Lesson: Order of Operations Flow Charts

Lesson Overview In this lesson, students will work in groups to order a flowchart for solving problems involving order of operations. They will be given index cards with all the steps to solve the problem in order. They will then need to show the work to solve the problem. If they finish early, they will write the steps to solve a separate problem, creating their own flowchart. NOTE: Students began working with order of operations in sixth grade and have been working with integer operations recently in seventh grade. They will use these skills to complete the steps to solve problems.

Standards Addressed
6.EEI.1 Write and evaluate numerical expressions involving whole-number exponents and positive rational number bases using the Order of Operations.

Disciplinary Literacy Strategies
Elbow Partners

Computational Thinking
Tools:
Flow Charts
Cornerstone(s) Addressed:
- Decomposition - students will be required to decompose a problem into its different parts to be able to place the cards in order.
- Algorithmic thinking - is required for both the initial task (ordering a given set of cards with the steps on them to create a flow map) and the subsequent task (crafting the steps to create a flow map for a second problem).
- Abstraction - They will need to abstract information when they are asked to create their own flow map.

Lesson Plan
Time required: one (55-minute) class period
Focus Question: What are the steps needed to follow the order of operations correctly?
Disciplinary Vocabulary: exponent, order of operations, operations
Materials needed:
- index cards (per student) for students to write the steps for the order of operations
  - Card Stock pages by star category (1 per type per pair/group of students) to be cut out by star type and used when creating a flowchart by problem
    NOTE: EACH "star" type sheet goes with the star type problems. For example, the operations and solutions for the 1-star cardstock handout goes with the first set of 4 problems under 1-star on the problem sheet.
- Handout with problems by star categories
- Handout with justification chart (in a sheet protector so students can write and erase easily OR a single copy of a handout for students to copy or duplicate on paper as they work
- dry erase thin tip markers, vis-a-vis markers, or pencils (depending on chart type)

Engage
Students should find an elbow partner and discuss the prompt: "Why do we have rules? Why are rules important?" Have a couple of students share out their responses. Next, review the order of operations and integer rules with the class. The class will talk about the importance of needing to follow certain rules so that everyone gets the correct and justified answer when solving a problem.

Explore
The teacher will lead the class in working through several random integer problems and order of operations problems. After discussion and examples, students will write the order of operations on an index card as the teacher writes the order of operations on a board or chart for reference.

Explain
Students will work in groups to order the flowchart correctly to solve the problem. When they think they are correct they will get their work checked by the teacher and will then begin to solve the next starred set of problems mathematically.

Elaborate
The students will create their own flowchart using a different problem given to them by the teacher. NOTE: These problems can be found in the text, supplemental materials, or be randomly generated problems.

Evaluate
Students will review other groups flowcharts and see if they can follow the steps to solve the problem.

Assessment Notes The teacher will review the flowcharts with the students to make sure they have a complete understanding of the order of operations. Students will be expected to turn in their flowcharts (created in elaborate/evaluate) for a grade.

Teacher Biographical Information
Lesson Author: Melanie Cummings is a math teacher at Alston Middle School in Summerville, SC. She has been teaching 7th grade math for 8 years. She received her Bachelor's degree in Middle School Education with a concentration in Math & Science from the College of Charleston in December 2010. She went back to school for her Master's degree in 5-9 Math Education from Western Governor's University in August 2017.

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Add	Divide	Multiply
Multiply	Subtract	Multiply
Evaluate Exponents	Subtract	Multiply
Evaluate Exponents	Subtract	Add
Evaluate Exponents	Subtract	Add
Subtract	Evaluate Exponents	Multiply
Subtract	Add	-27
-29	-34	11003

**		
Evaluate Exponents	Evaluate Exponents	Evaluate Exponents
Multiply	Subtract	Divide
Multiply	Multiply	Divide
Subtract	Subtract	Add
1684	0	-115

*** AND ****		
Divide	Evaluate Exponents	Evaluate Exponents
Multiply	Add	Multiply
Multiply	Divide	Add
Subtract	Evaluate Exponents	Subtract
Add	Add	Multiply
Subtract	Add	Evaluate Exponents
90	24	700
11680		

PART 1:

Cut out the steps for ***** (1-star problems) from the cardstock. All cards will be used for the 4 problems. The answers are provided.

1) $3 - 10 \bullet (5 - 3)^2 + 10$
2) $(7 - 2^2 \bullet 7) - 2 \bullet 4$
3) $8 - (14 \div 7)^3 \bullet 6 + 6$
4) $-8 - 11 \bullet (-2 - 8)^3 + 11$

PART 2:

Cut out the steps for ****** (2-star problems) from the

for the 3 problems. The answers are provided.

1) $-4 \bullet 3^2 - 3 + (-4)$
2) $8 \bullet (78 \div 13 - 6)^2$
3) $[-84 \div (-7)]^3 - (-11) \bullet (-4)$

> Use one justification flowchart for each problem.

cardstock. All cards will be used

> Use one justification flowchart for each problem.

PART 3:

Cut out the steps for ******* (3-star problems) AND   ******** (4-star problems) from the

cardstock. All cards will be used for the 4 total   problems. The answers are

provided.

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1) $\{10 + [-90 \div (-5)]\} \bullet 5^2$
2) $[10 + (16 \div 8)^3] \bullet 5$

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1) $[5 - (4^2 -)] \bullet (4 - 8)$
2) $[7 + (12 + 6)^3] \bullet 2 + 2$

> Use one justification flowchart for each problem.

JUSTIFICATION CARD – One per problem

Simplify	Justification Card

PART 1:

Cut out the steps for ***** (1-star problems) from the cardstock.

All cards will be used for the 4 problems. The answers are provided.

1) $3 - 10 \bullet (5 - 3)^2 + 10$ = -27

Subtract, evaluate exponents, multiply, subtract, add

2) $(7 - 2^2 \bullet 7) - 2 \bullet 4$ = -29

Evaluate exponents, multiply, subtract, multiply, subtract

3) $8 - (14 \div 7)^3 \bullet 6 + 6$ = -34

Divide, evaluate exponents, multiply, subtract, add

4) $-8 - 11 \bullet (-2 - 8)^3 + 11$ = 11003

Subtract, evaluate exponents, multiply, add, add

Use one justification flowchart for each problem.

PART 2:

Cut out the steps for ****** (2-star problems) from the cardstock. All cards will be used for the 3 problems. The answers are provided.

1) $-4 \bullet 3^2 - 3 + (-4)$ = -115

Evaluate exponents, multiply, subtract, add

2) $8 \bullet (78 \div 13 - 6)^2$ = 0

Divide, subtract, evaluate exponents, multiply

3) $[-84 \div (-7)]^3 - (-11) \bullet (-4)$ = 1684

Divide, evaluate exponents, multiply, subtract

Use one justification flowchart for each problem.

PART 3:

Cut out the steps for ******* (3-star problems) AND ******** (4-star problems) from the cardstock. All cards will be used for the 4 total problems. The answers are provided.

1) $\{10 + [-90 \div (-5)]\} \bullet 5^2$ = 700

Divide, add, evaluate exponents, multiply

2) $[10 + (16 \div 8)^3] \bullet 5$ = 90

Divide, evaluate exponents, add, mulitply

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1) $[5 - (4^2 -)] \bullet (4 - 8)$ = 24

Evaluate exponents, subtract, subtract, subtract, multiply

2) $[7 + (12 + 6)^3] \bullet 2 + 2$ = 11680

Add, evaluate exponents, add, multiply, add

Use one justification flowchart for each problem.

<p align="center">**SAMPLE** **JUSTIFICATION CARD – One per problem**</p>

Simplify	Justification Card
$3 - 10 \bullet (5 - 3)^2 + 10$	
$3 - 10 \bullet (2)^2 + 10$	SUBTRACT
$3 - 10 \bullet 4 + 10$	EVALUATE EXPONENTS
$3 - 40 + 10$	MULTIPLY
$-37 + 10$	SUBTRACT
-27	ADD