Properties

Summary

Students will recognize model, and apply the identity properties of addition and multiplication, the commutative and associative properties of addition and multiplication, the multiplicative property of zero, and the distributive property of multiplication over addition with numerical expressions.

Main Core Tie

Mathematics Grade 3

Strand: OPERATIONS AND ALGEBRAIC THINKING (3.OA) Standard 3.OA.5

Additional Core Ties

Mathematics Grade 1

Strand: OPERATIONS AND ALGEBRAIC THINKING (1.OA) Standard 1.OA.3

Materials

Ti-73' and view screen
Colored paper for foldable
30 Linking Cubes for each pair
8 Large chart papers titled with property's name and a different color marker for each team

- True False response cards
- Overhead of song

Worksheets: Linking Cube Properties, Properties Examples Record

Background for Teachers

Enduring Understanding (Big Ideas):
Properties of operations
Essential Questions:

What is the product of any number and 1? What is the sum of any number and 0?
What affect does multiplying by 0 have on the product?
How does applying the commutative or associative properties affect the sum or product?
How can I demonstrate the use of the distributive property of multiplication over addition?

Skill Focus:
Recognize and model properties, apply properties in simplifying numerical expressions.
Vocabulary Focus:
Commutative property, Associative property, Multiplicative Identity Property, Additive Identity Property, distributive property.
Ways to Gain/Maintain Attention (Primacy):
predicting, music, technology, stories, analogy, manipulative, writing, movement, cooperative discussion, journaling.

Instructional Procedures

Starter review:

Simplify using the correct order of operations: $3(2 + 4) + 6 \div 3$
Find the GCF for 24 and 40
Write 2,300,000 using scientific notation
Describe the relationship between 8 and 64?

Lesson Segment 1 (launch): Properties metaphors

Explain to students that a property is a trait, attribute or characteristic that is proper to something. We all have certain "properties". For example one of my properties might be that I have brown hair and eyes, or that I can play the guitar. Have students do a Round Robin to tell their team members three properties for themselves.
Rational numbers and operations have properties too. For example 3 + 5 has the property that the order can be changed without changing the sum, so 3 + 5 has the same sum as 5 + 3.
As each of the following properties are introduced, say the introductory statement. Have students use response cards to show whether they believe the statement is true or false. Have students use the TI-73 to check expressions for equivalency.

Using the TI-73 to Verify Equivalency
The graphing calculator may be used to checking for equivalency using the test feature. Begin with a blank home screen. Push the keys. Type in the entire expression including the = sign by highlighting each symbol. When you are finished, curser to DONE. Push the key twice. A result of *0* means no probability the two expressions are equivalent.
Example: 3(4 + 6) = 3 x 4 + 6 will show a result of 0. When you A result of1 means you are *100%* correct in thinking the two expressions are equivalent.
Example: 3(4 + 6) = 3 x 4 + 3 x 6 will show a result of 1.
Note: If you have not downloaded the TI fonts on your computer, parts of this may appear as unexplainable punctuation type marks.

Lesson Segment 2: What is the product of any number and 1? What is the sum of any number and 0?
Introductory statements:

"When you add two numbers, the answer will never be one of those numbers." A + B A or B (false when adding 0)

"Any number multiplied by one will always result in that same number". (true)

Ask students if they have heard of "identity theft". Explain that we have safeguards to help us keep our identity such as social security numbers, PIN numbers, finger prints, codes and encrypted messaging. Rational numbers have TWO safeguards that allow them to keep their identity. For addition, 0 is the safeguard. Q. What is 5 + 0? 6 + 0? 150 + 0?.
Q. If zero is the identity theft protection for addition, what is the identity theft protection for multiplication? Discuss.
Analogy: 1 is to multiplication as 0 is to _____.
Have students make a foldable where flaps open in the center to make four sections like this
For all the properties in this lesson, have students use the Graphing calculator to check equivalency as explained in the Ti-73 instructions attached. After discussing a property, have students write three examples of that property and an explanation for how that property works under the appropriate flap of the foldable.
Students will also be asked to build Linker Cube models for commutative, associative and distributive properties, and to sketch, label, and represent examples on the attached " Linker Cube Properties" worksheet.
Complete the foldable for Identity properties leaving space for examples of multiplication by zero property.
Lesson Segment 3: What affect does multiplying by 0 have on a product?
Introductory statement:
The product of any number and 0 is always 0. (True)
Write the following expression on the board and ask them to do mental math: 81 x 34 x 0 x 29. Ask

them if they could use more numbers in the multiplication and ever come up with a product other than zero when one factor is 0 and multiplication was the operation. They may use their calculators to check.
Complete the Multiplication by Zero property section in the Foldable.
Lesson segment 4: How will applying the commutative properties affect the sum or product?
Introductory Statement:
Changing the order of the numbers when adding, subtracting, multiplying, or dividing will not change the answer. (False for ÷ -)
Explain the commutative property for addition by using Linker Cubes to model one or two examples such as taking 3 Yellow Linker Cubes and 5 Green Linker Cubes and combining them to make a stack. Whether you put the 3 yellow first or the 5 green first, you still have the same size stack. Order of addends doesn't affect the sum. Have students work with a partner to build, sketch and write expressions for three examples on the Linker Cubes Properties Worksheet.
Explain the commutative property for multiplication by using Linker Cubes to model examples such as 2 stacks of 3 cubes and 3 stacks of 2 cubes each. The total number of cubes will be the same. Order or factors doesn't affect the product. Have students work with a partner to build, sketch and write expressions for three examples on the Linker Cubes Properties Worksheet.
Students should use their graphing calculators to write these expressions using the two commutative properties and checking for equivalency using the test feature as explained earlier. Have students complete the sections in the Foldable for the commutative properties.
Lesson segment 4: How will applying the associative properties affect the sum or product?
Introductory Statement:
Changing how numbers are grouped when adding, subtracting, multiplying, or dividing will not change the answer. (False for ÷ -)
Explain the associative property for addition by using Linker Cubes to model one or two examples such as taking 3 Linker Cubes, 2 Linker Cubes and 5 Linker Cubes and grouping them to make two stacks. Whether you group the 3 with the 2, or the 2 with the 5 cubes, you still have the 10 total cubes. The grouping of addends doesn't affect the sum.
Ask students which would be easier in finding the total number of cubes since the associative property is used to make computation easier. Have students work with a partner to sketch and write expressions for three examples on the Linker Cubes Properties Worksheet.
To model the associative property for multiplication, use Linker Cubes to make a rectangular prism 2 x 3 x 4. Whether you group the (2 x 3) for the Base area, then multiply by the height of 4 or group the (3 x 4) as the Base area and then multiply by 2, the number of cubes in the prism remains the same. These are a challenge for students to build unless you work with them to build the base first, then build the height. You may try assigning each team to work together build a prism, then showing the class that regardless of the orientation, the total cubes is the same. Students will find these prisms easier to demonstrate: 1x2x3, 1x2x4, 1x2x5. The grouping of factors doesn't affect the product .
Have students work with a partner to sketch and write expressions for the examples on the Linker Cubes Properties Worksheet.
Students should use their graphing calculators to write expressions using the two associative properties and checking for equivalency using the test feature as explained earlier. Have students complete the sections in the foldable for the associative properties.
Lesson segment 5: How can I demonstrate the use of the distributive property of multiplication over addition?
Introductory Statement: Numbers can be multiplied mentally by multiplying parts of the number. For example 4 x 23 is the same as 4 x 20 + 4 x 3.
Mental Math Computation Contest
Give each group of 4 a Team Board (small white board, wipe off rag and dry erase marker). Tell them

they will be working some multiplication problems without a calculator in a contest. They must work the problem mentally, and then record their answer on their Team Board.
Use roles with the Team Boards so one person is the scribe, two are the coaches and another is the encourager. They should rotate the roles with each problem in this activity. Divide the class in half to form Team A and Team B. Team A will work the problems in Column A. Team B will work the problems in column B.
Write the first problem from both A and B problem on the board, and say, "Go". Each small group works to find the answer. As soon as a small group has the answer, they raise their team board to face the teacher. The first four groups to raise their boards earn a point for their whole team. The team earning the most points after all the problems have been worked wins.

A	B	
1. 15 x 6	6(10) + 6(5)	90
2. 74 x 5	5(70) + 5(4)	370
3. 142 x 3	3(100) + 3(40) + 3(2)	426

Q. How are these problems similar? How are they different? Discuss
Tell students they have been using an important property even though they may not have realized it all these years. Help them see that 74 is 70 + 4, and 142 is 100 + 40 + 2. The distributive allows us to multiply a group of numbers by a common factor by distributing that factor.
Work with the students to build the following models using Linking Cubes. Then have them work in pairs to build and sketch one more example. These should all be checked using the calculator and should be sketched as examples on the Linker Cube Properties Worksheet. The example expression should be recorded under the Distributive Property flap on the Foldable.
Examples of the distributive property using an area model
Linking Cubes:
Lesson segment 6: Application and Practice
Sing the attached " Properties" Song with the class
Round The Room Writing Properties-One Example version,

Objective: Students will identify and write examples of several properties
Materials: Eight Large pieces of paper titled with the name of one property as listed below. Eight different color markers, (so each team will have its own color).

- Additive Identity
- Multiplicative Identity
- Multiplication by 0
- Commutative Property for addition
- Commutative property for multiplication
- Associative Property for addition
- Associative Property for multiplication
- Distributive Property of multiplication over addition

Assign rotating roles: Scribe, Editor, Coach(es). The scribe writes only what the coaches suggest. The editor makes sure the expression looks correct and is large enough to be read across the room. As students move to each successive chart, the roles should be rotated giving each a chance to perform all the roles.
Procedure:
Student teams will revolve around the room as directed by the teacher stopping at one of the 8 charts each time they move. When they stop at a chart, they should read any expressions already shown and put a small smiley face by the expressions they believe correctly model the property for that

paper. Beginning with the second chart the team visits, the team needs to choose one example already on the chart to put on the "Properties Examples Record" paper. The team will then work together to write their own example for that property on the chart paper. Examples must be large enough for the class to see but small enough to allow space for 7 other examples. The team's example should be recorded on their own "Properties Examples Record" paper. The team should show the example and simplify to show equality.
When all teams have visited all the papers, have the teams return to their first chart. Each team will discuss the expressions others have written on that chart making sure they know why each example is or is not a correct model for that property. After this discussion time, a student will be asked by the teacher (randomly) to explain to the class why any one of the examples may be correct or incorrect. The teacher chooses the example to be explained, so teams should make sure all members participate in the discussion. Teams should correct any mistakes, and the class members will write all corrected expressions on their own worksheet (attached).
Have students use their True/False response cards to hold up and pinch as you they do mental math for the following. Ask them which property helped them to know this faster.

15 x 1 = 1
14 + 2 +8 = 24
10/2 =2/10
3 x 5 x 2 = 30
2 x 5 + 2 x 8 =
3 + 28 + 7 = 38

Sing the properties song again
Assign any needed text practice.

Assessment Plan

Observation, questioning, writing, mental math, student response cards.

Bibliography

This lesson plan was created by Linda Bolin.

Authors

Utah LessonPlans