Erin Bendul | Lesson Plan 1 PEMDAS | September 21st, 2012

Goals

The students will understand the concept of Order of Operations using PEMDAS, and be able to relate these concepts in future learning.

Common Core Standards

Expressions & Equations **8.EE**

Work with radicals and integer exponents.

1. Know and apply the properties of integer exponents to generate equivalent numerical expressions. For example, 32 × 3–5 = 3–3 = 1/33 = 1/27.
2. Use square root and cube root symbols to represent solutions to equations of the form x2 = and x3 = p, where p is a positive rational number. Evaluate square roots of small perfect squares and cube roots of small perfect cubes. Know that √2 is irrational.
3. Use numbers expressed in the form of a single digit times a whole-number power of 10 to estimate very large or very small quantities, and to express how many times as much one is than the other. For example, estimate the population of the United States as 3 times 108 and the population of the world as 7 times 109, and determine that the world population is more than 20 times larger.
4. Perform operations with numbers expressed in scientific notation, including problems where both decimal and scientific notation are used. Use scientific notation and choose units of appropriate size for measurements of very large or very small quantities.

Seeing Structure in Expressions **A-SSE**

Interpret the structure of expressions.

1. Interpret expressions that represent a quantity in terms of its context.
a. Interpret parts of an expression, such as terms, factors, and coefficients.
b. Interpret complicated expressions by viewing one or more of their parts as a single entity. For example, interpret P(1+r)n as the product of P and a factor not depending on P.

Mathematical Practices

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

NCTM Standards

Represent and analyze mathematical situations and structures using algebraic symbols
Expectations: In grades 6–8 all students should—

• develop an initial conceptual understanding of different uses of variables;

Expectations: In grades 9-12 all students should—

• understand the meaning of equivalent forms of expressions, equations, inequalities, and relations

• write equivalent forms of equations, inequalities, and systems of equations and solve them with fluency—mentally or with paper and pencil in simple cases and using technology in all cases

• use symbolic algebra to represent and explain mathematical relationships

Process Standards

Problem Solving

Instructional programs from prekindergarten through grade 12 should enable all students to--

• build new mathematical knowledge through problem solving;

• solve problems that arise in mathematics and in other contexts;

• apply and adapt a variety of appropriate strategies to solve problems;

• monitor and reflect on the process of mathematical problem solving.

Reasoning and Proof

Instructional programs from prekindergarten through grade 12 should enable all students to--

• recognize reasoning and proof as fundamental aspects of mathematics;

• make and investigate mathematical conjectures;

• develop and evaluate mathematical arguments and proofs;

• select and use various types of reasoning and methods of proof.

Communication

Instructional programs from prekindergarten through grade 12 should enable all students to--

• organize and consolidate their mathematical thinking though communication;

• communicate their mathematical thinking coherently and clearly to peers, teachers, and others;

• analyze and evaluate the mathematical thinking and strategies of others;

• use the language of mathematics to express mathematical ideas precisely.

Connections

Instructional programs from prekindergarten through grade 12 should enable all students to--

• recognize and use connections among mathematical ideas;

• understand how mathematical ideas interconnect and build on one another to produce a coherent whole;

• recognize and apply mathematics in contexts outside of mathematics.

Representation

Instructional programs from prekindergarten through grade 12 should enable all students to--

• create and use representations to organize, record, and communicate mathematical ideas;

• select, apply, and translate among mathematical representations to solve problems;

• use representations to model and interpret physical, social, and mathematical phenomena.

NYS Learning Standard for Mathematics

Number Theory **A.N.1.**

Identify and apply the properties of real numbers (closure, commutative, associative, distributive, identity, inverse)

Performance Objectives

Given a Do Now pertaining to Translations, students will complete the Do Now using knowledge obtained from the previous days lesson, with 80% accuracy.

Given instructions pertaining to Order of Operations, student will learn how to solve problems involving multiple operations by following the rules for PEMDAS.

Given practice problems pertaining to Order of Operations, students will complete the problems with 80% accuracy.

Students will complete an Exit Slip, where they must create their own Order of Operations problem and give the problem to a partner to solve, with 100% accuracy.

Given a worksheet with 5 practice problems, students will complete the problems for homework, with 80% accuracy.

Materials

Other than routinely used materials in the classrooms, including paper and writing utensils, the only other additional material students will need is a calculator. Students will be given a calculator to aid them in their work. The majority of the students work will be simple mathematical operations that the students can mentally complete, however the calculators will be offered for additional assistance.

Use of Electronic Technology

Although students should not need a calculator to complete the simple math, a calculator will be given to help students in completing their work. Furthermore, a SMARTboard may be used throughout the lesson to introduce the topic to students, and proved students with examples of the concept.

Introduction

The lesson will begin by motivating the students and helping them become interested in the topic. Previously, the students would have learned about translating mathematical expressions to english, and vice versa. The students will be given a Do Now activity, which contains two translation problems, which they would have learned the day before. The reason the Do Now will contain information pertaining to translations is because students should be able to understand the relation between previously learned information and new information. After students complete the Do Now, we will go over their answers as a class, and I will answer any questions they have. Students will be given an opportunity to come up to the SMARTboard to answer the Do Now questions and demonstrate their mathematical understanding and ability. Students can expect to see questions such as:

"Nine less than the product of 6 and a number x" (6x-9)

"4 less than x" (x-4)

Development

The type of instruction used during the development is Cooperative Learning. After the students prior knowledge is activated, I will begin the lesson pertaining to Order of Operations. The first slide of the Power Point will introduce the topic of Order of Operations, and give the

students a brief definition of the concept. The slide will explain to students that Order of Operations is essential in mathematics because the answer will vary if the rules of PEMDAS are not followed. Furthermore, PEMDAS will be introduced, and students will understand what each letter stands for (parenthesis, exponents, multiplication, division, addition, and subtraction.) I will also introduce an acronym for PEMDAS to help the students remember the order ("Please Excuse My Dear Aunt Sally".) I will also explain to students that multiplication and division have the same value, and addition and subtraction have the same value. Therefore, while students are completing an Order of Operations problem they must complete the problem in the PEMDAS order, while reading from left to right. I will add a slide on the Powerpoint which emphasizes the order of PEMDAS and the fact that multiplication and division are read from left to right, as well as addition and subtraction. Also, I will emphasis when you have a bunch of operations in the same rank, you simply read from left to right. Due to the fact many of the students have seen these types of problems before, I will go over how to complete the problems with the class as a review. The purpose of this lesson is to review Order of Operations so students are able to complete problems involving evaluating expressions. Additionally, I will display numerical problems on the SMARTboard which will test the student's ability to complete an Order of Operations problem correctly. Once students appear to understand the concept of PEMDAS I will display a problem on the board for them to evaluate. The problem will read

"2+3 · 4."

Students will be given 30 seconds to answer the question without calculators. Then one student's will be asked to come up to the board and answer the problem. We will go over the problem as a class to make sure all students understand why we should get 14 as an answer. If students do not understand why we performed the problem in a specific order, I will apply the problem to the real world, and give the students a specific scenario. What if you work for 3 hours (mowing lawns, babysitting...) and you normally get $4/hour. But this time the people tip you an extra $2. How much did you earn? They all know that this is $14. How can we write this as a number sentence? 3 · 4 + 2. Isn't that the same as 2 + 3 · 4? Well, shouldn't it be? Once again I will stress the hierarchy of the steps is important, however multiplication and division are the same level, as well as addition and subtraction. I will also model this within the PowerPoint, by making P and E different colors, M and D the same color, and A and S another color which is the same. I will once again give students a problem to see if they have mastered the concept of PEMDAS.

"4+2(5 - 3)"

Ans: 4 + 2(2)

4+4

8

"-3(-4)²(2)+(4)(-4)"

"-3(16)(2)+(4)(-4)"

"(-96)+(-16)"

"-112"

Algorithm

When a numerical expression involves two or more operations, there is a specific order in which these operations must be performed.

P E M D A S

Letters in PEMDAS stand for:

P - Parenthesis

E - Exponents

MD - Multiplication or Division from left to right
AS - Addition or Subtraction from left to right
The following phrase helps students remember the PEMDAS rule further:
Please Excuse (My Dear) (Aunt Sally).
Students must understand that when completing an Order of Operations problem they must solve what is inside the parenthesis first, followed by the exponents. Next, students must focus on multiplication and division, followed by addition and subtraction. Multiplication and Division should be completed in order from left to right. Followed by addition and subtraction, completed in order from left to right.

Guided Practice

I will practice a few problems which contain basic operations, to see if the students have mastered the content. Next, I will give students problems which contain parenthesis and exponents, and see if they understand how to complete problems containing them. I will complete the first four problems with students, and ask the students to complete the next four independently. Types of problems the students can expect to see include:

1.) $2 + 5 \cdot 3 =$
$2 + 15$
17

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2.) $30 \div 6 \cdot (5 + 3)$
$6 \cdot 8$
48

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3.) Example: How do you work out $3 + 6 \cdot 2^2$?
Multiplication before Addition:
First $6 \cdot 4$
24,
then $3 + 24$ 27

4.) $30 \div 5 \cdot 3$
$6 \cdot 3$
18

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5.) Example: How do you work out $12 / 6 \cdot 3 / 2$?
Multiplication and Division rank equally, so just go left to right:
First $12 / 6 = 2$, then $2 \cdot 3 = 6$, then $6 / 2 = 3$

5.) $6 \cdot (5 + 3)$
$6 \cdot 8$
48

6.) $5 \cdot 2^2$

5 × 4
20

$(5 \cdot 2)^2$
$(10)^2$
100

7.) Example: How do you work out $(3 + 6) \cdot 2$?
Parentheses first:
First $(3 + 6) = 9$, then $9 \cdot 2 = 18$

8.) $7 + (6 \cdot 5 + 3)$
Start inside Parentheses, and then use Exponents First
$7 + (30 + 3)$
Then Multiply
$7 + (33)$
Then Add
40
Parentheses completed, last operation is an Add

9.) $5 \cdot (12/6)^2 - 2 \cdot 6$
$5 \cdot (2)^2 - 2 \cdot 6$
$5 \cdot 4 - 2 \cdot 6$
$20 - 12$
8

After students have completed their problems, we will go over the answers they found, and I will answer any questions the students have. After students grasp the material included in this lesson I will ask if students have any questions or concerns about the material we have covered.

Accommodations

If students with ELL or communication disorders demonstrate difficulty with the task, I will present the material in a different way which may relate to the students more. I will help the students understand the information by working with the student individually. If a student demonstrates behavior problems I will implement a token system for the entire class to motivate every student, not just the one with a behavior issue, to participate. If a student is Highly Able, I will ask them to solve additional problems located on their homework sheet. Also, I will ask the students to create a demonstration for their peers, where they will be given the opportunity to present their prompt to the class and help their classmate solve it.

Modifications

Extra time will be allotted to students with ELL or reading, writing, and behavior issues. If students still do not comprehend the material I will give extra help for a few minutes at the end of the period. I will ask students to give feedback, and request that they explain what they are struggling over. The difficulties may arise in understanding the Order of Operations, or

remembering how to complete a problem using PEMDAS. Furthermore, students may find it hard to evaluate a problem which contain multiplication and division or addition and subtraction without parenthesis. If students are struggling I will provide the students with learning strategies to help them better understand the material, or simplify the mathematical problems for the students. If students with reading, writing, or behavior problems demonstrate difficulty with the task, I will clarify or simplify the concept. If students continue to struggle I will lower the performance level. Students that are highly able will be given problems that challenge their mathematical ability.

Closure

To close the lesson, I will leave 5 minutes at the end of the period to wrap up. I will tell the students to pack up their things and then allow the class to ask questions about the lesson. If students ask any questions, I will answer the questions in front of the class so the information is clarified for everyone. Furthermore, I will sum up all the information with the class, and call on students to answer questions about the lesson. Before class is dismissed, I will make sure students are aware of the fact that extra help will be offered, provided they need it. Lastly, I will give the students and exit slip, where they must create their own Order of Operations problem, and exchange the problem with a classmate to solve. I will ask both the student who created the problem, and answered the problem to write their name on the paper. I will then collect the papers at the end of class to assure students have mastered the material. I will also remind students that this lesson directly relates to previous lessons, and explain this lesson will correlate to information students will learn in the next class period.

Independent Practice

For independent practice, students will have to answer homework problems which will be distributed on handouts in class. I will allow the students to work on the questions in class provided there is extra time. The students will be expected to complete the first 5 problems on homework, and complete the last 5 problems if they wish to receive extra credit. The homework problems will be reviewed during the next class period to assure students have mastered the material.

1. $16+ ((11+4) + 6^2)$
2. $((10+7) - (14 \div 2)^2)$
3. $((9+4) - (20 \div 4)^2)$
4. $5 + (10+ (9-3)^2)$
5. $((3+5)^2 \text{ x } 4) - 3^2$
6. $(3^2 + (14 \div 7+3^2))$
7. $20 + ((16-3) \text{ x } 2^2)$
8. $16 + (6 \text{ x } (4 +3)^2)$
9. $(3^2 + (10 \div 2 +3^2))$
10. $((9-2)^2 +4)- 3^2$

Evaluation

During the pre-assessment students will be assessed on their ability to concentrate during the Do Now and the Introduction of the lesson. I will pay attention to which students enter the classroom and attempt to concentrate and engaged themselves within the lesson. I expect most

students will be activated and motivated during the lesson. Also, students will be evaluated based on their ability to recall previously learned information. This will be important during the Do Now exercise, as well as the extent of the lesson. During the formative assessment students will be assessed based on their participation during the development, and their participation during the guided practice. Furthermore, students will be assessed on the completion of their independent practice. After the students hand in their independent practice I will review the worksheets to see what the students strengths are, and what they need to work on. Additionally, I will look at the students Exit Slips to evaluate their understanding of the lesson.

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Name:_____ Date:_____

Order of Operations Homework

1. **$16 + ((11+4) + 6^2)$**

2. **$((10+7) - (14 \div 2)^2)$**

3. **$((9+4) - (20 \div 4)^2)$**

4. **$5 + (10 + (9-3)^2)$**

5. **$((3+5)^2 \times 4) - 3^2$**

6. **$(3^2 + (14 \div 7 + 3^2))$**

7. **$20 + ((16-3) \times 2^2)$**

8. **$16 + (6 \times (4+3)^2)$**

9. **$(3^2 + (10 \div 2 + 3^2))$**

10. **$((9-2)^2 + 4) - 3^2$**

Name: (creator) _____ Date: _____
Name: (problem solver) _____
Exit Slip
Create a problem similar to the problems we completed during class, and exchange your problem with a partner. Then solve your partner's problem.

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