Representing Patterns and Evaluating Expressions

Summary

Students will create and extend patterns, write algebraic expressions to model rules or patterns, and evaluate algebraic expressions for a given value.

Main Core Tie

Mathematics Grade 5

Strand: OPERATIONS AND ALGEBRAIC THINKING (5.OA) Standard 5.OA.1

Additional Core Ties

Mathematics Grade 4

Strand: OPERATIONS AND ALGEBRAIC THINKING (4.OA) Standard 4.OA.5

Mathematics Grade 5

Strand: OPERATIONS AND ALGEBRAIC THINKING (5.OA) Standard 5.OA.2

Materials

- "Writing the Rule" cards
  for students, TI-73's
  Color Tiles
  Pattern Blocks Smart Pals
  Stand Up Card packet for each team
  One deck of cards
  Worksheets: Patterns In Our World, Building A Square Patio Patterns, Polygon Trains
  Journal page: Defining Algebraic Expression
  Game worksheets (Optional Practice) : Evaluating Expressions Tic Tac Toe, Evaluating Expressions War

Background for Teachers

Enduring Understanding (Big Ideas):
Patterns and sequences, Algebraic representation
Essential Questions:

- What real-world patterns can be modeled by a sequence of terms? How can I use a rule to find more terms in a sequence?
- How can an algebraic expression be used to model the rule for a pattern?
- When do we use substitution in the real-world?
- Given a value for the variable, what is the value for the algebraic expression?
- How does changing the value of the variable affect the value of an expression?

Skill Focus:
Create and extend patterns. Write and evaluate algebraic expressions to model patterns.
Vocabulary Focus:
Fibonacci numbers, triangular numbers, variable, algebraic expression, substitution, evaluate
Ways to Gain/Maintain Attention (Primacy):
manipulatives, game, patterns, technology, cooperative activities, connections to real world

Instructional Procedures

Starter: simplify each

- -2[3 â€¢ (5^2 -- 15)]

-0.25 Ã· 0.5 + 1.5

¾ + (- ½)

Lesson Segment 1: What real-world patterns can be modeled by a sequence of terms? How can an algebraic rule be used to find more terms for the sequence?

Patterns are all around us. Finding patterns and sequences helps pharmacists develop medicines, builders build structures, farmers plant crops, and even helps you know when to go to classes. (every 90 min a bell rings). Do Team List where a Round Robin is used to have team members suggest anywhere they might see a pattern in the world. Scribe writes list. Team with longest after 2 minutes wins. Have that team scribe read their list. Scribes from other teams each read one idea that hasn't been mentioned yet.

Introduce the Patterns In Our World Worksheet. Do Four Corners where a student from each team goes to a corner to meet with other team's students to complete the pattern or sequence shown in one of the problems on worksheet (attached) and to write a rule for the pattern they found to help them. Each person then returns to their team and teaches the team about their one problem, so all four problems get discussed. Students are all accountable to write the next two terms and the description of the pattern on their own worksheet.

TI-73 activity: All patterns can be modeled using verbal or written rules, and by using math symbols. That is why mathematics is such a powerful language.

Q. Think-Team-Share For example, in this pattern: 1, 2, 3, 4, 5, 6…, what operation is happening to one number to get the next term in the sequence? We can write the rule for finding the next term using math symbols. So if n was a number in the pattern, n + 1 would be the rule to help us find the next number.

Q. What would the next number be if the number you were looking at were 52? 65?

Demonstrate using the graphing calculator to find terms of a sequence and write the rule (algebraic expression) for finding the next term. Then play "Writing The Rule". Instructions are attached.

Lesson segment 2: How can algebraic expressions be used to model a rules or patterns? Given a value for a variable, what is the value for the expression?

Have students look at these two columns and identify characteristics that would qualify an expression for being in one column or the other. The expressions on the left are algebraic since they include at least one variable. The expressions on the right are numeric since they only include numbers and operations having no variable.

y + 1	3 + 5.8
r*t	12 â€¢ (-4)
lwh	2 â€¢ 3 â€¢ 6
2(3x -2)	2(6 -- 2)

Algebraic or variable expressions can help us describe patterns and extend them to find other possible values.

Journal: Work with students to complete the Frayer Model for defining Algebraic Expression (attached)

Manipulative Patterns

Color Tiles: Have student pairs work with Color Tiles to complete the first five rows in the "Building A Square Patio Patterns" table. The activity is a review of the manipulative activity found in the exponential lesson with additional patterns included. Discuss the patterns they find. Ask them to look for a rule that would involve operations on the length of the side of a square to find the information for the table. Use the "X" row to write algebraic expressions modeling the rule for the patterns. (# added on = 2x-1. Perimeter = 4x, Area = x^2, Radical expression = $x^2 = x$)

Pattern Blocks, Smart Pals: Use the attached Pattern Blocks: Polygon Trains worksheet for

discussion, Having the students work with a partner. Students should take turns building the trains and sketching and labeling on the Smart Pal. Guide them in recording the data in the tables on the worksheet and discuss the pattern for each train. Again, ask them to look for a rule to help them find the number of windows by operating on the number of cars in the train. Let x represent the number of cars in the train.

Writing Expressions from Tables Using The TI-73

To find patterns leading to the writing of single variable expressions, type an equation in the . Select and set the dependent and independent variables to Aask@. Select and push to type a value in the X column. Tell students you have performed an operation on that value to get a result. Place the curser in the Y column and push . Discuss what operation(s) might have been performed to get that result. Type another value in the X column and push in the corresponding position in the Y column. Ask students if the same operation they discussed was used on this new value for x to get the resulting value in the Y column. If not, tell them you want them to find an operation(s) that could be used for both x values to get the result in the table. Have them describe a "rule". Then, type a third value in the X column. Ask them if their rule works for that value. Then enter the corresponding value in the Y column and see if they got the same result.

Enter two or three more values in the x column. Have them write an expression that would produce the given value for each x value. For example if the "rule" were to add 5 to X to get a result the expression would be 5 + X . Some possible functions you may wish to try might be:

y = x + 1, y = 2x, y = x -- 4, y = 2 x, y = 2x + 1, y = x/2

Lesson segment 3: When do we use substitution in life? Given a value for a variable, what is the value for the expression? How does changing the value for the variable affect the value of the expression?

Have you ever been in a class where you were surprised when you came in to find a substitute teacher was there?

Think-Team-Share Q: What do we mean when we say the word "substitute"?

Think-Team-Share Q: Where do we see substituting things going on in the real world? (Splenda for sugar, Pinch-hit at a ball game)

Have you ever been in a class where the teacher was gone more than one day, and you had a different substitute each day?

Think-Team-Share Q: How did changing a substitute change the class?

In mathematics we can substitute too. In an algebraic expression, we can substitute values for the variable.

Have you ever gone to the store and tried to decide how many of something you could buy? For example, if a candy bar is 25 cents, you know you will have to pay $0. 25 x the number of candy bars (write 0.25c on the board). Let's do some mental math. How much would you have to pay if you bought 2 candy bars? 3 candy bars? 6 candy bars? You have been doing mental substitution. First, you replaced the c with a 2 to get $0.50. (Write $0.25(2) = $0.50 on the board) Then you substituted a 3 for the c and got $0.75. (Write $0.25(3) = $0.75). Finally, you substituted a 6 for the c and got $1.50. (Write $0.25(6) = $1.50 on the board).

Have students write the expression $0.25c on their paper and choose any number of candy bars and evaluate their expression. Then select several students to tell what value they chose for c and tell the class the cost of the candy bars. Think-Team-Share Q: How did changing the value of c change the amount you had to pay?

Team Challenge Game: (materials: Stand-Up cards, one card deck, TI-73's)

Give each team a pack of Stand-Up Cards (Large cards numbered from 1-20, operation signs cards, right and left parenthesis cards, a couple of variable cards, and a negative sign card. Have each team use the cards to create an algebraic expression (not an equation). The challenger team stands holding their cards to show the expression they have created. The class and teacher write the

expression. The challenger team then asks a classmate to come to the front of the class and pick a card(s) from a playing card deck the teacher is holding. The picker selects a card for each variable in the challenger team's expression. Red cards in the deck represent negative numbers. Black cards represent positive numbers.
All the students then work to evaluate the expression using the drawn card(s) as value(s). The challengers then pick one student to show explain how they evaluated the expression. If that student is correct, his/her team gets a point. If not, the challengers must show how to evaluate the expression correctly to earn the point.
Remind students to use the correct order of operations. Model this procedure once with the class.
Assign: Practice Writing and Evaluating Expressions Using The Ti-73. For additional practice assign Writing Expressions Tic Tac Toe, and Writing Expressions War (all attached). McDougal Littell 2005 p. 7, # 1-31 odd. or any appropriate text practice for evaluating expressions
Rules for the practice problems on the Writing and Evaluating Expressions Practice page are

2x + 1
x -- 2.5
x + 4 4. -- 1 x

Assessment Plan

observation, questions, task performance

Bibliography

This lesson plan was created by Linda Bolin.

Authors

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