

# OER IN MATHEMATICS PROFESSIONAL DEVELOPMENT PROJECT

## LESSON PLAN

### TOPIC OF THE LESSON:

Using the Order of Operations to Evaluate Expressions

### STANDARD(S)/LEARNING RESULT(S):

**ALGEBRA: Symbols and Expressions**

Create and evaluate expressions using real numbers.

- Order of Operations

### GOAL(S) OF THE LESSON:

*What do you want the students to know and be able to do? What overarching questions do you want them to be able to answer?*

We want students to be able to understand the meaning and effects of the order of operations in order to manipulate and solve expressions. The rules of this convention include the fact that multiplication and division are always done before addition and subtraction (given there are no parentheses or exponents involved.) Exponents are also evaluated before addition and subtraction since they are really just a form of repeated multiplication. The order for evaluating is parentheses then exponents, then multiplication and division (first left to right) then addition and subtraction (whichever comes first left to right).

- Students should be able to follow the correct order of operations to simplify an expression.
- Students should understand that the expression to be solved depends on the problem itself and where the operations are located within the problem.

### CONTEXT

*What should students know to engage in the lesson?*

Students should have an understanding of the symbols for addition (+), subtraction (-), multiplication ( $\times$ ,  $\bullet$ , or  $*$ ), division ( $\div$  or  $/$ ) and parentheses ( ). Students should also be able to recognize the exponent convention  $\rightarrow$  **Base**<sup>exponent</sup> for example students should be able to interpret  $5^3$  to be  $5 \times 5 \times 5$ .

### ASSOCIATED STUDENT DIFFICULTIES

*Describe known misconceptions (overgeneralizations, common errors, and misunderstandings) associated with the content in this lesson?*

Sometimes students think that multiplication comes before division and addition comes before subtraction rather than understanding that multiplication and division are on the same level and are evaluated left to right as are addition and subtraction. Some instructors use the mnemonic PEMDAS, which can contribute to misunderstanding if it is not explicitly stated to evaluate left to right when the operation is at the same level.



## PLANNING FOR DIFFERENTIATION

*Describe how the lesson design incorporates a plan for differentiation.*

Students grouped across abilities and degrees of understanding (not same ability groupings) to minimize students with similar misconceptions within the same group.

Possible pre-activities

- Engage students in talking about what will be done first, second, third, and so on before actually completing the computation.
- Have students create expressions and/or equations given a set of verbal statements. Repeat using written directions.

## PRE/POST ASSESSMENT

*Review what you want students to know and be able to do. How will you determine what they know and don't know? How will you determine that they have met the target? (Describe the pre/post assessment)*

Pre Lesson Probe: Administered to determine if students understand the meaning and effects of the order of operations in order to manipulate and solve expressions. The assessment includes 4 examples in which students determine the correct solution to expressions. They are also asked to explain their thinking related to the solution.

- Review results to determine specific instructional interventions.

Post Lesson Assessment: Administered to determine if students changed their understanding of the meaning and effects of the order of operations.

## MATERIALS & RESOURCES

*Describe any tools and resources that are needed to support the lesson.*

- Student Exploration

## TECHNOLOGY TOOLS / APPLETS

*What technology tools, applets, and/or resources you will use for this lesson?*

- Order of Operations (4) Applet: <http://maine.edc.org/file.php/1/tools/OrderOperations4.html>
- Projector
- Laptops
- Smartboard (optional)

*What management strategies will you utilize during the lesson?*

- Load the applet on the teacher computer before having students launch the applet
- Put the link on the classroom wiki (or blog, online bookmarks, or other management site)

Teacher Notes:

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LESSON DESCRIPTION	
PREPARATION	<p><i>What resources will you need? What type of preparation is needed before you can begin the lesson?</i></p> <ul style="list-style-type: none"> <li>- Clickers, Laptops</li> <li>- Print Exploration/Recording Sheet for exploring order of operations</li> <li>- Print Pre and Post Lesson Probes (Or make sure the probes are in an online administration site such as Google Forms)</li> <li>- Approximate Time: 1 1/2 hours</li> </ul>

	LESSON	QUESTIONS FOR LEARNERS	NOTES / REFLECTIONS
INTRODUCTION	<p>Steps of the lesson: learning activities (and time allocation)</p> <ul style="list-style-type: none"> <li>• Students complete the probe for the pre-assessment (10 min).</li> <li>• Students use the clickers to get class results on each question from the probe. Teacher explains the significance of the results (5 min).</li> <li>• Teacher picks out the questions from the probe that have the most discrepancy (5 min).</li> </ul>	<p>What is the significance of the information gathered by using the clickers? What do the percents/numbers represent and mean to the class? How can we use this information?</p>	<p>1) Review probe prior to instruction, make observations about misconceptions</p> <p>2) Clicker set up, have student data put into graphs</p>
CORE INSTRUCTION	<ul style="list-style-type: none"> <li>• Students answer the first few questions from the exploration (5 min).</li> <li>• Class discussion on the first few questions from the exploration (5 min).</li> <li>• Students use the applet to answer the questions from the exploration (25 min).</li> </ul>		

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	LESSON	QUESTIONS FOR LEARNERS	NOTES / REFLECTIONS
CORE INSTRUCTION (CONT.)	<ul style="list-style-type: none"> <li>Class discussion of the questions in the exploration (10 min).</li> <li>Class discussion on the final part of the exploration to come to a generalization (10 min).</li> <li>Students complete the probe again for the post assessment (10 min).</li> <li>Teacher and students go over the solutions to the probe (10 min).</li> <li>Final wrap up over lesson (10 min).</li> </ul>	<p>What did you notice about the order of operations that was performed on the left hand expression? How was this order different on the right hand expression? Why do you think this occurred?</p> <p>Were the values of the two expressions ever equivalent? When did this occur? Why do you think this occurred?</p> <p>Were the values of the two expressions ever different? When did this occur? Why do you think this occurred?</p>	
CLOSURE	<p>Students will retake the probe:</p> <ul style="list-style-type: none"> <li>Students will complete on paper first</li> <li>Students then will complete using clickers.</li> </ul>	<p>Do you think there is a correct order of operations when solving a problem with more than one operation? What do you think the order is?</p> <p>Does it always matter what the order of operations is? Why?</p>	<p>Review data</p> <p>Reflect on remaining areas of difficulty</p> <p>Determine next instructional steps</p>