be used to guide the applet, or the applet 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 Lemonade 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;**
- **use 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 java 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 **A1.2.1** is coded for Algebra I and addresses standard 2, algebra, and is objective number 1.

A1.2.1 simplify and evaluate algebraic expressions using grouping symbols, order of operations and properties of real numbers with justification of steps.

A1.2.2 solve multi-step linear equations in one variable and apply skills toward solving practical problems.

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.

A1.2.11 solve systems of linear equations numerically and graphically, by the elimination method and by the substitution method.

A2.2.7 define the components of a matrix: develop and use the appropriate field properties by adding, subtracting, and multiplying; solve a system of linear equations using matrices; and apply skills toward solving practical problems.

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 Lemonade Stand applet.

Distinguished

The student demonstrates exceptional and exemplary performance with distinctive and sophisticated application of knowledge and skills that exceeds the standard in **Algebra I**. The student solves linear, and equations to interpret solutions of complex, practical application problems. The student justifies and judges the reasonableness of real number solutions given in both exact and approximate forms in a clear concise manner. The student factors and performs operations on polynomials and simplifies algebraic expressions. The student solves linear systems numerically and graphically justifying solutions analytically. Given graphical and numerical data, the student determines the slope and various forms of the equation of a line and performs linear regressions using the regression equation to predict values. The student predicts and interprets outcomes of collected data summarizing results in a clear concise manner.

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 I**. The student solves simple, multi-step practical application problems using linear equations. The student simplifies algebraic expressions with integer exponents and factors and performs basic operations on simple polynomials and solves linear systems numerically or graphically. The student predicts outcomes of collected data based on constructed graphs.

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 I**. The student solves simple, multi-step problems using linear equations. The student simplifies algebraic expressions with whole number exponents. The student given a graph, solves linear systems.

Partial Mastery

The student demonstrates basic but inconsistent performance of fundamental knowledge and skills characterized by errors and/or omissions in **Algebra I**. Performance needs further development. The student inconsistently solves one-step linear equations, simplifies algebraic expressions without exponents and adds, subtracts, and multiplies simple polynomials.

Novice

The student demonstrates substantial need for the development of fundamental knowledge and skills, characterized by fragmented and incomplete performance in **Algebra I**. Performance needs considerable development. The student solves one-step linear equations in one variable with procedural errors and attempts to simplify algebraic expressions.

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 1/2 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/>