

General Information

Lesson Parts & Duration

Total Duration: 1 hour

- Playing with Parentheses, Brackets and Braces: (Minimum and Maximum Values)

Subject(s)

- Use parentheses, brackets, or braces in numerical expressions, and evaluate expressions with these symbols (5.OA.A.1).

Objective

- Students will be able to apply previous knowledge about the order of operations (PEMDAS) to new situations.
- Students will be able to evaluate numerical expressions with parentheses, brackets, and braces.

Materials

- blank paper (1 per student)
- rulers (1 per two students)
- pencil & crayons/colored pencils
- document camera/projector or whiteboard
- **Optional:** printable “Break Up Your Day” brain/movement break ideas (page 6)

Instructional Setting

- Students should be seated with or near another student for partner work.

Throughout this lesson, you will find:

- ☀ **Scripted Text** indicates things that need to be said directly. Bullets starting with a “T” followed by *italicized type* indicate scripted text
- ☀ **Clarifiers** within scripted text are in orange
- ☀ **Teacher Directions** indicate things you should be doing
- ☀ **Side notes** provide helpful hints, ELL strategies, differentiation and information
- ☀ **Break Up Your Day** (Brain/Movement Breaks) are in green boxes (at the end)

Remember!

Quality over quantity. All components do not have to be accomplished; lessons may be ended at any time and resumed later.

Instructional Plan: 60 minutes

Introduction

- T* Today we will talk about numerical expressions and how we can read them correctly.
- T* You know how when we learn to read, we learn that each punctuation mark gives our text different meaning.
- T* These punctuation marks tell someone what needs to be done, like when a reader sees a comma, they know they must pause or end punctuation like a period tells a reader to take a longer pause.
- T* Similarly, in math, we use symbols as well; for example, a plus sign and a minus sign.
- T* But you may already know that there are some other symbols as well.
- T* Can anyone think of an example of another mathematical symbol?
- T* Turn and tell a partner sitting next to you all of the mathematical symbols that you know.

Provide about 30 seconds for students to discuss. Monitor to ensure student conversations are on topic.

- T* Who would like to share their answers with the class? **Call on several students.**
- T* Addition sign, subtraction sign, multiplication sign, division sign, fraction line, percentage, decimal point, exponents.
- T* All these are symbols that mean that we need to calculate something.
- T* We also use symbols like parentheses, brackets, and braces to help us separate our expression into different groupings.
- T* There is also a particular order to solve when using these symbols.
- T* When using the order of operations we first solve the parentheses (), then the brackets [], and last the braces { }. **Draw these on the board for students to use as a reference later.**

Directions for the Activity

Pass out 1 piece of blank paper to each student. You will be modeling each step for students to copy using either the document camera or a whiteboard.

- T* Write your name and date in the top right hand corner of your paper. **See example & model so students can follow.** Name & Date
- T* Write the title: "Evaluating Expressions with Parentheses, Brackets and Braces." **Evaluating Expressions with Parentheses, Brackets, and Braces**
- T* Remember that PEMDAS helps us to remember the order in which to solve our expression. **Expression: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$**
- T* Please write the word "Expression:" and after it write the expression: " $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$ "
- T* First, we will solve this expression just using PEMDAS, we will not be adding any extra symbols.
- T* I am going to give you a few minutes to attempt to solve it on your own first and then we will discuss how you solved it and what answers you all got.

Give time to complete this task. Monitor students and provide assistance as needed.

- T* Now that everyone has had a chance to solve this expression, who would like to come up and share the steps you took and what your answer was? **Call on a student to share.**
- T* Did anyone arrive at a different answer? **If any students raise their hands, ask them to share how they solved the problem as well.**
- T* Now I would like us all to quickly solve the problem together and we will see whose answer was correct!

T The “P” in PEMDAS tells me to look for parentheses, since there are none in this expression I will move onto the “E.”

T The “E” stands for exponents, I see two sets of exponents in this expression: 4^2 & 2^3 .

Name & Date

T Remember that when solving for exponents it does not indicate to multiply by that number, instead it tells us how many times the whole number should be multiplied by itself.

Evaluating Expressions with Parentheses, Brackets, and Braces

Expression: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$

T Therefore, 4^2 is 4×4 , which equals 16.

No extra symbols: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 = 16 + 2 + 80 = 98$

T When I am solving expressions with many steps, I like to indicate the answers to the portions I am solving below.

$$4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$$

T So, below 4^2 I will write 16, and below 2^3 I will write 8 because $2 \times 2 \times 2 = 8$.

$$16 + 6 \times \frac{1}{3} + 8 \times 10 =$$

$$16 + 2 + 80 =$$

$$18 + 80 = 98$$

T Since there are no more exponents we are ready to move on to the next letters which are M & D.

T Multiplication and Division will happen at the same time, start at the left and solve any multiplication or division problems you encounter.

T After solving for our exponents our expression now reads: " $16 + 6 \times \frac{1}{3} + 8 \times 10 =$ ".

T I see 2 multiplication problems that need to be solved: $6 \times \frac{1}{3}$ and 8×10 .

T Just like in the last step I will indicate my answers below.

T I can solve $6 \times \frac{1}{3}$ or I can first divide 1 by 3 to convert it from a fraction into a decimal.

T $\frac{1}{3}$ is .3333, so $6 \times .3333 = 2$, I will record a 2 below $6 \times \frac{1}{3}$.

T Next, I will solve 8×10 , which I know is 80.

T So now my expression reads: " $16 + 2 + 80 =$ ".

T The final step in order of operations is adding or subtracting.

T I say “or” because just like multiplication and division, you will decide what to solve first by working left to right.

T First, we will solve $16 + 2$, which is 18 and then add 80, which is 98.

Using Symbols to Create Minimum & Maximum Values

T As you know, adding symbols like parentheses, brackets, and braces into an expression will change the meaning or the value of an expression, just as adding different punctuation marks into a sentence can change the way a sentence is read or even its meaning.

T Now you will put parentheses, brackets, and braces into an expression to try to find the minimum value it.

T Then, by placing the symbols in different places you will try to achieve the maximum value of the expression. **See example & model so students can follow.**

T This can be very challenging because you will need to try a variety of placements.

T It is okay if your first attempt gets you the maximum value, when you were trying to find the minimum instead.

T Your goal is to find both the minimum and the maximum.

T You are going to work with a partner who is wearing the same color as you.

T When I say, “Go”, you will stand up and find someone to work with who is wearing the same color as you are today.

T Ok, Go!

Give time for students to find partners. Monitor students and ensure they are being respectful when choosing a partner and that everyone is paired up. If there is an odd number of students you will need to create a group of 3.

- T* Don't forget to show your work.
T If you have any questions, do not hesitate to ask me!
T Here is the expression: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$
 See example & model for answers.

Give time to complete this task.

Monitor students and provide assistance as needed.

Name & Date

Evaluating Expressions with Parentheses, Brackets, and Braces

Expression: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 =$

No extra symbols: $4^2 + 6 \times \frac{1}{3} + 2^3 \times 10 = 16 + 2 + 80 = 98$

Minimum: $[(4^2 + 6) \times \frac{1}{3}] + 2^3 \times 10 = 22/3 + 80 = 87.3$

Maximum: $[(4^2 + 6) \times (\frac{1}{3} + 2^3)] \times 10 = 22 \times 8.33 \times 10 = 1,832.6$

- T* Now that you have had some time to work on the numerical expression with your partner, let's take some time to share your solutions.
- T* Who would like to begin? If you have the same solution on your paper, show me a thumb instead of interrupting your friends. Call on a student for each part of the problem. Write their ideas on the board. Answers shown on the right. Students' answers may vary depending on how they chose to input the symbols. The maximum value is 1,832.6 and the minimum is 87.3.
- T* Even though some of you were unable to find the exact minimum answer and the exact maximum, you should be proud if you were able to find multiple answers by moving around the different symbols in your expression.
- T* Ok, so now that we know how to play around with parentheses, brackets, and braces, we will move on to the next problem.
- T* We have solved an expression to find a minimum and a maximum, now I will give you a numerical expression with an answer.
- T* Your task is to place the parentheses in necessary spots to make the equation true.
- T* For example: $2 + 3 \times 4 = 20$; I need to rewrite it with parentheses as, $(2 + 3) \times 4 = 20$. Write example on the board.
- T* However, your problems will be a bit more difficult.
- T* Let's see if you can solve these problems by adding parentheses to make the expression true.
- T* Remember to show your work step by step.
- T* Please copy this equation on your paper and then you may begin.
- $6^2 + 15 - 4 \times 0.25 \times 7 + 1 = 58$

Give time to complete this task. Monitor students and provide assistance as needed.

- T* Now that you have had a chance to work through this problem, who would like to share their answer with the class?
- T* If you came up with the same solution, show me a thumbs up instead of calling out. Call on a student to answer. Write their ideas on the board.
- T* Make sure you also tell the class what steps you took to arrive at your answer. Indicate what parentheses you added and the steps you took. Record steps on the board. Repeat with more volunteers. Answers are on the model sheet.

- T** Great! Now we will move on to the next one.
- T** We will use the same problem solving skills for the next problem.
- T** Are you ready? This one will be tougher, so take your time.
- T** On your paper please copy this equation: $14 + 68 \times 2 \times 4 \times 3 = 480$.
- T** Just like the last problem, you will need to add parentheses to make the equation true.

Give time to complete this task. Monitor students and provide assistance as needed.

T Who would like to volunteer and explain where the symbols should go? If you agree with the person speaking, don't forget to put your thumb up. **Call on a student to answer. Write their ideas on the board.**

Place the missing parentheses to make the equation true:

$$6^2 + 15 - 4 \times 0.25 \times 7 + 1 = 58$$

$$6^2 + (15 - 4) \times 0.25 \times (7 + 1) = 58$$

T Ok, can you tell me why you decided to place these symbols there? **Record steps on the board. Repeat with more volunteers. Answers are on the model sheet.**

$$14 + 68 \times 2 - 4 \times 3 = 480$$

$$[(14 + 68) \times 2 - 4] \times 3 = 480$$

T Great job everyone! The final problem that we will work on before the break is comparing the same numerical expression, but with different placement of the symbols.

T For example, $(2 + 3) \times 4 > 2 + (3 \times 4)$.

T What do you notice about this statement? **Call on a student to answer.**

T We will solve both sides, show our work and then compare the answers.

T Then, we will put a less than, greater than or equal sign to make the expression true.

T Here is your problem! $(3^2 - 4) \times 6 - \frac{1}{2} \quad ? \quad 3^2 - 4 \times (6 - \frac{1}{2})$

Give time to complete this task. Monitor students and provide assistance as needed.

T Ok, who would like to tell me how you compared these expressions? **Record steps on the board. Repeat with more volunteers. Answers found on the right.**

T As you can see, moving the parentheses around can have a big impact on the answer.

$$\begin{array}{rcl} (3^2 - 4) \times 6 - \frac{1}{2} & > & 3^2 - 4 \times (6 - \frac{1}{2}) \\ 5 \times 6 - \frac{1}{2} & > & 9 - 4 \times 5.5 \\ 29.5 & > & -13 \end{array}$$

T Thank you to those of you who volunteered to share.

T Now I would like to collect your papers so that your teacher can see your progress.

T Make sure you have written your name on your paper before you hand it in. **Collect papers and use them as exit slips for this segment. Give them to the teacher to review later.**

T Great! Now that we have worked so hard, we can finish this lesson with a bit of movement!

T So, let's get up and stretch!



Make sure to "Break Up Your Day!"



Now is a great time to take a break and get students re-energized.

See our list of engaging movement and brain break ideas to get your students moving and ready to refocus! (see page 6)

Make sure to “Break Up Your Day!”

These can be used in the middle of a lesson or at the end of your lesson.

Here are a few engaging movement and brain break ideas to get your students moving and ready to refocus!



Break Up Your Day: Math Outside!



- Students take scratch paper/pencil and find multiplication problems outside.
- Students write multiplication problems they see on the playground. (examples: 3 basketball courts times 6 students equals 18 basketball players, four hopscotches times 5 students equals 20 students playing hopscotch.)



Break Up Your Day: Thumbs Up!



- Student is called on (use name cards or equity cards if available) to state a rounding observation from within the classroom using numbers from 1 to 500.
- Other students signify whether they understand and agree with the observation. (Example: “There are approximately 100 pencils in the classroom because each student has 3 pencils and there are 32 students. 3 times 32 is 96 and 96 rounds to 100.)
- Tally how many students agree with the rounding statements.
- The statement with the most votes or Thumbs Up is the “Round Up Captain”!



Break Up Your Day: Body Stretches!



10 minutes

FORMATION: Standing at desks

- Have students begin the day with a series of simple activities lasting 30 seconds or more: jumping jacks, knee lifts, flap arms like a bird, hopping, scissors (feet apart then cross in front, feet apart then cross in back)...
- Follow each activity with a basic stretching movement:
- Reach for the sky runner’s stretch
- Butterfly stretch (sit with bottom of feet together)
- Knee to chest, rotate ankles, scratch your back

Hold stretches for 10 - 30 seconds. Repeat a different simple activity followed by a new basic stretch as many times as desired.