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| **Title** | **Math Made “SIMPLE” as 1-2-3 (Simplified Educational Approach to Algebra)** | |
| **Introduction** | Have you ever gotten tired of trying to figure out how to simplify complex linear equations? Learning how to manipulate linear equations is the cornerstone of Algebra and mathematics after middle school  Have you ever gotten frustrated with working out math problems and still not grasping the concept of why you are doing what you are doing to the math problem? The following lesson takes the major concepts of Algebra and middle school mathematics and simplifies the process so that a 4th grader could understand the concept. | |
| **Curriculum Alignment** | NC Standard Course of Study  Grade 9–12 — Algebra I COMPETENCY GOAL 5: The learner will understand and use linear relations and functions.**Objective 5.02** - Write an equation of a linear relationship given: two points, the slope and one point on the line, or the slope and y-intercept.Common Core Standards - 8. EE **Understand the connections between proportional relationships, lines, and linear equations.**  5. Graph proportional relationships, interpreting the unit rate as the slope of the graph. Compare two different proportional relationships represented in different ways. *For example, compare a distance-time* *graph to a distance-time equation to determine which of two moving* *objects has greater speed.*  6. Use similar triangles to explain why the slope *m* is the same between any two distinct points on a non-vertical line in the coordinate plane; derive the equation *y* = *mx* for a line through the origin and the equation *y* = *mx* + *b* for a line intercepting the vertical axis at *b*.  **Analyze and solve linear equations and pairs of simultaneous linear equations.**  7. Solve linear equations in one variable.  a. Give examples of linear equations in one variable with one solution, infinitely many solutions, or no solutions. Show which of these possibilities is the case by successively transforming the given equation into simpler forms, until an equivalent equation of the form *x* = *a*, *a* = *a*, or *a* = *b* results (where *a* and *b* are different numbers).  b. Solve linear equations with rational number coefficients, including equations whose solutions require expanding expressions using the distributive properties. | |
| **Learning Outcomes** | 1. The student will demonstrate knowledge of algebraic concepts, properties and terminology when working with linear equations.  2. The student will demonstrate mastery of algebraic concepts relative to linear equations and graphing of linear equations by applying the necessary algebraic manipulations.  3. Use the definition of slope to analyze, connect and formalize the different forms of the linear relationships: slope-intercept, standard, and point-slope forms. | |
| **Time Required and Location** | 90 Minute Sessions for two daysStrategy 1 – 45 minutes for teaching strategy45 minutes for guided practice and independent practiceStrategy 2 – 45 minutes for teaching strategy45 minutes for guided practice and independent practice | |
| **Materials Needed** | The materials that will be needed by both teacher and student will be a white board, handouts, PowerPoint notes, paper, poster board, pencils and graph paper. This should be given at the beginning of the lesson.  **Technology resources**  LCD Projector  Computer for PowerPoint and Overhead review for the guided practice review  Internet Connection (If Possible) | |
| **Participant Prior Knowledge** | The teacher will review that connecting points on the coordinate plane will form a line and that the slope of the line is measuring how steep the line is. Teacher will test the prior knowledge of the students by having an open discussion on what each student remembers about the four different types of slope (positive, negative, zero, and undefined slope). Teacher and students will practice these types of slope using arm movements. Students will create a four part graphic organizer that will illustrate the four types of slope as well as list their attributes.  **\*Example of the four part organizer will be attached with instructions on how to use it for concept review\***  Teacher will explain that slope is calculated by counting the rise over the run. Teacher will discuss that the student must start with two distinct points on the line (any two points). Teacher will emphasize to leave the answer a fraction but to simplify when necessary (teacher may want to show students how to simplify using the graphing calculator math, enter, enter).  **How to simplify fractions on the TI-83/84 Plus**  **On the TI-83/84**  **Hit the Math Button located under the 2nd Key**  **Hit the enter button once which will highlight simplify fraction**  **Hit the enter button twice to get the reduced fraction for an answer**  Teacher will present the **“commonly used”** slope formula by investigation. The teacher will give examples of lines with different slopes and have the student discuss what has changed. This level of student thinking will help the student remember the formula and also will help the student see the connection to “rise over run”  **M = y2-y1 or rise/run**  **x2-x1**  Teacher will explain the correlation between this formula and rise over run. Teacher may also want to take the time to discuss how to find slope if given a table. Teacher will use an example table. Teacher will explain that the table is another representation of a group of ordered pairs. Teacher will have students pick two ordered pairs from the table and find slope using slope formula. Students will complete graphic organizer illustrating the three ways they have learned to find slope.  **\*Example of a graphic organizer will be attached with instructions on how to use it for concept review\***  Strategy # 1  During this lesson the student will be able to explain that intercepts are the points where the line crosses the axes. The point where the line crosses the x axis is the x intercept and the point where the line crosses the y axis is the y intercept. The student will also be able to explain that to find the intercepts algebraically the equation is typically in standard form.  The student will also be able to explain that the standard for of a linear equation is the same thing as y= and be able to change any form of a standard linear equation using simplified mathematical processes that encompasses all modification for ELL, EC and regular education strategies.  Teacher will demonstrate the conversion as follow:  1. change the sign of x  2. divide by y  3. bring down (write y =)  4. simplify  Teacher will explain that change the sign of x is referring to the number in front of x called the moving the variable to the other side of the equal sign in reference to solving it algebraically.  At the conclusion of the graphing presentation, return to the blackboard and ask the students to relate the terms of each of the equations to the parameters of the standard form of a linear equation. **Bloom’s Comprehension**. Next, have the students explain the difference between alinear equation in standard form with one in slope intercept form. **Bloom’s Application** (*Note: the equation in slope intercept form has been solved for the**y value*.)  Students will be able to come to the board and convert the equations from standard form to slope intercept form by solving for the y value. Assist the students, and draw the class’ attention to correct conversions and how they were accomplished.  Strategy # 2 - Writing the equation of a line simplified | |
| **Facilitator Preparations** | The teacher will use the handouts as a step by step guide for each strategy and self-made assessments for each student to demonstrate understanding | |
| **Activities** | Lesson # 1Pre-Activity Let’s discuss the slope intercept form y=mx + b which is the cornerstone of linear equations. As a review, think the most useful form of straight-line equations is the "slope-intercept" form:  ***y = mx + b***  This is called the slope-intercept form because "*m*" is the [slope](http://www.purplemath.com/modules/slope.htm) and "*b*" gives the *y*-intercept. (For a review of how this equation is used for graphing, look at [slope and graphing](http://www.purplemath.com/modules/slopgrph.htm).)  I like slope-intercept form the best. It is in the form "*y=*", which makes it easiest to plug into, either for graphing or doing word problems. Just plug in your *x*-value; the equation is [already solved](http://www.purplemath.com/modules/solvelit2.htm) for *y*. Also, this is the only format you can plug into your (nowadays obligatory) graphing calculator; you *have* to have a "*y=*" format to use a graphing utility. But the best part about the slope-intercept form is that you can read off the slope and the intercept right from the equation. This is great for [graphing](http://www.purplemath.com/modules/slopgrph.htm), and can be quite useful for [word problems](http://www.purplemath.com/modules/slopyint.htm).  Common exercises will give you some pieces of information about a line, and you will have to come up with the equation of the line. How do you do that? You plug in whatever they give you, and solve for whatever you need, like this:   * **Find the equation of the straight line that has slope *m* = 4 and passes through the point (–1, –6).**   Okay, they've given me the value of the slope; in this case, *m* = 4. Also, in giving me a point on the line, they have given me an *x*-value and a *y*-value for this line: *x* = –1 and *y* = –6.  In the slope-intercept form of a straight line, I have *y*, *m*, *x*, and *b*. So the only thing I don't have so far is a value for is *b* (which gives me the *y*-intercept). Then all I need to do is plug in what they gave me for the slope and the *x* and *y* from this particular point, and then solve for *b*:  *y = mx + b* (–6) = (4)(–1) + *b* –6 = –4 + *b* –2 = *b*  Then the line equation must be "***y* = 4*x* – 2**".  What if they don't give you the slope?   * **Find the equation of the line that passes through the points (–2, 4) and (1, 2).**   Well, if I have two points on a straight line, I can always *find* the slope; that's what the [slope formula](http://www.purplemath.com/modules/slope.htm) is for.  Description: slope m = -2/3  Now I have the slope and *two* points. I know I can find the equation (by solving first for "*b*") if I have a point and the slope. So I need to pick one of the points (it doesn't matter which one), and use it to solve for *b.* Using the point (–2, 4), I get:  *y = mx* + *b* 4 = (– 2/3)(–2) + *b* 4 = 4/3 + *b* 4 – 4/3 = *b* 12/3 – 4/3 = *b b* = 8/3  ...so *y* = ( – 2/3 ) *x* + 8/3.  On the other hand, if I use the point (1, 2), I get:  *y = mx* + *b* 2 = (– 2/3)(1) + *b* 2 = – 2/3 + *b* 2 + 2/3 = *b* 6/3 + 2/3 = *b b* = 8/3  So it doesn't matter which point I choose. Either way, the answer is the same:  ***y* = (– 2/3) *x* + 8/3**  As you can see, once you have the slope, it doesn't matter which point you use in order to find the line equation. The answer will work out the same either way. The teacher will have to guide the students through the step and examples of using the simplified methods for calculating slope intercept form and writing the equations of a line.The student-teacher dialogue will give the teacher an in-depth overview of the slope intercept from before moving on to changing standard form to slope intercept using the second strategy.Lesson # 2Here are the outlined steps below: Example: Change the following linear equation from standard form to slope-intercept form  Problem: 6x + 4y = 30  *Strategy # 1*  Step 1: Change the term that is beside the “y” term to the opposite sign  Original equation: 6x + 4y = 30  Change the sign: - 6x + 4y = 30  Step 2: Divide all of the terms except the term with the y by the coefficient in front of “y  - 6x + 4y = 30  + 4y =  Step 3: Write y = and simplify the “x” term and the constant  **Y = - +**  ***Strategy # 2 –***  **Write the equation of a line with a slope of 2 that goes through point (3, 4)**  **M= 2**  **X= 3**  **Y = 4**  **B= ?**  **Step 1: Multiply the slope (m) times the x value**  m(x) = 2(3) = 6  **Step 2: Change the sign of your answer**  Change 6 to -6  **Step 3: Add the y-value which will now become your y-intercept (b)**  Add -6 + 4 which equals -2  B= -2  **Step 4: Rewrite y = mx + b**  y= 2x - 2  **Lesson # 3**  **Objective:** Students will be able to identify the slope of a line given two points; to create a line given slope; to identify positive, negative, zero and undefined slope visually.  **Materials:** Several sheets of lined paper for each student.  **Opening:** Start with a simple problem about slope that you've previously taught--for example, identifying positive, negative, zero or undefined slope visually.  **Introduction:** Have student summarize on different ways to find slope. Collect pictures that show sharp edges that could help students visualize and conceptualize slope: ladders, mountains, the roof of a house, and most importantly, stairs.  Tell your students that they're going to make some stairs that have a specific slope. Talk about the stairs they walk up and down to get to class every day. Ask them what happens when one step isn't the same size as the rest (you trip, fall, break your neck and/or die). Ask how many of them have tripped and fell in this situation. Since my uncle owns the family stair building business, I would share a personal anecdote about that as well.  **Rubric Link:** [**http://www.rcampus.com/rubricshowc.cfm?code=J7274A&sp=yes**](http://www.rcampus.com/rubricshowc.cfm?code=J7274A&sp=yes)  As suggested by my fellow teachers, we would show a model of completed stairs folded out of lined paper. The lines on the paper would serve as our unit of measurement, eliminating the need for rulers. 4 lines up and 6 lines across would be a slope of 4/6 or 2/3. The example would be labeled "rise" and "run" on each part of the steps. They could also be color coded.   Now you could give your students traditional slope problems to practice, perhaps an assignment from earlier in the year that everyone had trouble with. Encourage them to use their paper to model what they see in the suggested problems. Have the students have dialogue about positive slopes going up the stairs and negative slopes going downward.  Suggested Problems:  **SLOPE INTERCEPT FORM**  **Given the \_\_\_\_\_\_\_\_\_\_ and the \_\_\_\_\_\_\_\_\_\_\_\_\_\_ of a line, the equation is \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. (Use the model to answer this question)**  **1. Write an equation in slope-intercept form if the line has a slope of 2 and a**  **y-intercept of 6.**  **2. Find the slope and y-intercept of each equation.**  **A) y = 3x - 7**  **B) y = 2/3x**  **C) y = 5**  **3. Find the slope and y-intercept of each equation.**  **A) 5x - 3y = 6**    **B) 2x + 4y = 6**  **4. Write an equation in standard form given the points (-2, 1) and (4, 2)**  **5. Write the standard form for a line passing through the points (-3, -1) and (6, -4).**    **Guided Practice 1**  1. Sticky Note- Students will be given a sticky note containing an ordered pair. Each student will have to graph the ordered pair on the smart board and explain their understanding. Once every student has gone, teacher and students can discuss any similarities or differences between the graphed ordered pairs.  2. List three things you learned about slope.  3. If you were explaining finding slope from two points to someone else what is one important detail you would point out?  4. Draw your own line on graph paper and have a friend find the slope.  5. Create your own points and have a group member find the slope.  6. Answer the essential questions from the lesson and compare answers with group members.   * How can you read, display, understand, and interpret coordinate points? * How do you find the slope of a line from a graph? * How do you find the slope of a line from two points or a table? * How do you write the equation of a line from two points? * How do you write the equation of given a slope a point? * How do you graph a line given its equation in slope-intercept form? * What is the most useful equation of the line? * How do you write the equation of the line given a slope and intercept?   **Guided Practice Part 2**  Teacher will use the questions found at the following website  <http://www.phschool.com/webcodes10/index.cfm?fuseaction=home.gotoWebCode&wcprefix=ata&wcsuffix=0602>  There are only 5 questions here so they can be used in one class  Teacher will use the exam view pro quiz found at the following website <http://teachers.henrico.k12.va.us/math/HCPSAlgebra1/Documents/examviewweb/ev6-4.htm>  This is a 13 question review but it has some good questions on it teacher can review these questions and give them 1 to 3 questions at a time.  **Content Wrap Up**  Have students create, in pairs or small groups, stairs with various slopes. Start with something easy like 4/4 or 2/3, then try 1/10 and 10. Ask students to hold up their stairs each time, which will provide plenty of teachable moments. Ask guiding questions like, "*Will stairs with a slope of \_\_\_ be more or less steep than the last line we made?*" "*Would it be easy or hard to climb stairs with a slope of...*?" Challenge them to show you zero or undefined slope as well. | |
| **Assessment** | The assessment will be based on the student following the rubric using the link above. It will be evident that mastery is achieved if the student gets high scores on the rubric. | |
| **Critical Vocabulary** | slope  rise  run  steep  x and y intercepts  standard form  slope-intercept form  coefficient  equation of a line  point-slope form  linear equation  Quadrants, x-axis, y-axis, cardinal directions, coordinate point, ordered pair, x and y coordinate, origin, Linear, nonlinear, vertical, horizontal, positive slope, negative slope, rise over run, Substitution, slope formula, double negative | |
| **Modifications** | **EC and SIOP modifications:**   * Arm movements illustrating types of slope (look in the supplemental section) * Explain vocabulary in simplified ways being sure to point out prefixes and root words to deepen understanding.  Differentiation activities for the Exceptional Children Using Linear Equations Individuals Pre-Assessment Task  Present the following problem to the class and ask them to solve it individually using any method they choose (e.g., algebraically, graphically, guess and check). Have manipulatives available for the students to use.  Nasir just purchased a custom T-shirt from *T-riffic Prints* with his favourite saying written on the front. T-*riffic Prints* charges $9 for the T-shirt and $0.80 for each letter written on it. If Nasir’s custom shirt totaled $30.60 before taxes, how many letters are in his favorite saying?  Circulate while students individually solve the problem to observe students’ readiness to solve linear equations.  Observe to determine which students:  (1) Need teacher guidance to solve the problem  (2) Can solve this equation independently but would benefit from more practice  (3) Can solve this equation accurately and with ease  Create student groupings for the Tiered Assignment based on student readiness.  **Small Groups Corners, Think-Pair-Share**  Students:  • Take their solutions to the corner that best represents the method they used to solve the problem  • Review their solution for correctness and form with another student who used the same method  • Note any variations that were used within their chosen method and share with their corner group  • As a corner group, write one complete solution on chart paper, present their solution to the class and describe why this corner was their first choice for solving this particular problem  **Pairs/Small Groups Tiered Assignments**  Students work in groups to complete three tasks solving equations algebraically.  Tiered assignments are differentiated based on student readiness as described below:  Tier 1—Assignment A is for students who still need support to solve equations  algebraically. In this highly structured Tiered Assignment, students work through examples that progress from those that provide detailed scaffolding to those that require independent practice.  Tier 2—Assignment B is for students who are somewhat comfortable with solving equations  algebraically. In this Tier, the assignment is less structured so that students can deepen their understanding.  Tier 3—Assignment C is for students who are skilled at solving equations  algebraically. In this Tier, the assignment is more open and complex; students are challenged to think critically and deeply about solving equations.  Observe students as they complete their Tiered Assignment. | |
| **Alternative Assessments** | | This section contains alternative assessments designed for special audiences, such as participants with learning disabilities or English language learners.   * If you provided modifications above, provide an alternative assessment for each modification or special audience. * If you did not provide modifications above, make sure to include the intended audience for the alternative assessment. |
| **References** | | This section contains a consistent and properly annotated list of publications related to the research focus for this module. |
| **Supplemental Information** | | <http://www.phschool.com/webcodes10/index.cfm?fuseaction=home.gotoWebCode&wcprefix=ata&wcsuffix=0602>     * The following website is through PHSCHOOL.COM. This website had a very good review that gives a good guided practice for the teacher   <http://teachers.henrico.k12.va.us/math/HCPSAlgebra1/Documents/examviewweb/ev6-4.htm>     * The following website is through Henrico VA Mathematics. Many of the NC Standard Course of Study lessons are very similar and this is another good review for a guided practice activity. |
| **Author Info** | | Thomas E. Kirkley  Martin Luther King Middle School  Charlotte-Mecklenburg Schools  Charlotte, NC  6-9 Middle School  Teaching Experience: 10 years high school and middle school mathematics  Degrees and Certifications:  **Educational Qualifications**   * Kenan Fellows Recipient for 2011 and 2012 School Year through NC Department of Public Instruction * Certified Mathematics Consultant for the state of North Carolina * CMS Teacher of the Year Candidate (2004, 2007, and 2008) * CBS Radio - Infiniti Broadcasting Volunteer of the Year Award (2007) * National Board Candidate in Middle School Mathematics for the 2010 and 2011 School Year * STAR Teacher Award for Outstanding EOC Scores (2006 through 2011) * Souls of Our Teacher Documentary Participant (Nationally recognized documentary) * Presidential Academic Award of Excellence Candidate with the US Department of Education * Experience in teaching Calculus at Johnson C. Smith University (Summer ’01 and ’02) and at the University of North Carolina at Charlotte (2007) * This project was developed to modify algebraic concepts for my inclusion classes over the past 3years of teaching. Many of my students were struggling with linear equations which was over half of the EOC and EOG state test in North Carolina. By formulating these strategies my students grew from 35% to over 85% in 3years. The district asked me to share certain strategies with the school district that not only helped the EC/inclusion environment but I did not even realize that the strategies also helped SIOP, ELL, and ESL student because of how linear equations had to be verbalized. This project has been passionate to me and I am in the process of publishing a book with the strategies in it call Math Made “SIMPLE” |