**Order of Operations**

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**People:**

Students in college who do not have enough skills in math to addend college algebra classes

Their learning goal is to become familiar enough with basic math skills to successfully complete a beginning Algebra course.

The majority of students are proficient with technology and have access to wifi at home.

**Objective:**

By the end of this lesson (two classes), students will:

Effectively solve multi-step order of operations problems (including critical thinking word problems) with 100% mastery

**CCRS Standards:**

Mathematics, Level C

* Operations and Algebraic Thinking
* Use the four operations with whole numbers to solve problems. (4.OA.3)

Mathematics, Level D

* Expressions and Equations
* Solve real-life and mathematical problems using numerical and algebraic expressions and equations. (7.EE.3)

**Strategy:**

The "flipped classroom" model is how I set up the class. Students sign in to the CCV online classroom page, find the current week's assignment, and preview the week's work prior to class.

The Order of Operations lesson includes:

-An explanation and example of how to solve an "OofO" problem,

-An article about applying "OofO" to back to school shopping,

-A game about solving "OofO" problems, and

-A problem to have them bring in to class

**Technology:**

The college is supplying the class with laptops and Internet access to use during class, so that we will be able to use interactive simulations, watch videos, and share answers using Google Docs (that could be projected) or software like PollEverywhere, where students can text answers to questions and everyone can see the results immediately.

Using videos and interactive math manipulatives will help the students that may not be comfortable with technology as it can be projected onto a large screen or wall. For the students that are comfortable with technology, they can be paired with those with limited tech skills.

**Formative Assessment:**

Students will have a baseline score at the beginning of the semester, and will take formative and informal assessments throughout the semester. Talking to students, having them pair up and take a test, using the tools, could demonstrate student understanding.

Using the "Millionaire" game as an assessment tool might help students build both comprehension and fluency of the math concept.

**Materials Needed:**

* Two class periods (1.25 hours/class)
* CCV Moodle Page
* “Operational Order” lesson
* “Back to School Shopping: Applying the Order of Operations” article, found at [Math for Grownups](http://www.mathforgrownups.com/back-to-school-shopping-applyin-the-order-of-operations/)
* “The Order of Operations Royal Rescue” game, found at: [Order of Op play](http://mrnussbaum.com/orderops-play/)
* “The Order of Operations Millionaire Game,” found at: [Millionaire](http://www.math-play.com/Order-of-Operations-Millionaire/division-millionaire.html)
* Print out “Order of Operations cards”, found at: [Order of Operations in reality](http://nzmaths.co.nz/sites/default/files/OrderOfOperationscm1.pdf)
* Additional Practice: [Which Operation and why?](http://nzmaths.co.nz/sites/default/files/OrderOfOperationscm2.pdf), [Practice, page 1-2](http://cdn.kutasoftware.com/Worksheets/Alg1/Order%20of%20Operations.pdf)
* [PEMDAS rap](https://www.youtube.com/watch?v=zanq7gmXY88)

 **Lesson:**

1. Students assigned “Operational Order” lesson on CCV prior to class.
	1. Includes: “Back to School Shopping” article and “Royal Rescue” game
2. Introduce topic: review game and article. Discussion about thoughts?
3. Begin by distributing one line from “Order of Operations cards” to each student in the class. Students brainstorm to form groups of related statements and agree on the logical order of their action statements. Have groups present their action statements in order to the whole class and defend each step in order.
4. Why is order important? Give students this problem, ask them to solve it independently:

[ 8 ( x + 1 ) + 2 } ] (3 / 2 \* 2 ) 2

Ask for solutions

Answer: 72x + 90

1. Solve this problem: Say for instance, you go to the supermarket. Suppose peanuts cost $3.00 per pound and a bottle of water is 1 dollar. You get yourself 2 pounds of peanuts and 1 bottle of water.

How much money do you pay?
	1. Answer: Since 1 pound of peanuts is 3 dollars and you bought 2 pounds, peanuts cost 6 dollars. Add that to the amount you pay for the water (1 dollar), you paid a total of 7 dollars.
	You may have figured this out without any major problems. However, if I present you with the following equation, which model the problem above, you might have a tendency to add 3 to 1 and multiply the result by 2.

	2 × 3 + 1

	Doing this will give 8 and it is not equal to 7. Discuss differences. (<http://www.basic-mathematics.com/order-of-operations.html>)
2. Joe buys 2 shirts at $8.00 each. He also buys a pair of jeans for $20.00 that gets a $3.00 discount. Write a numerical expression and solve.
	1. (2 x $8 shirts) + ($20 jeans – $3 discount) = X dollars total cost

(2 x 8) + (20 – 3) =

16 + 17 =

$33

* 1. (<http://lessonplanspage.com/MathCIOrderOfOperationsPhotoStory68.htm/>)
1. Game: Students practice putting () in order.
2. Working in pairs, students are given the first two or three problems from here ([Real life order of operations problems](http://www.bwccschool.org/ourpages/auto/2013/10/11/53200611/Order%20of%20Operations%20WP.pdf)), answers are discussed. Rest assigned for homework before second class.
3. Allow students to practice Order of Operations using above practice. Create their own problems and share with class. Discuss.
4. Assign “Millionaire” game as a formative assessment to assure students can “become a Math Millionaire!”

Day 3: Class needs additional practice

Do “Millionaire” as a class again. Discuss problems.

Using [Rules of Exponents](http://www.mcckc.edu/services/tutoring/tutoringbtc/files/exp_rad_log/Exponent_Rules_%26_Practice.pdf) and [Variables and Exponents](http://cdn.kutasoftware.com/Worksheets/Alg1/Properties%20of%20Exponents.pdf), class needs to practice the rules, especially with the variables and exponents. Allow enough time for all students to be able to solve several problems together, independently, and be able to answer additional problems.