Test Construction Project

I. <u>Introduction</u>

This unit is simple titled "Solving Equations", but encompasses solving equations by using the distributive property, combining like terms, simplifying, and solving using one or more of the following properties: Addition, Subtraction, Multiplication, or Division Properties of Equality. These types of problems are the building blocks of algebra and require both rote calculation and problem-solving techniques on the student's part. The summative assessment will cover a total of 5 lessons from Chapter 3 of the text and will instruction will occur over a projected 8 to 10 day period with a pre-assessment/review day at the beginning, five days of instruction, homework days in between lectures, final review, and a day for the post assessment. Questions will be encouraged at all times and individual student mastery of the material is the desired goal.

Area: Mathematics, Pre-Algebra
Unit Topic: Solving One- and Two-step Equations
Grade level: This is geared for an 8th grade class, but is essential material for any Pre-algebra class.

OH – Ohio Academic Content Standards
Subject: *Mathematics*
Standard: *Patterns, Functions, and Algebra Standard*
Students use patterns, relations and functions to model, represent and analyze problem situations that involve variable quantities. Students analyze, model and solve problems using various representation such as tables, graphs, and equations.
Grade Range: By the end of the 5-7 program:
    Benchmark G: Write, simplify and evaluate algebraic expressions.
    Benchmark I: Explain how inverse operations are used to solve linear equations.

II. Learning Objectives

1. **L.O. #1:** Students will interpret the correct usage of Property/Procedure corresponding to worked-out used in solving one-step equations. (*Comprehend* level on Bloom's Taxonomy)
2. **L.O. #2:** Students will translate word problems into mathematical equations and solve. (*Analysis* on Bloom's Taxonomy)
3. **L.O. #3:** Students will identify correct definitions of vocabulary. (*Knowledge* on Bloom's Taxonomy)
4. **L.O.#4:** Students will use analytical and tactile methods to solve equations. (*Apply* on Bloom's Taxonomy)

Table of Specifications
The following is a distribution of the 23 items for the summative unit exam of my learning objectives and Bloom's Taxonomy levels.

	Knowledge	Comprehend	Analyze	Application
L.O. #1 OH Bm G	0	8	0	0
L.O. #2 OH Bm G	0	0	4	0
L.O. #3 OH Bm I	7	0	0	0
L.O. #4 OH Bm I	0	0	0	4

III. Pretest Assessment Plan

Prior to the start of the unit, students will be given a worksheet that is a compilation of problems that should be review for most students. The free-responses questions are comprised of a series of problems involving products of positive and negative integers, writing subtraction expressions as addition expressions and evaluating, translating verbal expressions into algebraic expressions, and review vocabulary. Mastery of these skills is essential for success in Unit 3 – calculators will not be permitted since I am more interested in students' working knowledge of signs (+/-) than the numerical value. Each student will receive 10 points for completing >60% of the worksheet. This will be used to determine whether a class as a whole is ready for the unit or if some review is necessary. It will also serve as a good activation of prior knowledge for students in preparation for more applications of basic arithmetical skills.

IV. Formative Assessment Plan

Socratic questioning during class lectures will prompt active learning in students and hopefully alert the teacher as to potential misunderstandings that students may have with the material. Homework will be assigned daily and collected for grades. Students will receive points for completion of homework and a question/answer portion of the class period will be set aside everyday. If a number of students seem to be struggling, a quick "re-teach" session will be conducted during class. This will give students a feel for the type of questions that will be asked on the test, provide them with multiple grades to contribute to their overall class grade, and give the teacher indication of the level of mastery that students have met.

The summative assessment is designed to test students comprehension and ability to apply learned knowledge to the 5 lessons in the unit on solving one- and two-step equations. A summary of the test is as follows:

(1) 10 Multiple Choice (3 points each)
(2) 5 True/False (3 points each)
(3) 5 Matching (3 points each)
(4) 2 Constructed Response/Solving Applications (10 points each)
(5) 1 Performance Task using Algebra Tiles (20 points)

The first 20 questions on the test are selected response items involving a assessing a mixture of the learning objectives. The 2 constructed response problems are "real-life applications" (aka: story problems) that will require that students read the problem, assign a variable, set up a correct equation, and solve. These problems are holistic in that they really do assess each learning objective related to deciphering a written problem and solving using properties of equality learned in the unit. The performance task is similar to the constructed response problems in that students will be asked to analytically solve the equation. They will, however, be required to use "Algebra Tiles" – paper tiles that use squares for digits (yellow=positive/red=negative) and rectangles for variables (yellow=positive/red=negative) – that have been used throughout the unit. This task of demonstrating the solution will be performed individually for the teacher. These solutions require that students verbally explain their thought process and reasoning for solving the equation while manipulating the tiles.

The school district's standard grading scale will be used for assigning a letter grade for this assessment: A: >92%, B: 85-92%, C: 77-84%, D: 69-76%, and F: <69%.

Unit 3 Assessment: Solving Equations

Name: _____

Date: _____

Directions: Read each problem carefully and be sure to answer what it asks for. Scientific calculators are permitted. However, you **must show your work** for the problem or you will <u>not</u> receive full credit. The point values are given with each section. Use a *pencil* **and** an *eraser*! Do your best – good luck!!!

Multiple Choice (3 points each)

Circle the correct answer for each of the problems below.

1. What value of x makes $-x + 2 = 9$ a true statement?
    A. 7
    B. -11
    C. 9
    D. -7

2. Which expression is **not** equivalent to the other three?
   A. -7(x – 3)
   B. -7x – 3
   C. -7x +21
   D. -8x + 21 + x

3. Katie practiced the clarinet for *m* minutes. Her sister practiced 15 minutes more. Which expression represents the **total time they spent practicing**?
   A. 2m + 15
   B. m + 15
   C. 2m – 15
   D. m – 15

4. One ticket to a baseball game costs *t* dollars. A soft drink costs *s* dollars. Which expression represents the total cost of a ticket and soft drink for *p* people?
   A. ps + t
   B. p(s + t)
   C. pst
   D. t(p + s)

5. The *Additive Property of Equality* says that you can
   A. add a number to just one side of an equation.
   B. subtract a number from just one side of an equation.
   C. add the same number to both sides of an equation.
   D. subtract the same number from both sides of an equation.

6. When 7 is subtracted from a twice a number, the result is 3. What is the number?
   A. 5
   B. -11
   C. 10
   D. -2

7. Which is an expression that correctly represents "five more than twice a number is 27"?
   A. 5x + 27 = 2
   B. 5(x + 2)=27
   C. 5 + 2x = 27
   D. 2x – 27 = 5

8. What is the solution to 13 + (p/3) = -4?
   A. -51
   B. -17
   C. 12
   D. 9

9. Which of the following are like terms?
    A. *xy* and 5*x*
    B. 4*m* and 4*n*
    C. 9 and *h*
    D. 7*bc* and -11*bc*

10. Which equation demonstrates appropriate use of the distributive property?
    A. $9(x + 2y) = 9x + 2y$
    B. $9(x + 2y) = 9x + 18y$
    C. $9(xy) = (9x)(9y)$
    D. $9(x + 0) = 9x + 9$

True/False *(3 points each)*

Read each question carefully. Write "T" in the blank if the statement is true, "F" if the statement is false.

11. _____ You can multiply any quantity by 0, the additive identity, and not change the quantity's value.

12. _____ Equivalent equations are equations that have the same solution.

13. _____ 5*x* and 5*y* are *like terms*.

14. _____ Inverse operations 'undo' each other.

15. _____ A two-step equation involves multiplying one side of the equation and dividing the other side of

the equation by the same number.

<u>*Matching Solutions and Properties*</u> *(3 points each)*

For problems 16-20, the solution is worked out for you. Decide which property or simplification technique was used to arrive at the solution by selecting the appropriate property from the list on the right.

16. _____

$$x + 2 = -13$$
$$x + 2 - 2 = -13 - 2$$
$$x = -15$$

17. _____

$$-7 = x - 13$$
$$-7 + 13 = x - 13 + 13$$
$$x = 4$$

18. _____

$$-3(x - 5)$$
$$-3x + 15$$

19. _____

$$9x = -81$$
$$\frac{9x}{9} = \frac{-81}{9}$$
$$x = -9$$

20. _____

$$-11x + 4 + 5x + 11y - 3 - 5y$$
$$-6x + 6y + 1$$

a. Addition Property of Equality

b. Division Property of Equality

c. Subtraction Property of Equality

d. Multiplication Property of Equality

e. Distributive Property

f. Combining like terms

<u>*Constructed Response: Real-Life Applications*</u> *(10 points each)*

*Read each problem carefully – make sure you **write a statement assigning the variable**. Show all your work in order to receive full and partial credit. Include the label and/or units for the answer. Check your answer.*

21. For Jillian's cough, her doctor says that she should take eight tablets the first day and then four tablets each day until prescription runs out. There are 36 tablets. *Find the number of days that she will take four tablets.*

22. Todd is 5 inches taller than his brother. The sum of their heights is 139 inches. *Find Todd's height.*

Performance: Hands-on Application *(20 points)*

Use Algebra Tiles and Equation Mat to work out solutions to the problem. ***Verify your answer*** by working out the problem by hand. You will receive credit for both the worked out solution and demonstrating your solution with Algebra Tiles to the teacher. ***Raise your hand when you are ready to show and explain your solution to the teacher*** (the teacher may, however, come around at any point and ask you to show the solution).

23. Demonstrate finding the solution of $g - 9 = -2$ using Algebra Tiles. Verify your solution by working it out by hand.

<u>KEY - Unit 3 Post-Assessment</u>

<u>Post-Assessment Quick Key</u> (Learning objectives identified)

Multiple Choice *(3 pts each)*	Matching *(3 pts each)*	Performance: Hands-on (20 pts)
1. D *(L.O. #4)*	16. C *(L.O. #1)*	23. $g = 7$ *(L.O. #4)*
2. B *(L.O. #1)*	17. A *(L.O. #1)*	
3. A *(L.O. #2)*	18. E *(L.O. #1)*	
4. B *(L.O. #1)*	19. B *(L.O. #1)*	
5. C *(L.O. #3)*	20. F *(L.O. #1)*	
6. A *(L.O. #2)*		
7. C *(L.O. #2)*		
8. A *(L.O. #4)*		
9. D *(L.O. #3)*		
10. B *(L.O. #1)*		
True/False *(3 pts each)*	Constructed Response *(10 pts)*	
11. False *(L.O. #3)*	21. $4x + 8 = 36$, x = 6 days *(L.O. #2)*	
12. True *(L.O. #3)*	22. $x + (x\text{-}5) = 139$,	
13. False *(L.O. #3)*	Todd is x=72 inches tall.	
14. True *(L.O. #3)*	*(L.O. #2)*	
15. False *(L.O. #3)*		

<u>Rubric for Constructed Response Real-Life Problems (21 & 22)</u>

Correct answer	2 pts
Assigned correct variable	1 pt
Correct equation set up	2 pts
All steps to solve shown	3 pts
Included correct label	1 pt
Checked Answer	1 pt
Total	**10 pts**

Rubric for Performance: Hands-on Applied Problem (23)

Correct answer	2 pts
Correct set-up with tiles	3 pts
Demonstrated correct solving process	6 pts
Provided correct verbal reasoning	5 pts
Worked problem by hand	3 pts
Checked answer	1 pt
Total	**20 pts**

VI. Alternative Assessments for Two Students

(1) One student, Tasha Springer, is a very conscientious student who suffers from severe test anxiety. She has difficulty selecting an answer from a list (multiple choice) since she repeatedly second-guesses herself, even when she has solved the problem and found the correct answer. She does, however, enjoy telling stories and writing historical narratives. She does not do well on traditional exams in which she must select her response from a list. Thus, her alternative assessment will be worth 100 points; it will be taken in the resource classroom.

Task: Tasha will be given a separate exam that is comprised of 15 constructed-response problems requiring her to solve for the variable. All work/steps used to solve the problem need to be shown. Next, she will be asked to create a short background story from the Civil War (her favorite historical topic) involving a supply problem for a battlefield hospital. From this, she is to create and solve a two-step equation. The goal is to have her exercise her creativity while having as little distraction (making extra decisions that cause doubt in her ability) while solving and showing work for these types of problems.

(2) Another student, Jeremy Brickman, is a very talkative and outgoing student that has mild dyspraxia. He has little fine-muscle control and thus cannot write and take a traditional paper-and-pencil test or manipulate the algebra tiles like his classmates' test requires. His alternative assessment will be a role-reversal interview with the teacher in which Jeremy will play the role of the teacher and the teacher will play a confused student. This one-on-one assessment will take place after school as previously arranged and approved by Jeremy's parents.

Task: The teacher will stand at the board and solve 5 to 7 one- and two-step equations, stopping and being "strategically confused" and asking for verbal help from Jeremy. The questions will address vocabulary, definitions, "wrong steps" and reasoning behind solving these equations. The teacher will have a list of critical questions that are addressed in questions on Jeremy's peer assessment. Jeremy will be required to answer the questions of the "confused student", explain why certain steps are incorrect, and explain how to translate a word problem into an algebraic equation, solve, and check. This will also be worth 100 points and will be awarded based on the depth of Jeremy's responses with minimal prodding from the teacher.