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| Concrete to Abstract |
| Algebra that Works Instructional Design Project |
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***Rationale***

 The 7th grade algebra curriculum is heavy with abstract concepts that are often above the scope of student cognitive development. The issue for instruction thus becomes the challenge of teaching this abstract content in a way that is accessible to the concrete learner while also making the learning relevant to the students at the same time.

One issue addressed by this instructional design is making abstract material concrete. According to Brown and Canniff, only “1/3 of 8th graders reach Piaget’s last stage of cognitive development,” formal operational thought (2007, 16). Therefore, in order for students to be successful the task/learning activity must match the child’s current level of cognitive ability (Lawson & Wollman, 2003, 47). Teachers can help students make the transition to formal thought by including “concrete referants” as much as possible along with frequent opportunities to discuss the material (Lawson & Wollman, 203, 47). Therefore, this instructional design is heavy in the use of concrete manipulatives, discussion, and cooperative learning activities that provide students with the opportunity of using language and concrete materials to construct their own learning.

The second major issue addressed in this instructional design is vocabulary. According to researchers, math has one of the largest content vocabularies of all the subjects. This means that “although students may excel in computation, their ability to apply their math skills may be hindered if they do not understand the vocabulary” being used (Kovarik, 2010, 2). Vocabulary instruction is even more important for poor students who often begin school with limited vocabularies (Kovarik, 2010, 3). This instructional design places a heavy emphasis on vocabulary instruction. The major way this is handled is by incorporating lots of reading and writing into the math instruction. Incorporating reading and writing into the content has been shown by research to increase vocabulary retention and yields deeper learning (Bosse’ & Faulconer, 2008, 8). Students are often given ample opportunities to use their new vocabulary and to discuss the words and their meaning in class.

The instructional design in this project will include a combination of constructivist and behaviorist teaching methods. Rather than focusing solely on direct instruction and worksheet practice, this unit will put the student at the center of the learning process by picking instructional strategies that get the student involved in the learning process both individually and with other students. The lessons in this design most resemble the “inductive model” for instruction. The teacher uses a variety of activities to help students start with specific examples that grow into understanding the big picture of the concept (Chiarelott, 2006, 114). As student’s understanding grows, the teacher will incorporate activities and examples that illustrate the connection between algebra concepts and everyday life. This will make the learning process more meaningful and contextualized for students which is an essential part of the instructional process. (Chiarelott, 2006). The lessons in this unit are written using the “basic lesson planning model” (Chiarelott, 2006, 90).

**References:**

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***Unit Outcomes***

**Subunit One: Patterns and Expressions**

1. Students will be able to construct written or symbolic expressions using a given form (application).
2. Students will be able to construct models of expressions using algebra tiles and pictures (application).
3. Students will be able to analyze whether two expressions are equivalent using models and symbolic algebra (analysis).
4. Students will be able to use models and symbols to compose linear and non-linear patterns (synthesis).

**Subunit Two: Equations**

1. Students will be able to use models to demonstrate the addition, subtraction, multiplication, and division of integers (application).
2. Students will be able to compose the rules for the addition, subtraction, multiplication, and division of integers using their experience with models (synthesis).
3. Students will be able to explain the correct order of operations for given problems.
4. Students will be able to demonstrate their knowledge of solving equations using models and symbolic form (application).
5. Students will be able to apply their knowledge of equations to word problems of real life context (application).
6. Students will be able to justify how models for equations show inverse operations (evaluation).
7. Students will be able to formulate an explanation for the connection between order of operations and solving equations (synthesis).
8. Students will be able to evaluate and judge the similarities and differences between equations and expressions (evaluation).

**Subunit Three: Inequalities**

1. Students will apply their knowledge of solving equations to solve inequalities using inverse operations (application).
2. Students will be able to construct a model for inequalities (application).
3. Students will be able to apply their knowledge of inequalities to word problems of real life context (application).
4. Students will be able to evaluate and judge the similarities and differences between inequalities, equations, and expressions (evaluation).

**Subunit Four: Linear Equations**

1. Students will be able to translate pattern data into tables, graphs, written form, and symbolic form (comprehension).
2. Students will be able to construct the forms of linear equations to match lab data (application).
3. Students will be able design a lab that would result in the collection of linear data (synthesis).
4. Students will be able to evaluate and judge the similarities and differences between linear equations, inequalities, equations, and expressions (evaluation).

**Subunit Five: Linear Inequalities**

1. Students will apply their knowledge of linear equations to solve and graph linear inequalities (application).
2. Student will be able to identify solutions that make an inequality true or false (comprehension).
3. Students will be able to interpret when exact answers are needed or when a range is appropriate for given application problems (evaluation).

***7th Grade Algebra Unit Pre-Assessment***

Patterns, Functions, Algebra Content Standards

**Directions:** Circle the number that best resembles your knowledge of the following.

**1 – I’ve never seen 2 – I’ve seen it 3 – I have an idea of what it is 4 – I could give you a definition 5 – I could teach it to another person**

**1.) Expressions 1 2 3 4 5**

**2.) Equations 1 2 3 4 5**

**3.) Inequalities 1 2 3 4 5**

**4.) Linear Equations 1 2 3 4 5**

**5.) Linear Inequalities 1 2 3 4 5**

**6.) Simplifying 1 2 3 4 5**

**7.) Inverse Operations 1 2 3 4 5**

**8.) Integers 1 2 3 4 5**

**9.) Order of Operations 1 2 3 4 5**

**Directions: Solve the following questions to the best of your ability.**

**10.) What is an expression?**

**11.) Model and simplify the following expression using algebra tiles.**

$$2x^{2}- 3x+4+5x- 4x^{2}- 1$$

**12.) How is simplifying different from solving?**

**13.) Determine if the following pattern is linear or non-linear. How do you know?**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **n** | **1** | **2** | **3** | **4** | **5** |
|  | **4** | **6** | **8** | **10** | **12** |

**14.) Solve -7 - - 2 = ?**

**15.) Solve -5 \* -4 = ?**

**16.) A positive number minus a negative number is**

 **a.) always positive. c.) sometimes positive or negative.**

 **b.) always negative. d.) always zero.**

**17.) Which step should be completed first in the following order or operations problem?** $\sqrt{36}- 2 ∙6 ÷3+( 4-2)$

**18.) Complete the following table for inverse operations.**

|  |  |
| --- | --- |
| **Operation** | **Inverse** |
| **+** |  |
| **-** |  |
| **\*** |  |
| **÷** |  |

**19.) Sam’s dad gave him $50 to start a savings account. Each week, Sam saves his $5 allowance for his savings. Create a table and graph for the amount of money Sam will have in his savings for weeks 1,2,3,4 and 5. Write an equation to represent the total savings, t, for each week, w Sam saves money.**

**Equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

|  |  |
| --- | --- |
| **Week** | **Total Money in Savings** |
| **1** |  |
| **2** |  |
| **3** |  |
| **4** |  |
| **5** |  |

**20.) Solve and model -2x + 4 > 8.**

**21.) What does linear mean? Give an example of linear data in real life?**

**22.) Solve and model 2x + 3y ≤ -6.**

**23.) Describe how expressions, equations, inequalities, linear equations, and linear inequalities are alike? How are they different?**

***Lesson One: Setting Precedence for sub-unit Vocabulary***

***Unit Outcomes:***

1. Students will be able to construct written or symbolic expressions using a given form (application).

***Lesson Outcomes***:

1. Students will able to identify the operations that correspond to given vocabulary (Comprehension).

***Materials Needed:*** Chart paper, markers, post-it notes, overhead projector, word template for notes

***Procedures:***

**1.) Introductory Activity (10 Minutes) Class Discussion**

* The teacher will begin by putting the following OAA questions up for the class during the warm-up portion of class. The following question will be posted with the OAA questions: Why might these questions be difficult for students?

OAA 1.) Oakland has an elevation of 1,639 feet above sea level. Lake Enriquillo’s elevation is 149 feet below sea level.

What is the difference in altitude between the two locations?

1. 1,341 feet
2. 1,490 feet
3. 1,788 feet
4. 1,937 feet

OAA 2.) Rachel is dividing –30 by a negative integer. Which statement describes the quotient Rachel should get?

1. It will be positive and greater than 30.
2. It will be negative and greater than –30.
3. It will be positive and less than or equal to 30.
4. It will be negative and less than or equal to –30.
* After students have had time to look at the questions, the teacher will facilitate a mini discussion. Students will share reasons why this question might be difficult. The major reason these questions may pose a difficulty to students is a lack of understanding of what the questions say/ mean.
* Discussion prompting questions will be as follows: Is this a math problem or a reading comprehension problem? Why is it so important to address this issue?
* The teacher should take the time to express the importance of understanding key math vocabulary not only to success on the OAA but in life as well.
* This activity sets precedence for the importance of the topic of the lesson.

**2.) Developmental Activity (20 Minutes) Group Work**

* The developmental activity for the day begins the sub-unit by activating prior background knowledge and assessing students’ current knowledge of the vocabulary.
* Chart paper will be broken into the four operations, addition, subtraction, multiplication, and division.
* Students will be given a word bank on the overhead of the vocabulary words for this activity. (see attached sheet)
* Students will write each word from the word bank on a post-it note.
* The teacher will then explain that each word in the bank stands for one of the four operations on the chart paper. These words often appear in word problems, scenarios, etc. that require math to solve them. The problem with these words is that people often do not know their meaning so they are unable to solve the problems using them.
* Students will work in their small group to discuss the words and organize them according to the four operations on the chart paper by placing the post-it note in the correct section of the chart paper.
* Students will then compare their chart to another small group. Students will discuss any differences and decide as a group where things will be placed.
* The teacher will then rotate around the room checking the group charts. The teacher will mark beside each operation how many in that box are incorrect.
* Students will then discuss their charts and try to determine which words are incorrect and should be moved.
* The teacher will then check the charts one more time. This time the words will be completely removed and students will try one more time to get them in the correct operation.
* After the final reorganization, the teacher will use the words in a sentence to give the students one last chance to get it in the correct place. For example, if you had 12 pieces of candy and I told you to give 2 per person, what would you be doing with your candy?
* Finally, the teacher will show the students where words go if there are still unknown words at this point.
* The teacher should make a note of which words were unknown by each group for assessment purposes.

**3.) Concluding Activity (10 Minutes) Direct Instruction/ Class Discussion**

* The teacher will discuss the words with the class. How did your group do? Most of the time there is a small amount of words that are not known by the group.
* The teacher will pull up the Microsoft word worksheet. The class will work together to get all of the words in the correct location for the notes.
* The teacher will highlight the specific words that were unknown to the class from the post-it note activity to pinpoint words that may need additional study time.

***Summary/Closure/Evaluation:***

**Closure/Evaluation ( 5 Minutes) Exit Ticket/ Review**

* Have student’s answer the following question on an exit ticket: Why is understanding math vocabulary so important? (put on notebook paper)

**Word Bank:** per, triple, half, more, diminish, less, product, times, quotient, quadruple, more than, exceed, sum, difference, plus, twice, less than, multiplied by, divided by, increased by, gain, of, ratio, third, fourth, minus, decreased by

|  |  |
| --- | --- |
| ***Addition*** | ***Subtraction*** |
| ***Multiplication*** | ***Division*** |

***Lesson Two: Putting Expressions into Written Form: Application of***

***New Vocabulary***

***Unit Outcomes:***

1. Students will be able to construct written or symbolic expressions using a given form (application).

***Lesson Outcomes:***

1. Students will be able to correctly use their operation vocabulary words to write symbolic equations in written form.

***Materials Needed:*** Overhead, Mobi, matching games, homework problems

***Procedures:***

1. **Introductory Activity (5 minutes) Group Activity**
* For the warm-up activity, students will return to their original small groups from the previous day.
* Students will work to sort the post-it notes again as a group. Discussing words they are not certain about.
* Students will use their notes from the previous day to check their most recent sort.
1. **Developmental Activity ( 20 minutes) Direct Instruction and Guided Practice**
* Students will pull the previous day’s notes from their binder to add the current notes.
* The expression 3x will be put up on the overhead using the Mobi. The teacher and class will discuss the following questions: What operation does this expression represent? (When a number and letter are written side by side with no operation that signifies multiplication.) What do we call x? (Variable) What does it stand for ? (An unknown number.)
* When writing expressions in written form, we use the operational words learned the previous day as well as using the words “a number” to signify a variable.
* Therefore, 3x could be written as 3 times a number. The teacher will prompt and guide the class through using the other words to write 3x.
* The teacher will ask the class if the problem could also be written as a number times 3? Many kids will say yes while others will say no.
* The teacher will ask the class which property allows you to change the order of a multiplication problem? (Commutative property)
* The teacher will then put up the following examples to remind the students of which operations are commutative and which are not. 2+ 3 = 5 or 3 + 2 = 5 so addition is commutative, 2 \* 3 = 6 or 3 \* 2 = 6 so multiplication is commutative, 4 ÷ 2 = 2 and 2 ÷ 4 = 0.5 so division is not commutative, and 4 – 2 = 2 and 2 – 4 = -2 so subtraction is not commutative
* Therefore, with division and subtraction expressions the class must be very careful that they not only use the correct words but also put the terms in the correct order.
* The following examples will also be worked through as a class: a.) x +4 , b.) $\frac{x}{2}$ , c.) 4 – 9 , d.) 2x + 4
* Example d is particularly challenging because it involves two operations, multiplication and addition.
1. **Closure ( 10 minutes) Review/ Practice of New Material**
* Students will be given a set of expression cards made by former students.
* Each card deck has 5 expressions written in symbolic form and the written form of the same expressions on the other 5 cards.
* Students will sort the cards into two sections on their desk and play a matching game with the cards.
* Once students think they are done, the teacher will check their matches to make sure they are correct. (formative assessment)
* If students finish quickly they can swap with a friend or grab another deck from the bag.

***Summary/Closure/Evaluation:***

1. **Closure/Evaluation ( 10 minutes) Homework/Practice**
* The following problems will be put up on the Mobi. Students will be directed to write each at least 3 different ways.
* Homework Problems: a.) 6 – 3x , b.) 4x + 5, c.) $\frac{x}{4}$ , d.) $2+ \frac{x}{2}$ , e.) 2 – x

***Lesson Three: Modeling Expressions: Using Background Knowledge to Build the Big Picture***

***Unit Outcomes:***

1. Students will be able to construct models of expressions using algebra tiles and pictures (application).
2. Students will be able to evaluate and judge the similarities and differences between linear equations, inequalities, equations, and expressions (evaluation).

***Lesson Outcomes:***

1. Students will be able to draw a model for expressions without division or distributing.
2. Students will be able to explain what characteristics make an expression different from other algebra topics such as those listed in unit outcome 2 above.

***Materials Needed:*** Table Outline for Mobi, Algebra Tiles, colored pencils

***Procedures:***

**Introductory Activity (15 minutes) Building Understanding**

* The following question will be put up on the overhead for the warm-up problem: What is an expression?
* Although students have been looking at expressions what they actually are has yet to be discussed.
* The teacher will put the following table up on the overhead. Students will get their notes out and copy it down.

|  |  |
| --- | --- |
| **Expressions** | **Other Algebra Concepts** |
| **Examples:** **2x – 3 + 4x2****-4xy + 3x3 – 2x2****x + y**$$\sqrt{36}+ \left( 4\*6-2+1\right)\*( 2-4 )^{2}$$ | **Examples:****2x + 4 = 8** (equation)**-3x – 2 > 7** (inequality)**-2x + 3y = -6** (linear equation)**-6x + 2y < 6** (linear inequality) |

* The teacher will then ask the following questions: “How are expressions alike the other algebra concepts we will learn about later this year?” (Both can contain variables. Both can contain numbers.) Students will record the information in their notes under the table.
* Second question: “How are expressions different from the other algebra concepts we will learn about this year?” Most students will see that expressions do not contain equal signs or inequalities. The teacher may need to provide prompting to get the word inequality out of the class. If students do not mention how they are worked out the teacher will ask “How would you work these problems out?” For expressions you simply put things together (simplifying) and for the other concepts you do the opposite to solve for the variable (inverse operations).
* The teacher will continue to provide prompts until the students reach the desired conclusions above.
* Lastly, students will go back to the table and label the other algebra concepts by name (included in parenthesis on the table above).
* The term linear and coordinate plane will be discussed when looking at/ identifying linear equations/ inequalities.

**2.) Developmental Activity ( 20 minutes) Presentation of New Material on Modeling**

* The algebra tiles will be passed out.
* The teacher will remind the students which shapes represent x2, x, or a constant and which colors represent negative.
* The teacher will put up the following expression: 2x2 – 3x+ 4 + 5x – 4x2 + 2
* The teacher will ask students to copy the expression into their notes and will show them how to properly circle the terms to aid in creating the model.
* 2x2 – 3x+ 4 + 5x – 4x2 + 2
* The teacher should point out that the sign in front of the term indicates whether the model pieces are positive or negative.
* The teacher will walk the students through laying out the algebra tiles as follows.

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* The teacher will then ask the students “what can cancel a positive x2?” “Can a x2 cancel a negative x?” Most students will say no. The teacher will prompt them to explain why. Since the tiles are different shapes they can only be put with tiles of the same shape or only terms that are alike can go together.
* The teacher will walk the students through pulling away the positive/negative pairs that would cancel each other out. The result should appear as follows:

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* The teacher will then walk the class through the process of using the model to write the final simplified answer: -2x2 + 2x + 6
* The teacher will use the above process to walk the students through another example,

5x – 2 + 2x – x2 + 4 – x = -x2 + 6x + 2

**3. Concluding Activity (5 minutes)**

* Students will be given 2 expressions to draw models for and simplify on the overhead.
* Problems: a.) -5 + 2x – 3x2 + 5x2 – 6x + 7 + x2 ( 3x2 – 4x + 2 )

 b.) 2x2 + 4 – 3 – x2 + 4x – 1- x2  ( 4x )

***Summary/Closure/Evaluation:***

**Closure/Evaluation (5 minutes) Writing Prompt**

* Students will answer the following prompt before leaving class on scrap paper to turn in to the teacher : “When you initially saw the first expression and were asked to simplify it how did you feel?” “How does the model change how you feel or think about this topic?”
* As time permits, students will share their answers with the class.

***Lesson Four: Comprehension Check for Expressions***

***Unit Outcomes:***

1. Students will be able to construct written or symbolic expressions using a given form (application).
2. Students will be able to construct models of expressions using algebra tiles and pictures (application).
3. Students will be able to evaluate and judge the similarities and differences between linear equations, inequalities, equations, and expressions (evaluation).

***Lesson Outcomes:***

1. Students will be able to correctly use their operation vocabulary words to write symbolic equations in written form.
2. Students will be able to write the symbolic form of an expression given the written form.
3. Students will be able to draw a model for expressions without division or distributing.
4. Students will be able to explain what characteristics make an expression different from other algebra topics such as those listed in unit outcome 2 above.

***Materials Needed:*** Overhead, clicker system, clicker problems, algebra tiles if needed

***Procedures:***

**1.) Introductory Activity ( 10 minutes) Formative Assessment of Current Learning**

* The following problems will be put into the CPS clicker system. CPS is a Power Point type system that allows students to submit answers via clickers that look like small remotes.
* Students will work through the clicker problems individually. The teacher will use this to determine which lesson outcomes need to be focused on for the day.
* Clicker Problems:

Question #1:Which of the following written expressions accurately reflects $\frac{x}{4}- 2$ ? a.) the product of a number and 4 minus 2 ***b.) the difference of a fourth of a number and 2*** c.) a number divided by four less than 2 d.) a number diminished by 4 minus 2.

Question #2 : Which of the following symbolic expressions matches quadruple a number gain 3? a.) $\frac{x}{4}\*3$ b.) $4x\*3$ c.) $4+x$ + 3 ***d.)*** $4x+3$

 Question #3 Draw a model for the expression -2x2 + 3x – 4 + 5 – 5x + 3x2 – 2x on your dry erase board. Determine which of the following is the correct simplified answer for the model. a.) –x2 – 4x + 1 , ***b.) x2 – 4x + 1*** , c.) 5x2 – 2x – 2x + 1 , d.) -3x + 1

* Correct answers are italicized above.

2.) **Developmental Activity ( 25 minutes ) Think, Pair, Share**

* The teacher will use the clicker report to pair students based on strengths and weaknesses with the assessed content.
* Students will initially work on a problem individually (think). They will then compare their answers with their partner (pair). Finally, a pair of students will be chosen randomly to explain the problem to the class.
* Student pairs will be picked randomly from a hat. After each turn, the names are returned to the hat. This discourages kids from quitting after they have a turn.
* The teacher will circulate around the room helping students as needed.
* The teacher will pull from the following question bank to provide students with practice in needed areas.

**Written Form of Expressions**: For this section of the bank each pair could provide a way to write the expression in written form.

* 1. -3x + 4 2.) $5+ \frac{x}{2}$ 3.) x – 5 4.) 5 – 4x 5.) $\frac{2}{x}\*3$

 **Write the symbolic form** for the following problems.

1. The sum of two times a number and 15 ( 2x + 15 or 15 + 2x)
2. Twenty-six more than one half of a number ( $\frac{x}{2}+ 26 or 26+ \frac{x}{2}$ )
3. The difference of 12 and a third of a number ($12- \frac{x}{3}$ )
4. The ratio of a number and 12 increased by 4 ( $\frac{x}{12}+ 4 or 4+ \frac{x}{12}$ )
5. 6 less than 12 of a number ( 6 – 12x )

**Application Problems for Expressions**:

1. Write an expression that represents the number of free throws Jessica made if she made 8 less than twice as many as Mark make, m. ( 2m – 8)
2. Write an expression that represents the sum of the ages of Geri and Jerry if Geri is 3 years younger than Jerry, j. ( j – 3 )
3. Write an expression that represents the area of a trapezoid if the area can be found by taking the product of 0.5, the height of the trapezoid, h, and the sum of the lengths of the bases of the trapezoid , b1 and b2. (0.5\* h \* ( b1 + b2 ) )
4. Write an expression that represents the total cost of renting a car if the rental car agency charges $12.95 each day the car is rented , d, plus $0.03 for each mile the car is driven, m. ( 12.95d + 0.3m )

\*\*Application area problems have been taken from the *Buckle Down on Ohio Mathematics* grade 8 workbook page 47.

**Modeling Expressions**:

1. -3x + 4 – 5x2 + 6 +2x – 5 – x2 ( -6x2 – x + 5 )
2. 6 – 2x2 + 6x – 4 – 4x + 5x2 – 3 (3x2 + 2x -1 )
3. -5x2 + 4x – 5 + 2x + 3x2 + 4 + 1 ( -2x2 + 6x )
4. 4 + 2x + 3x2 – 5x + 3x – 2x2 – 4 – x2 ( 0 )
* Students will work the problems out on their white boards individually. Students will then pair up and get one of the boards ready for their final answers.
* The students will hold up their boards for the teacher to see before a pair will be picked to explain the problem to the class.

**Concluding Activity ( 5 minutes) Pulling it all together, Writing Definitions**

* The teacher will summarize student performance and what the class should be working on as a whole to improve.
* The teacher will then ask the students to use their knowledge and experience up to this point to write a definition for the words *expression* and *simplify*.

***Summary/Closure/Evaluation:***

**Closure ( 5 minutes) Word Wall**

* Students will share the definition they came up with which will be written under each word on the board.
* The words will then be pulled up on the overhead projector.
* Students will compare their definitions with the dictionary to pick the student created definition that best fits the real meaning of the word
* Modifications will be made to the definitions if needed.

**Evaluation/ Homework:**

* The following worksheet will be completed for a grade. The teacher will use this work to formatively assess student learning up to this point. This information will also be used to judge the effectiveness of the new curriculum up to this point.

Modeling Expressions

Directions: Draw a model and simplify the following expressions. Make sure to write your final answer starting with the variable that has the highest power and working your way down to the constant. Example: -2x2 + 3x – 4 Put models on notebook paper.

1.) -4x + 5 - 6x2 – 2 + 3x + 4x2 - 1 \_\_\_\_\_\_\_\_\_\_\_\_\_\_

2.) 3x2 + 4x – 7 + 2 – 7x + x2 – 5x2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

3.) -6 + 2x – 5x + 3x2 + 9 – 6x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

4.) -5x2 + 6 – 3x + 4x – 2 + 3x – 2x2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

5.) -6 + 5x – 2 + 3x – 2x2 + 5x2 + 3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

6.) -2x2 + 3 – 2 + x – 1 + 2x2 – x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Directions: Write ***2*** verbal expressions for the following.

7.) 2x + 4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 8.) x – 5 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

9.) 5 – x \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ 10.) 6x + 4 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

 3 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Directions: Write the following written expressions in symbolic form. Example ***2 increased by a number*** would be written as ***2 + x.***

11.) eleven more than a number \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

12.) the quotient of a number and eight \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

13.) the sum of ten and triple a number \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Directions: For the following section write an expression for a real life situation. Use the following example as a guide. Sarah would like to write an expression to represent the perimeter of her square yard. Use s for the length of each side. This expression could be written as 4s or s+s+s+s.

14.)

15.)

16.)

***Lesson Five: Equivalence of Expressions***

***Unit Outcomes:***

1. Students will be able to analyze whether two expressions are equivalent using models and symbolic algebra (analysis).

***Lesson Outcomes:***

1. Students will be able to use models to determine if two expressions are equivalent.
2. Students will be able to write application problems/ expressions that reflect real life scenarios.

***Materials:*** Overhead projector, Mobi, colored pencils

***Procedures:***

**Introductory Activity: ( 10 minutes) Class Discussion**

* Students will share the application problems they had written for the previous night’s assignment.
* The teacher will then ask, “Did you initially think that expressions had any application to real life?” “Now that you have a firm understanding of what an expression is, can you see how this algebra concept is rooted in daily life?”

**Developmental Activity: (10 minutes) Think, Pair, Share**

* When analyzing situations from real life, it is often necessary to make judgments about them. Are the two situations the same or are they different?
* The teacher will ask the students to initially think about the question, talk about it with their partner, and then share with the class. “If you were asked to determine if two expressions were equivalent, what does that mean and how would you figure it out?” example: -2x + 3 – 4x2 + 5x – 7 + 2x2 = -x2 + 2 + 6x – x2 – 3x – 6
* The teacher will circulate around the room listening to student responses and prompting where necessary.
* Students will share what the word equivalent means and how that could be determined for the above problem.
* Students will add the definition of equivalent to their notes.
* Students will then work the above problem out be creating a model for each expression and simplifying it.
* The teacher will then ask, “Are the above expressions equivalent?” (Yes they are, both simplify to –2x2 + 3x – 4 )
* Students will then practice doing an additional problem on their white boards.

- 4 + 2x – 3x2 – 3x + 2 + x2 = 5x2 + 4x – 5x – 1 - 3x2 – 1 ( The two are not equivalent, on the left the model simplifies to -2x2 – x – 2 while on the right the model simplifies to 2x2 – x – 2 .)

**Closure Activity (20 minutes) Group Work**

* Students will be put into a small group of four.
* The teacher will explain that the students will be making a card game for expressions.
* The game could focus on simplifying, the forms of expressions, or the equivalence of expressions.
* The class will briefly discuss some of the card games they are familiar with.
* The card game could be matching like the previous games the class used or the group could come up with something completely different.
* The only limitation is that the game has to include a minimum of 10 cards.
* Students will be graded on creativity, neatness, clarity of directions, and if their game is mathematically correct.
* Students will begin to brainstorm for their game which will be worked on in class throughout the following week.

***Summary/Closure/Evaluation:***

**Summary ( 5 minutes ) Class Discussion**

* The important vocabulary learned up to this point in the sub-unit will be briefly discussed. The words are as follows: expression, simplify, model, and equivalence.

**Evaluation Graded Homework Assignment**

* Before students transition into the pattern part of this sub-unit, they will complete the following homework assignment for a grade. The purpose of this assignment is to assess student learning before moving on to the next topic.

**Rubric for Expressions Card Game:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **1** | **2** | **3** | **4** | **5** |
| **Creativity/Neatness** | Game has not been constructed neatly. The group has not put any time into making the game unique or appealing. | Game materials are constructed quickly and without regard to quality. Idea is not original. | Materials are constructed well but lack anything that makes them unique from pre-existing card games. | Materials are constructed well and are appealing. The group has tried to bring in new creative aspects to the game. | The materials are well constructed and appealing. The game has a new twist that makes it unique from other card games. |
| **Directions** | Directions for the game are not included. | Directions are poorly written and hard to follow. | Directions make sense but have multiple writing errors. | Directions make sense and have minimal writing errors. | The directions are easy to follow and contain no writing errors. |
| **Problems** | Problems are not appropriate for the topic or are all incorrect. | Problems match the desired topic but are not written correctly or are solved wrong. 3 or 4 mistakes. | Problems match the topic but have 2 mistakes. | Problems match the topic but have 1 mistake. | Problems match the topic and are all solved correctly. |
| **Total Points \* 5** |  |  |  |  |  |

**\*\* All students will receive a copy of the rubric.**

Modeling Equivalent Expressions

Directions: On a sheet of notebook paper, draw models for the following expressions to simplify them and determine if they are equivalent.

1.) 2x2 + 4x + 2 – 6x – x2 = -3x2 – 4x + 6 – 4 + 2x + 2x2 Equiv. Not Equiv.

2.) x + x + x + x – 4 = 2 + 4x – 6 Equiv. Not Equiv.

3.) 3x2 + 5x – 4 + 2x – 6x2 – x + 1 = -2x2 – 3 + 4x – x2 + 2x Equiv. Not Equiv.

4.) -5x + 3 + 4x + x2 – 1 – x2 = 6x – 2 + 4 – 5x + 3x2 Equiv. Not Equiv.

5.) 4x2 + 2x – 3 + 5 + 3x – x2 – 2x = x2 + 2x – 4x + x2 + 2 + x2 Equiv. Not Equiv.

6.) Create your own problem where two expressions are equivalent. Draw the model for your problem and simplify it.

7.) Create your own problem where two expressions are not equivalent. Draw the model for your problem and simplify it.

8.) In your own words, what is an expression and how do you simplify them? Use complete sentences.

9.) How are expressions different from the other algebra content we will learn about later this year? Use complete sentences.

***7th Grade Algebra Unit Post-Assessment***

Patterns, Functions, Algebra Content Standards

***Expressions:***

1.) What is an expression? How do you work them out?

2.) Determine if the following expressions are equivalent by drawing a model for them.

-4x2 + 2x – 5 + x2 + 3 + 4x = -5x2 + 3x – 3 + 2x2 + 3x + 1

3.) Write the following expression in written form *2 different ways*.

a.) $\frac{x}{4}- 5$ b.) $3+2x$

4.) Write an expression that represents the sum of Geri and Jerry if Geri is 3 years younger than Jerry, j.

***Equations and Inequalities:***

Solve the following equations.

5.) 4 – 2x = 12 6.) $\frac{-x}{3}+ 2= -7$ 7.) -13 = 4x + 7

Solve the following inequalities and graph on a number line.

8.) 3 – 2x > 9 9.) 12 > $\frac{x}{5}+ 9$

10.) How are inverse operations and order of operations used to solve equations, inequalities, etc.?

11.) Simplify the following $\sqrt{36}- 2 ∙6 ÷3+( 4-2)$ .

12.) A positive number minus a negative number is

 a.) always positive. c.) sometimes positive or negative.

 b.) always negative. d.) always zero.

13.) Show tiles for -4 \* -3

14.)Determine if the following pattern is linear or non-linear. How do you know?

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| n | 1 | 2 | 3 | 4 | 5 |
|  | 4 | 6 | 8 | 10 | 12 |

***Linear Equations and Inequalities***

15.) Sam’s dad gave him $50 to start a savings account. Each week, Sam saves his $5 allowance for his savings. Create a table and graph for the amount of money Sam will have in his savings for weeks 1,2,3,4 and 5. Write an equation to represent the total savings, t, for each week, w Sam saves money.

Equation:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

|  |  |
| --- | --- |
| Week | Total Money in Savings |
| 1 |  |
|  2 |  |
| 3 |  |
| 4 |  |
| 5 |  |

16.) Solve and graph the following linear inequality -2x + 3y > 6

 

17.) Explain how expressions, equations, inequalities, linear equations, and linear inequalities are all different.

18.) Explain how simplifying and solving for a variable are different.

\*\*During the Linear Expressions sub-unit, the students will also complete a large project where they must create their own lab that will result in the collection of linear data. Students will then conduct the lab and share results with the class. This project will require them to use most of the skills learned in this unit as well. Therefore, the project will cover application while this post-assessment is more skills oriented.