Number Sense

8th Grade

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Executive Summary

Integer operation is an important concept for 8th graders to understand before they can dig into the Algebra concepts that they are required to learn. In this unit you will find activities and explorations dealing with integer operations, order of operations and scientific notation. The following lessons in this unit are geared for 8th graders.

We have addressed the following standards in this unit. 7.1.2.1 Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals 8.2.3.2: Justify steps in generating equivalent expressions by identifying the properties used, including the properties of algebra. Properties include the associative, commutative and distributive laws, and the order of operations including grouping symbols. 8.1.1.5: Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, using the correct number of significant digits when physical measurements are involved.

The first unit will take about 7 days and walks you through an exploration for students to find the rules that go along with adding, subtracting, multiplying, and dividing integers. At the end of the lesson students should feel comfortable with their integer rules. The second unit takes about 3 days and goes through an exploration on order of operations. Students should understand how to follow the order of operations at the end

of this lesson. The 3rd unit takes about 5 days and goes through writing numbers in scientific notation, standard form, and multiplying and dividing numbers in scientific notation.

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Lesson 1 adding and subtracting integers (3 days)

Objective: Students will be able to add and subtract positive and negative numbers.

Standard: 7.1.2.1 Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals
(We realize this is a 7^{th} grade standard but as 8^{th} grade teachers we end up spending a good amount of time revisiting the integer rules.)

MCA Sample Question. This problem has subtracting integers and multiplying integers within the problem In order for students to solve this we need to break it apart and start by looking at adding, subtracting and multiplying integers first.

12. Simplify the expression

$$-19(8-16)^2 \div 12$$

Start by giving students the pretest before you start this launch. The pre-test should take no more than 20 min.

Launch: Read a story about chef's found at http://bfc.sfsu.edu/PRIME2/The-Chefs-Amazing-Soup.pdf

For example, suppose 4 hot cubes and 10 cold cubes were dumped into the cauldron. The temperature would be lowered by 6 degrees altogether. This is because 4 of the 10 cold cubes would balance out the 4 hot cubes, leaving 6 cold cubes to lower the temperature 6 degrees. To represent these actions and their overall result, the chefs would write +4 + -10 = -6

It is our job to help the chefs record what they are adding and taking away from the cauldron and how it affects the temperature of the cauldron.

Explore: Have students work in pairs. Each pair should have unifix cubes in 2 different colors. Have students assign one color to be hot (positive) and one color to be cold (negative). One person in the group should be the recorder and one student should be handling the cubes. Make sure students switch roles as well. To start off the chefs are starting with a cauldron that is at a temperature of 0. If I add one hot cube and one cold cube does my temperature vary at all? Hopefully students say no you would stay at zero. Tell students this is an important thing to remember and is called a zero pair. If the chef wants to make a cauldron 3 degrees warmer that is at temperature 0 how can I represent that with my cubes? Students may say you can have 3 hot cubes. (HHH) which would be represented by a positive 3. Some may apply zero pairs and say that you could have

HHHHC. There may be other variations with zero pairs as well. What if the chef needs the cauldron to get 3 degrees colder? Students may say use 3 cold cubes (CCC) which would be represented by a -3. Some may apply zero pairs and say something like CCCHC. You may need to do more examples to make sure all students understand what hot cubes mean and what cold cubes mean.

One more thing that I will need to tell my students is remember adding means you are putting something into the cauldron and the subtraction sign means that you are taking something away.

Now we should be ready to help the chef get the cauldron to the perfect temperature by adding and taking away hot and cold cubes. Remember it is our job to help the chefs' record what they are putting into the cauldron so that they can remember for next time. I will put up 10 adding and subtracting expressions. Having my students work in pairs to see if they can come up with models using their hot and cold cubes to show the class. Before they start I would model that 2+3 means HH HHH I started with 2 hots and added in 3 hots. I would also model 3 -1 means HHH and then take one hot a way and you would be left with HH or 2 hots.

1.) 5 + 3 2.) 5 + -3 3.) -5 + 3 4.) 5 – 3 5.) 5 - -3

6.) -5 – 3 7.) -5 - -3 8.) 7 - - 3 9.) – 7 – 3 10.) -7 + 3

I would go over at least 7 more expressions that are very similar to the ones above as well.

Share: Students will come up to the board with their partner and explain to the class what they think the answer to the different addition and subtraction expressions are. Here is what some of them may say

1. HHHHH HHH = 8 hots so 5 + 3 = 8
2. HHHHHCCC = 2 hots because HC is a zero pair so you have 3 zero pairs. Therefore 5 + -3 = 2
3. CCCCCHHH = 2 colds or – 2 because you again have 3 zero pairs so -5 + 3 = -2
4. HHHHH take away HHH and left with 2 so 5 – 3 = 2
5. HHHHH I do not have 3 negative cubes to take away so I would need to add in 3 cold cubes the only way to add in 3 cold cubes would be to also add in 3 hot cubes so now I would have HHHHHHCHCHC now I can take 3 cold cubes away leaving me with 8 hot cubes so 5 - -3 = 8
6. CCCCC I again don't have 3 hot cubes to take away so I would need to add in 3 zero pairs CHCHCH so I would be left with CCCCCCHCHCH now I have a positive 3 to take away so –5 – 3 = -8
7. CCCCC take away 3 cold cubes I would be left with CCC so -5 - -3 = -2
8. HHHHHHH I don't have 3 cold cubes to take away so add in CHCHCH no I would be left with HHHHHHHHHH so 7 - -3 = 10

9. CCCCCCC I don't have 3 hot cubes I can take away so add in CHCHCH and I would be left with CCCCCCCCCC. So -7-3 = -10
10. CCCCCCC HHH I would have 3 zero pairs and be left with CCCC so -7 + 3 = -4

Summarize: Let's look at our expression 1- 10 and the answers we got from them using our hot and cold cubes to see if we could see any types of patterns and be able to apply the rule you came up with so we could add something like -0.5 + - 0.75.

What did you notice when you added 5 + 3? That you got a positive number so could we say a positive + positive = Positive? Another way to think about this is we have a positive team and a negative team we have to decide which team is winning. Since both 5 and 3 are on the same team the positives are winning. What happened with 5 + -3? Can we say positive + a negative = positive? Couldn't we rewrite -5 + 3 as 3 + -5 and we would have a positive + a negative? But do we get a Positive? Hopefully students see that we would say no to this question.

I would ask if any students had an idea of a rule we could make? Hopefully they would. If not I would say let's think about it in teams if we have a positive team and a negative team. With 5 + -3 the positive team was winning by 2. With -5 + 3 the negative team was winning by a -2. Hopefully with the help of the students we could come up with a rule such as positive + a negative = depends on which team is winning. Now lets look at something like -5 + -3 = -8. Both -5 and -3 are on the negative team so we would get a negative answer. Hopefully as a class we could come up with a rule such as same signs add keep the sign different signs subtract keep the sign of the larger in absolute value. Now what did we do with our subtraction problems such as 5- - 3? Hopefully students will come up with that we had to add in the opposite cube and then the addition rules applied. So we could say change all subtraction problems to adding the opposite.

Analyze/Assess:
Adding integers can be tricky for students. After this lesson I would make sure I take notes on what students had trouble with and what went really well.

Adding and Subtracting integers lesson 2 (1 day)

Launch: Remember our amazing chef. We are going to continue helping our chef out to keep the cauldron at the right temperature.

Exploration day 3: Students will be in groups of 4. Each student will need to come up with 5 different adding problems and 5 different subtraction problems with negative and positive fractions, decimals, and integers. They will need to make sure they have at least 3 problems that add or subtract positive and negative fractions, 3 problems that add or subtract positive and negative decimals and 4 problems that add or subtract positive and negative integers. They will then have their group try out the problems they made up. Each person in the group should check the other people's answers as well. I would let students use individual white boards during this.

Share: Each group would have to come up to the board and explain one of the problems someone in their group came up with. Showing the class their exact thinking for the problem.

Summarize: After all groups have shared a problem I would make sure every student has in their notes When adding and subtracting positive and negative numbers change all subtraction problems to adding the opposite. Then when adding numbers with the same signs add keep the sign of the number if they have different signs subtract and keep the sign of the larger number in absolute value.

Analyze/Assess

Lesson 3 Multiplying Integers (1 or 2 days)

Objective: Students will be able to multiply positive and negative numbers. (3 days)

Standard: 7.1.2.1 Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals
(We realize this is a 7th grade standard but as 8th grade teachers we end up spending a good amount of time revisiting the integer rules.)

MCA Sample Question. This problem has subtracting integers and multiplying integers within the problem. In order for students to solve this we need to break it apart and start by looking at adding, subtracting and multiplying integers first.

12. Simplify the expression

$$-19(8 - 16)^2 \div 12$$

Launch: When we think back to our amazing chefs. Sometimes the chefs wanted to raise or lower the temperature by a large amount, but they did not want to put the cubes into the cauldron one at a time. So, they would put in or take out bunches of cubes.

For instance, to raise the temperature 100 degrees, the chefs might toss 5 bunches of 20 hot cubes each into the caldron, instead of 100 cubes one at a time. This saved a lit of time because they could have assistant chefs do the bunching.

When the chefs used bunch of cubes to change the temperature, they used a multiplication sign to record their activity. For example, to describe tossing 5 bunches of 20 hot cubes into the cauldron, they would write

5 x 20 = 100

The chefs could also change the temperature by removing bunches. For example, suppose they removed 3 bunches of 5 hot cubes each. This would lower the temperature 15 degrees, because each time a bunch of 5 cubes was removed, the temperature went down 5 degrees. To record this change, they would write -3 x 5 = -15

We need to help the chefs record what kind of cubes they are adding or taking away in the cauldron and how it is affecting the temperature.

Explore: What does multiplication mean? For example does anyone have an idea on how they can represent 3x5. Hopefully someone will remember it means 3 groups of 5. How can we help the chefs model the following expressions with hot and cold cubes? Students will work with a partner to come up with the models. I may need to model one like #5 to the whole class or at least read the problem out loud to them.

1). 2x3 2.) 4 x 2 3.) 2 x -3 4.) 4 x -2 5.) -3 x 2

6.) -4 x 2 7.) -2 x -3 8.) -4 x – 2

Share: Students will come up to the board with a partner and explain to the class how they thought of the above multiplication problems using their hot and cold cubes. Hopefully they come up with something similar to the below explanations.

1. 2 x 3 = 6
HHH
HHH 2 groups of 3 hots

2. 4 x 2 =8
HH
HH
HH
HH 4 groups of 2 hots

3. 2 x -3 = -6
2 groups of 3 colds
CCC
CCC

4. 4 x -2 = -8
4 groups of 2 colds
CC
CC
CC
CC

5. -3 x 2 =-6
One way to read this would be take away 3 groups of 2 hots. Students would need to know 3 x 2 = 6. The only way to take 3 groups of 2 hots away would be to have 3 groups of 2 hots. I can add in zero pairs so I keep the cauldron at 0 to begin with.
HC HC now I have 3 groups of 2 hots I can take away and I would be left
HC HC with 6 colds.
HC HC

6. -4 x 2 = -8
Is read as take away 4 groups of 2 hots. Again I would have to add in 4 groups of 2 hots to be able to take them away. I would need to add in zero pairs.
HC HC
HC HC Now I have 4 groups of 2 hots I can take away and I would be
HC HC left with 8 colds
HC HC

7. -2 x -3 = 6
This is read as take away 2 groups of 3 colds. I again would add in zero pairs.
HC HC I then could take away 2 groups of 3 colds and I would be left
HC HC with 2 groups of 3 hots
HC HC

8. -4 x -2 = 8
I would read this as take away 4 groups of 2 colds.
HC HC
HC HC I then would need to take away 4 groups of 2 colds and be left
HC HC with 4 groups of 2 hots.
HC HC

When you multiplied the hot and cold cubes together what did you notice about the signs?

Summarize: Hopefully students came up with that when multiplying a positive x positive the got a positive number. A negative x a negative = positive number. Negative x a positive= negative. Hopefully as a class we can come up with a general rule to count the signs when multiplying. Odd number of negatives answer will be negative. Even number of negatives answer will be positive.

Analyze/Assess

Lesson 4 Multiplying Integers (1 day)

Activity for lesson day 6
We will play multiplying integer war. Black cards are negative and red cards are positive. Jacks, Kings, Queens are worth 10. Aces are worth 11. Each student will flip over 2 cards for the first round. They will multiply their cards together. The person with the biggest number gets to take the cards. For round 2 each student will flip over 3 cards and multiply all 3 together. The difference from the actual card game war is students will need to flip over more than one card at a time.

Share: Students will share any strategies they used for the game and or share any problems they had when multiplying their positive and negative cards.

Summarize: Remind students the rules for multiplying positive and negative numbers. Count the negatives. Odd number of negatives answer will be negative. Even number of negatives answer will be positive.

Analyze/ Assess

Lesson 5 Dividing Integers (1 day)

Objective: Students will divide real numbers.

Standard: 7.1.2.1 Add, subtract, multiply and divide positive and negative rational numbers that are integers, fractions and terminating decimals
(We realize this is a 7^{th} grade standard but as 8^{th} grade teachers we end up spending a good amount of time revisiting the integer rules.)

Launch: What do you suppose the chefs mean by the expression 15 / -3? What might the numbers 15 and -3 in this division problem represent in terms of the "hot and cold cubes" model?

Explore: Make up some other division problems using integers. Explain them using a model. Include different combination of signs.

Share: Have students share some of the problems they came up with. Can we come up with some type of rule for dividing integers?

Summarize: Do you see why we learn rules for the different operations with integers. I know I would not want to model the problem every time especially when I got to multiplying and dividing integers.

Analyze/Assess

Lesson 7 Divide rational numbers

Objective: Students will divide rational numbers.

MCA Sample Question

10. A moving truck is $16\frac{1}{2}$ feet long. How many $3\frac{1}{4}$ -foot-long boxes will fit lengthwise in the truck?

Launch: You and a few of your family members live on different dirt roads and you all want your roads to be paved. You are trying to figure out how many days the paver will take to pave the different roads. You all want the roads done at the same time. The pavers all work at different speeds so it may take longer for different roads.

Explore: Let's say your road is 6 miles long and the black top paver can pave 2 miles in a day. Use Unifix cubes to model this. And figure out how many days it will take the paver.

Your grandma's road is 2 miles long and the paver can pave ½ mile in a day. How many days will it take the paver to pave your grandma's road?

Your cousin's road is 2/3 of a mile and the paver can pave ½ mile in a day. How many days will it take the paver to pave your cousin's road?

We would do a few more examples similar to the above ones until students seemed like they were feeling comfortable.

Share: Students will have looked at the above situations with a partner. Partners will come up to the board to explain their thinking.
Sample for the first example would be I have 6 blue unifix cubes on top on the bottom I have 3 groups of 2 green unifix cubes. Each cube would represent 1 mile. This would show it takes 3 days to pave the road.

Sample for the second example would be 2 cubes represent 1 mile. I have 4 blue cubes on top on the bottom I have I have 4 blue cubes. Showing it would take 4 days to complete.

Summarize: Using the above examples can you come up with what operation we were using? Hopefully everyone can say we were dividing. Can someone come up

with the rule for when we are dividing fractions what we could do? Keep the first fractions change division to multiplying by the reciprocal. When happens if I had to divide a positive number by a negative number do I know what my answers sign would be? Hopefully students would say that the rules are the same for division and multiplication since we are really changing division to multiplication.

Analyze/Assess:

Pre/Post Test.
Use hot and cold chips to show me what your answer would be to the following problems.

1. 5 + 4

2. 11 + -4

3. 12 – 5

4. -12 + 6

5. 12 – - 7

Evaluate the following expression. Use your integer rules.

6. -12 + -8

7. -12 + 9

8. -3 - - 4

9. 5 - - 9

10. 5(-3)

11. 5(6)

12. -5(-6)

13. -6/ 3

14. ½ divided by -2/3

Scientific Notation Lesson 1 (2 days)

Student Objective: Students will learn to write very large and very small numbers using scientific notation.

Standard: 8.1.1.5: Express approximations of very large and very small numbers using scientific notation; understand how calculators display numbers in scientific notation. Multiply and divide numbers expressed in scientific notation, using the correct number of significant digits when physical measurements are involved.

MCA Test Question:

4. The chart shows the average distance of some planets from the Sun.

Planet	Distance in Miles
Mercury	36,000,000
Mars	141,000,000
Jupiter	480,000,000

Which expression represents the distance from Jupiter to the Sun in scientific notation?

A. 0.48×10^9 **C.** 4.8×10^8

B. 4.8×10^7 **D.** 48.0×10^7

Before we start with the launch we will have students take a pre-test, which should take about 20 min at the most.

Launch: Start with Scientific Notation Rap (RhymenLearn.com) We are going to look at the distances to Mars and express this large number using scientific notation. For a very small number we are going to look at the size of the Ecoli virus. We will also watch the video Powers of ten https://www.youtube.com/watch?v=0fKBhvDjuy0. We will have students look at the US debt calculator to see another place that big numbers come in.

For scientific notation there must be exactly one digit on the left side of the decimal and there must be a power of ten that is being multiplied to get a number in scientific notation. Scientific form is R x 10^a where R is greater than of equal to 1 and less than 10 and a is and element of the integers. Ie. 323 is 3.23 x 10^(2) or .00543 is 5.43 x 10^(-3) in scientific notation. Students will learn very large numbers will have a positive power for base 10 and very small numbers will have a negative power for the base 10. The number of places the decimal is moved is the power for the base 10.

Explore: Students work in pairs challenging each other with 10 problems expressed with positive and negative exponents for the power of ten. Example: Tom gives Jack the problem 3,546,234 to be expressed in scientific notation. Jack gives Tom the problem 2.4563 x 10^(-3) to be expressed in decimal form. Next students will challenge each other with 10 problems written in scientific to be expressed as decimals. Tom gives Jack the problem 2.35 x 10^3 Jack changes the form to decimal 2,350.

Share: Students go to the board with their partner and express decimal number in scientific form and scientific notation in decimal form.

Summarize: Very large and very small numbers can be expressed using scientific notation. There must be exactly one digit on the left side of the decimal and there must be a power of ten that is being multiplied. Very large numbers will have positive powers of 10 and very small numbers will have negative powers for ten. The number of places the decimal gets moved is the power for the base 10.

Exploration 2: Students will work with a partner. Each student will be assigned an object and they will need to come up with how much it weighs. One student will write the weight in standard form and the other student will write the weight in scientific notation. Once all students have finished writing out their numbers on the index cards we will have the whole class order the numbers from least to greatest. Students will tape their paper to the board. The students get to pick if they will order their numbers in standard form or scientific notation.

Share: Students will share what their weight of the object was and students will share how they put their number in both forms. They will also share if they found it easier to compare their number to the other numbers in standard form or scientific form.

Summarize: Scientific notation can be very useful when comparing very large and very small numbers.

Scientific Notation Lesson 2 (1 day)

Student Objective: Students will learn to add and subtract numbers that are in scientific form. Students will learn to change scientific notation into decimal form and line up decimals to add or subtract numbers. Student will also learn to use TI-84 calculators to compute very large and very small sums and difference in scientific notation. The display of the calculator will indicate the power to be used for the base 10. Example: if the TI-84 displays 3.25 E6. Then the answer is 3.25 x 10^6 using scientific notation.

We are going to review what we learned in lesson 1 and apply it to adding and subtracting numbers in scientific notation. Example 1: Students should understand that if I add $4.14 \times 10^{5} + 3.12 \times 10^{-6}$ together my answer could be written as 4.14×10^{5} since 3.12×10^{-6} is so close to 0. Example 2 3.12 x 10^5 + 2.15 x 10^4 should be rewritten into decimal form as 312,000 + 21,500 which is = 333,500. Several examples will be examined to see how scientific notation sums and differences are accomplished. Similar problems will be displayed for subtraction.

Explore: Students will work in partners creating 5 problems using sums and 5 problems using differences for each other. To begin with student will only use exponents between -5 and 5 and at most 5 digits in their original numbers.

Share: Students will come to the board with their partners and solve sums and differences of scientific notation problems.

Summarize: Sums and differences of scientific notation problems are best solved by changing to decimal form and lining up the decimals before operations are preformed. A TI-84 calculator displays 2.3 E(-5) means 2.3×10^{-5} using scientific notation.

Scientific Notation Lesson 3 (1 day)

Student Objective: Students will learn to multiply numbers that are in scientific notation. Students will learn to use the commutative property of multiplication to rearrange a product of numbers in scientific notation. They will then multiply the decimal numbers and add the powers of the base 10 numbers. Example: (2.3 x 10^5) x (3.0 x 10^3) will be rewritten (2.3 x 3.0) x (10^5 x 10^3) = 6.9 x 10^8

Launch: If we wanted to find the mass of the Sun we would multiply mass of the earth x 330,000. The mass of the earth is 5.3446683 x 10^{24} KG. Find the mass of the sun. (5.3446683 x 10^{24})(330,000)

Several examples will be examined to develop understand of multiplying numbers in scientific form. The commutative property will be used to rewrite the original problem to multiply the decimal numbers first and add the powers of the base 10 numbers. If the product of the decimal numbers is more than 10 then express the number in scientific notation before multiply times the base 10 number. Example (5.2 x 10^3) x (2.0 x 10^5) = (5.2 x 2.0) x (10^3 x 10^5) = 10.4 x 10^8 = 1.04 x 10^1 x 10^8 = 1.04 x 10^9.

Explore: Students will work in pairs creating 3 problems multiplying numbers in scientific form. The decimal numbers will be restricted to 2 places and powers of 10 between -5 and 5. Students will need one of their problems to have decimals when multiplied give you a number bigger than 10.

Share: Students will come to the board and demonstrate understanding of multiplying numbers in scientific form.

Summarize: When multiplying numbers in scientific form, rearrange the numbers using the commutative property of multiplication. Multiply the decimal numbers. Change the number to scientific form if product is greater than 10. Add the powers of the base 10 numbers to express answers using scientific notation.

Scientific Notation Lesson 4 (1 day)

Student Objective: Students will learn to divide numbers that are in scientific notation.

Launch: Have students watch Scientific notation rap. If we wanted to find the mass of the Earth. We would divide the mass of the sun by 330,000. $(2.0 \times 10^{30}) / 330{,}000$

Examples of dividing numbers using scientific notations, (8.4 x 10^5) / (4.2 x 10^3). Divide the decimal parts of the problem. 8.4 / 4.2 = 2.0 Next divide the base 10 numbers by subtracting the powers. 10^5 / 10^3 = 10^2 . Multiply the decimal part by the base 10 part . 2.0 x 10^2.

Explore: Students will work with a partner and come up with 3 examples for each to try. One quotient of the decimal needs to be smaller than 1 example (2.4/4.3) and one decimal needs to be between 1 and 10 and then they can pick the other decimal.

Share: Students will come up to the board and share and teach an example that they did with their partner.

Summarize: Remind students to divide the decimal parts of the problem. 8.4 / 4.2 = 2.0 Next divide the base 10 numbers by subtracting the powers. 10^5 / 10^3 = 10^2 . Multiply the decimal part by the base 10 part . 2.0 x 10^2.

Name:_____

Pre/Post test for Scientific Notation

Problems (1-4). Write the following numbers using scientific notation.

1. 8,342

2. .000278

3. 12,356,789,000

4. .0361000

Problems (5-6). Add or Subtract the numbers. Express answers using scientific notation.

5. 3.125 x 10^5 + 2.52 x 10^4

6. 8.76 x 10^6 - 3.12 x 10^5

Problems (7-10). Multiply or Divide the numbers. Express answers using scientific notation.

7. (2.3 x 10^3) x (4.12 x 10^2)

8. (8.4 x 10^6) / (4.2 x 10^5)

9. (6.5 x 10^5) x (2.0 x 10^2)

10. (2.2 x 10^5) / (4.4 x 10^3)

Numbers for Scientific notation Exploration 2

1). 1 inch = .0000157828 miles

2.) African Bush Elephant weigh: 13, 256 pounds.

3.) Pluto lies 4,460,000,000 miles from Earth

4.) .000002 kg is the weight of an ant

5.) 4,069 pounds is the weight of a car

6.) 40,120 pounds is the weight of the bus

Extra numbers:

7.) 3.2×10^{3}

8.) 5.3×10^{-4}

9. 7,423,824

10.) 3,284,610

11.) 3.15×10^{6}

12.) 92,000,000

13.) 7.9×10^{-2}

14.) .0083

15.) .0521

Lesson 1 Order of Operations (1 day)

Student Objective: Students will be able to follow order of operations to evaluate mathematical expressions.

Standard: 8.2.3.2: Justify steps in generating equivalent expressions by identifying the properties used, including the properties of algebra. Properties include the associative, commutative and distributive laws, and the order of operations including grouping symbols.

MCA sample question

1. Use the order of operations to simplify.

$$95 \div (8 - 3) - (3 \times 0.6)^2$$

A. 2.635
B. 7.84
C. 15.76
D. 22.8

Before the launch have students do the order of operations pre test. This should take 10 min at the most

Launch: Start class off with order of operations rap
https://www.youtube.com/watch?v=McvHL5tHbXY

Explore day 1: Students will work with a partner and go through 10 mathematical expressions and try to get an answer see attached sheet labeled Exploration 1. They will use a TI-84 calculator to check to see if they got the correct answer. If they did not get the correct answer they will need to see if they can go back to the mathematical expression and get the correct answer. Have students see if they are noticing what order they need to do operations in to get the correct answer.

Share: Students will share with the class how they got each answer on explore sheet 1 and what operations they did in what order.

Summarize: We will define order of operations as a class. One way to help students remember order of operations is PEMDAS (Please Excuse My Dear Aunt Sally). Students' need to understand that any time there are multiple operations in a mathematical sentence they will follow order of operations.

Lesson 2 Order of Operations (2 days)

Launch: Watch order of operations Rap
https://www.youtube.com/watch?v=McvHL5tHbXY

Explore day 2: Students will be paired with a partner I will pass out white boards and have students make up their own expression using parentheses, exponents, multiplication, division, addition, and subtraction for a partner to evaluate make sure students check each other's work and check on a calculator to make sure they evaluated correctly. Have students come up with one problem that they will share with the class. Make sure it is a bit of a challenge. The goal is to stump the class or the teacher!

Share: Students will come up to the board present their problems and see if the class gets the right answer they will then teach the class what they did to follow order of operations.

Summarize: Remind students that order of operations is not just a lesson to forget about. Any time even outside of math class I will use order of operations if there are multiple operations in the same expression.

Explore Day 3: Students will get to work with a partner. Using exactly 5 5's and any operation students need to come up with answers of 1 – 20. This exploration will not end until right before the post test. We will keep the expressions up on the board. Our goal is to come up with as many different expressions for each number as possible.

Analyze/Assess:
I will give a pre-test and a post-test which will be the same tests to see how well the students improve.

*To keep order of operations fresh in my student's mind the whole year at the beginning of class have 5 students put a digit on the board. I will circle one of the digits and the class needs to come up with a mathematical expression that will equal that digit.

Pre-test/ Post test

Evaluate the following expressions.

1.) $5^2 + 3(6) - 12$

2.) $\frac{3^2-5+12}{3(6)-12}$

3.) $(5 + 10) + 2 \times 6 - 6$

4.) $95 \div (8 - 3) - (3 \times 0.6)^2$

Exploration 1

Evaluate the following expressions. Use a calculator to make sure you are correct.

1. $2 \times 3 + 4$

2.) $(4 + 3) \times 2$

3) $72 \div 9 + 7$

4) $2 + 7 \times 5$

5) $9 + 8 - 7$

6) $9 - 32 \div 4$

7) $5(10 - 1)$

8) $48 \div (4 + 4)$

9) $20 \div (4 - (10 - 8))$

10) $40 \div 4 - (5 - 3)$