## Socks and Shoes

## Summary

Activities teach students a mnemonic device to remember the order of operations and help them see how order of operation applies to nearly everything they do during the day.

Group Size
Small Groups
Materials
Invitation to Learn
Math Journals
Pencils
Socks and Shoes
Socks
Shoes
Math journals
Pencils

## Background for Teachers

Before beginning this lesson, teachers must have a sound understanding of why the process of order of operations is important in math and how to correctly perform it. Order of operations is important in math because it helps assure us that math works the same way for everyone, regardless if they are students in Utah or professors in Japan. Through this understanding; we can safely say that an addition or multiplication problem solved correctly will always result in the same answer. As educators we need to help our students understand that they will always get the right answer if they follow the process correctly.
A common misconception is that multiplication must be performed before division. When we use the mnemonic Please Excuse My Dear Aunt Sally, it is often assumed that because we say My (multiplication) before Dear (division) that we need to multiply first. However, multiplication and division are on the same level and should be performed based on their position in the order of operations problem. This same principle applies with addition and subtraction. The correct order of operations starts with working in parentheses, then looking for exponents, and then returning to the left or beginning of the equation and working your way towards the right as you solve. Once you have performed the multiplication or division steps, you return the beginning of the problem and work your way left to right, performing addition or subtraction in the proper order. This will allow you to answer the problem correctly.
For these activities, we are going to focus on order of operations problems that deal with addition, subtraction, multiplication, and division. Students need to be familiar with basic multiplication and division facts and need to be taught about parentheses. Exponents are not found in the Utah State Math core until the 5th grade and so we are not going to be working with problems that have exponents in them.

## Intended Learning Outcomes

2. Become effective problem solvers by selecting appropriate methods, employing a variety of strategies, and exploring alternative approaches to solve problems.
3. Communicate mathematical ideas and arguments coherently to peers, teachers, and others using the precise language and notations of mathematics.

Instructional Procedures
Invitation to Learn
The most commonly used mnemonic for order of operations is Please Excuse My Dear Aunt Sally. Instead of teaching this mnemonic to the class, the purpose of this invitation to learn is to help students develop ownership for their learning as they work together to develop a unique classroom mnemonic of their own liking.
The first step in this process is to say, "Today we are going to create a mnemonic that is going to help us as we learn about order of operations. Does anyone know what a mnemonic is? A mnemonic is a phrase or saying that makes information easier to remember. Has anyone ever heard of "righty-tighty, lefty-loosey"? How about "Every Good Boy Does Fine"? These are mnemonics that help us remember how to tighten or loosen a bolt and the order of musical notes on a treble staff. Using these mnemonics makes it easier to remember these things."
Go to the board and write order of operations at the top of the board. Explain that there are five steps in solving order of operation problems. (Don't worry about explaining the steps in detail. We will do that in greater detail later.) As you introduce the steps, write the steps on the board. The steps are Parentheses, Multiplication, Division, Addition, and Subtraction. Remember that our students are not going to be using exponents in 4th grade and so we do not need to include exponents in our mnemonic.
Next say, "Now we need to come up with a mnemonic phrase that will help us remember the steps when solving order of operations problems. Do you remember what a mnemonic phrase is? It is a phrase or saying that helps us remember. The most common mnemonic for order of operations is Pardon My Dear Aunt Sally (The mnemonic changes when the E for exponents is taken out), but that's no fun. Let's come up with a fun mnemonic. For example, we could say "Pink Monkeys Dance Around Santa" or "Pretty Muffins Dream About Snickerdoodles."
The next step can be done either as a whole class process or as a think-pair-share activity. We will focus on the think-pair-share activity because it gives every student an opportunity to participate. Begin by saying, "We are going to do this by doing a think-pair-share. First, you are going to use your math journals and write down a fun mnemonic phrase. Then, you are going to share your mnemonic phrase with your neighbor."
While the students are thinking and sharing, go around the room and put the class into groups of six. Then say, "Now that you have had a chance to share with your neighbor, you are going to get into your groups and share again. When you have all had a chance to share, you need to pick one mnemonic phrase from your group that you feel would be the most successful as our class saying." When the students have decided, have each group share the mnemonic phrase. Write each mnemonic on the board and then have the class vote on which mnemonic phrase they would like to use. Once the mnemonic phrase is decided, have the students write down the phrase in their math journals.
Instructional Procedures
Socks and Shoes
The purpose of this activity is to bring students' background knowledge into the lesson and to allow them to see how order of operation applies to nearly everything they do during the day.

Divide the class into 4-6 groups. Students need to bring their math journals and a pencil to their group. You are going to need 1 sock and 1 shoe for every group. For health reasons do not use student socks or shoes.
Begin by saying, "I am going to be passing out two objects to every group. Before you do anything with these two objects, I want each group to discuss how these two objects relate to each other." Pass out 1 sock and 1 shoe to each group. Give them 2 or 3 minutes to discuss how a sock and shoe relate to each other.
Once you have done this, have each group share their ideas with the rest of the class.

Say, "Now that we have talked about how a sock and shoe relate to each other, I want you discuss the correct way of putting on a sock and shoe. Come up with a series of steps that you need to follow to do it correctly. When you think you have the correct way, write the steps down in your math journals. Be ready to share your ideas." Give the students 5 minutes to write down their steps.
When they are done, have each group share their steps. Compare the order of steps from each group and come up with a class list of the proper and correct manner of putting on your socks and shoes.
Now ask, "Why is important that you have steps as you put on your socks and shoes? What would happen if you didn't follow the steps correctly?" Call on some students to share their ideas, and then say, "Now for some fun. I am going to give every group 5 minutes to come up with as many creative ways to use your sock and shoe without using them correct way or following the steps. Write down your ideas in your math journal. Remember, have some fun and be creative." Don't be afraid of silly or goofy answers because this is what you are looking for. As your students finish their lists, say, "I need you to choose your top three ways that your group thinks no one else has thought of, and label them 1, 2, and 3." Let them choose.
Say, "Now that you have come up with your top three ways, we are going to make a class list." As each group shares, write their answers on the board. Make sure that the students share their fun answers.
Once you have the list on the board, ask the class, "What do you notice about the ideas on the board?" Guide the students in their answers and help them understand that even though the ideas on the board might be funny, they are all wrong and that if we don't use socks and shoes properly, they "don't do what they are supposed to."
Then ask the class, "What other things do you do throughout the day that need to be done in a certain order?" Possible answers could range from brushing your teeth, getting dressed, eating breakfast or lunch, to even doing homework. Discuss what could happen if you stopped doing those things in the right order. Help the students understand that order is very important in everything that they do.
End this activity by saying, "Now that we have talked about order of operations and why we need to do things in order, you are going to write an entry in your math journal about why order of operations is important to you." If you want, you can have the students label their math journal entry "Why Order of Operations is Important to Me" or you can have them write their own title. Have the students turn in their journal when they are done to check for understanding.

## Extensions

Curriculum Extensions/Adaptations/ Integration
Advanced learners may design a science experiment that needs to follow a certain order of steps. They could demonstrate the results of doing it incorrectly (not following the steps in order) and then show what happens when the correct steps are followed.
This activity may be adapted by having students act out or model the proper way of doing things instead of writing the steps down.
This activity can be integrated into writing by having students write a story about what the world would look like if things were done out of order.
Teachers may use previously learned math concepts to demonstrate wheat happens when math problems are done out of order.
Family Connections
Students can discuss order of operations with their parents.
Students can come up with a list of activities that they do everyday as a family that are done in a
certain order. Then they can come up with ideas of what would happen if the family started doing things differently.

## Assessment Plan

Use the students' journals to assess their journal entry on "Why Order of Operations is Important to Me".
Listen and monitor group discussion on order of operations.
Make sure that students don't start wearing socks over their shoes.
Bibliography

## Research Basis

Millis, B.J. (2002). Enhancing learning-and more! through cooperative learning. Idea Paper \# 38. The Idea Center, 211 South Seth Child Road Manhattan.
In this article, Millis explains the power and effectiveness of cooperative learning. Not only is cooperative learning an effective teaching strategy, it "promotes a shared sense of community" in the classroom because "learning, like living, is inherently social." As students learn to work together through cooperative learning, they develop trust with each other and are given an opportunity to develop self-efficacy. As teachers come to understand how to implement cooperative learning, "student learning can be deepened, students will enjoy attending classes, and they will come to respect and value the contributions of their fellow classmates."
Willis, J. (2007). Cooperative learning is a brain turn-on. Middle School Journal. March pgs. 4-13 Judy Willis states in her article that research has shown that "in math collaboration, students learn to test one another's conjectures and identify valid or invalid solutions." This happens because cooperative learning provides students with the most opportunities to ask questions, express ideas and opinions, and come to conclusions that they might not otherwise have through whole group instruction. Teachers can increase student understanding and involvement by increasing the amount of cooperative learning in their classrooms.

## Authors

Utah LessonPlans

