

# Custom T-Shirts

## Concept Lesson Guide

### LESSON OVERVIEW

**Overview:** This lesson is set in the context of *Custom T-Shirts*, a company that produces and sells T-Shirts with the customer's design printed on them. Students are provided with a description of the pricing scheme that includes a one-time fee and a cost per shirt. Students are required to use the given information to calculate the total price for various sized orders in order to create a table and graph, and to determine the price for several large orders. Students then work to create an equation that can be used to determine the price for any number of shirts. Finally they have an opportunity to "think backwards" when asked to find out how many shirts could be purchased for \$100. This lesson can serve as an introduction to equations of linear functions and provides an opportunity to begin to explore the notion of rate of change and y-intercept in the context, equation, table and graph.

#### **NCTM Standards Addressed:**

- Use symbolic algebra to represent situations and to solve problems, especially those that involve linear relationships.
- Model and solve contextualized problems using various representations, such as graphs, tables, and equations.
- Develop an initial conceptual understanding of different uses of variables.
- Interpret representations of functions of two variables.

#### **Mathematical Goals of the Lesson:**

- An algebraic rule can be written to describe the relationship between two variables in a pattern or context.
- A linear function has a constant rate of change.
- A linear relationship can be represented by an equation of the form  $y = mx + b$  where  $m$  and  $b$  have a regular and predictable meaning in the context, table, graph, and equation.
- Reason mathematically, build arguments to support or refute hypotheses, use and make connections among a variety of mathematical representations.

#### **Academic Language Goals of the Lesson:**

- Develop academic vocabulary to be used in the descriptions.
- Describe algebraic patterns orally or in writing.
- Explain the process used in solving the task, orally or in writing.

#### **Assumption of Prior Knowledge:**

- Recognize that variables represent an unknown quantity.
- Understand the conventions for representing arithmetic operations involving numbers and variables.
- Are able to create t-tables and construct graphs (including scaling the axes).

#### **Academic Language:**

- Variable, constant, coefficient
- Variable expression and equation
- Independent variable, dependent variable
- Linear

#### **Materials:**

- Lesson Task
- Logo t-shirt for discussion during the set-up phase
- Scientific Calculators (basic calculators must be used with care since  $15 + 8*n$  will yield wrong answers if numbers are entered in this fashion).
- Graph paper, ruler
- Table paper or transparencies, markers
- Blank Tables (at end of this document)

**Key:**

**Suggested teacher questions are shown in bold print.**

Questions and strategies that support ELLs are underlined and identified by an asterisk.\*

*Possible student responses are shown in italics.*

| Phase                                 | SET-UP PHASE: Setting Up the Mathematical Task   |
|---------------------------------------|--|
| <b>S<br/>E<br/>T<br/><br/>U<br/>P</b> | <p><b><u>INTRODUCING THE TASK</u></b></p> <ul style="list-style-type: none"><li>• Show the class a t-shirt with a design and ask students if they can think of situations where people have t-shirts with special designs printed for a large group. They might mention a family reunion, a school club, a community fundraiser, or a neighborhood sporting team. Ask them what they think a process would be to have these special t-shirts printed by a T-shirt company and what would they have to pay for. Listen for such things as designing the logo or pictures, the shirts themselves, and printing the logo or picture on each shirt. Press the students until it seems clear that they understand that the customer will only have to pay once for the design, but will have to pay an additional amount for each shirt that is printed.</li><li>• <u>Have students read the Lesson Task individually, then select a student to read it aloud as others follow along. Ask students to circle words that they do not understand, and make note of these words as you circulate around the room.*</u> Clarify the meaning of terms that are not understood. Then have a few students explain to the class what the task is asking them to do, and what they are trying to find when solving the problem. As students describe the task, make certain they indicate that the goal is to find how much they will have to pay for different numbers of shirts if they have to pay a one-time fee of \$15 and \$8 for each shirt.</li></ul> <p><b><u>SETTING UP THE EXPECTATIONS FOR DOING THE TASK</u></b></p> <p>Remind students that they will be expected to:</p> <ul style="list-style-type: none"><li>• Justify their solutions in the context of the problem.</li><li>• Explain their thinking and reasoning to others.</li><li>• Make sense of other students' explanations.</li><li>• Ask questions of the teacher or other students when they do not understand.</li><li>• Use correct mathematical vocabulary, language, and symbols.</li><li>• Tell students that their groups will be expected to share their solutions with the whole group using table paper, the overhead projector, etc.</li></ul> |

To assist ELLs' participation in the class discussion:\*

- Allow time for students to first talk in small groups (pairs) and then have the groups report to the whole class.\*
- Reinforce appropriate language as students communicate their ideas (e.g. revoice a student's contribution in mathematically and grammatically correct language). Ask students if you have captured what they said.\*
- Develop a word wall and insert new terminology as it is introduced. Continually refer to it until the words become a part of student dialogue.\*
- Expect students to incorporate appropriate mathematical vocabulary in their discussions once the terminology has been introduced.\*

| Phase  | <b>EXPLORE PHASE: Supporting Students' Exploration of the Task<br/>STRUCTURE</b>   |
|--|--|
| <b>E<br/>X<br/>P<br/>L<br/>O<br/>R<br/>E<br/><br/>E<br/>X<br/>P<br/>L<br/>O<br/>R<br/>E<br/><br/>E<br/>X<br/>P<br/>L<br/>O<br/>R<br/>E</b> | <p><b><u>PRIVATE THINK TIME</u></b></p> <ul style="list-style-type: none"> <li>• Ask students to work individually for 5-10 minutes so that they can make sense of the problem for themselves.</li> <li>• Circulate around the classroom and clarify confusions. Be careful to NOT give away too much information or suggest a way to solve the problem.</li> </ul> <hr/> <p><b><u>SMALL-GROUP WORK</u></b></p> <ul style="list-style-type: none"> <li>• After 5-10 minutes, ask students to work with their partner or in their small groups.</li> <li>• As students are working, circulate around the room. <ul style="list-style-type: none"> <li>○ Be persistent in asking questions related to the mathematical ideas, problem solving strategies, and connections between representations.</li> <li>○ <u>Be persistent in asking students to explain their thinking and reasoning.*</u></li> <li>○ <u>Be persistent in asking students to explain, in their own words, what other students have said.*</u></li> <li>○ <u>Be persistent in asking students to use appropriate mathematical language.*</u></li> </ul> </li> </ul> <p><i><u>What do I do if students have difficulty getting started?</u></i></p> <ul style="list-style-type: none"> <li>• Ask: “What would it cost to buy 1 shirt?” “What would it cost to buy a second shirt with the same design?” “Why?”</li> <li>• Ask: “If you placed an order and Custom T-Shirts created your design but didn’t print any shirts, how much would they charge you?” “Why?”</li> </ul> <p><i><u>What do I do if students finish early?</u></i></p> <ul style="list-style-type: none"> <li>• Make sure all the students in the group can explain their reasoning. If not, tell them that you will return and may ask any of them to provide their explanation.</li> <li>• Ask students to come up with a different price structure that includes a set-up fee and price per shirt but that is always cheaper than the original plan. Have them come up with another price structure that is always more expensive than the original plan.</li> </ul> |

| Phase   | EXPLORE PHASE: Supporting Students' Exploration of the Task  |
|---|--|
| E<br>X<br>P<br>L<br>O<br>R<br>E<br><br>E<br>X<br>P<br>L<br>O<br>R<br>E<br><br>E<br>X<br>P<br>L<br>O<br>R<br>E | <p data-bbox="289 266 842 293"><b><u>MONITORING STUDENTS' RESPONSES</u></b></p> <p data-bbox="289 334 1919 496">As you circulate, attend to students' mathematical thinking and to the strategies and representations used. It is not necessary for all groups to have answered Questions 3 and 4 before the Share, Discuss, and Analyze phase, as long as they have discussed Questions 1 and 2 thoroughly in their small groups and are able to verbalize the procedure that they would use to calculate the charge for 150 and 750 shirts. Question 4 will be addressed during the Share, Discuss and Analyze phase of the Lesson Task. As you circulate around the room you will need to:</p> <ul data-bbox="289 537 1919 967" style="list-style-type: none"> <li>• Observe students' solution methods and listen carefully to their verbal explanations. Press students to explain why their method works. Have students share their approaches with their group members.</li> <li>• Make note of the solution methods that students use and choose the solutions to be shared, and the order in which you want them to be shared during the Share, Discuss and Analyze phase. You might want to start with the solution path that was used most frequently.</li> <li>• Make special note of groups whose tables are not constructed systematically or whose graphs have irregular or incorrect scales. <u>It will be important for their tables and graphs to use regular increments so that a constant rate of change is apparent.*</u> Try to address these issues during the Explore Phase – if you find it is a common problem then you should also address it during the Share, Discuss and Analyze phase.</li> <li>• Identify the groups that will share their solution, and let them know the solution path that you want them to share. Decide which group member you will ask to lead the presentation, and give them advanced warning. You might want to select a group member who might not have originally constructed the solution in order to encourage group accountability. Let other group members know that you might ask any of them to add to the discussion.</li> </ul> |







| Phase   | LESSON TASK QUESTION 2 (continued)   |   |   |  |
|---|--|---|---|--|
|   | 2. How much should Custom T-Shirts charge a customer for 150 shirts? How much should they charge for 750 shirts? Explain how you determined your answers.  |   |   |  |
|   | Possible Solutions   | Possible Questions  | Misconceptions/Errors   | Questions to Address Misconceptions/Errors   |
| E<br>X<br>P<br>L<br>O<br>R<br>E<br><br>E<br>X<br>P<br>L<br>O<br>R<br>E<br><br>E<br>X<br>P<br>L<br>O<br>R<br>E | <p>Writing and evaluating an equation:<br/><i>The cost can be represented by the expression, <math>C = 15 + 8N</math></i><br/><i>The cost for 150 shirts would be <math>15 + 8(150) = 15 + 1200 = \\$1215</math>.</i></p> <p><i>The cost can be represented by the equation <math>C = 15 + 8N</math> where <math>N</math> is the number of shirts.</i><br/><i>The cost for 750 shirts would be <math>15 + 8(750) = 15 + 6000 = \\$6015</math>.</i></p> | <p>You might ask:</p> <ul style="list-style-type: none"> <li>• <b>How did you come up with your expression?</b></li> <li>• <b>What does the <math>N</math> represent? Why did you use a variable to represent the number of shirts?</b></li> <li>• <b>Explain in your own words what ____ (another student) said.*</b></li> </ul> | <ul style="list-style-type: none"> <li>• Writing <math>8 + 15N</math> as the expression</li> <li>• Combining the 8 and 15 before multiplying by 150 (i.e., <math>23 \times 150</math>).</li> <li>• Entering numbers incorrectly into the calculator.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>Look at the problem. What do the 8 and 15 mean? What does <math>N</math> represent? What does <math>15N</math> represent?</b></li> <li>• <b>What would the cost of 10 shirts be? How does this compare to your table? What does the 23 represent?</b></li> <li>• <b>Show me what you put into the calculator. If you were doing this problem without a calculator, how would you do it?</b></li> </ul> |
|   | <b>LESSON TASK QUESTION 3</b>  |   |   |  |
|   | 3. Key Question: Write an equation that could be used to determine how much to charge a customer for any number of shirts.   |   |   |  |
|   | Same as above  | Same as above   | Same as above   | Same as above  |

| Phase                           | LESSON TASK QUESTION 4   |   |   |  |
|---------------------------------|--|---|---|--|
|                                 | 4. What is the largest number of custom t-shirts that a customer can buy for \$100? Explain how you figured this out (it is not necessary for all students to have gotten to this prior to moving to the Share, Discuss, Analyze phase).   |   |   |  |
|                                 | Possible Solutions   | Possible Questions  | Misconceptions/Errors   | Questions to Address Misconceptions/Errors   |
| E<br>X<br>P<br>L<br>O<br>R<br>E | <p><b>Look for indicators of students' understanding:</b></p> <ul style="list-style-type: none"> <li>• that they can make use of the information in their table.</li> <li>• that they can work backwards (i.e., subtract the one-time fee first) when they are given the total amount of money that they can spend.</li> <li>• that they can evaluate the variable expression for various numbers of shirts.</li> <li>• that they must “round down” – i.e., “parts of a shirt” should be ignored in this Lesson Task (i.e., although the calculated answer is 10.625, they can not purchase 0.625 of a shirt).</li> </ul> <p>Using the table:</p> <ul style="list-style-type: none"> <li>• <i>Since 10 shirts cost \$95, 11 shirts would cost \$8 more (\$103) which is more than \$100. Therefore, you could only purchase 10 shirts.</i></li> </ul> <p>Working backwards and giving a verbal description:</p> <p><i>If I have \$100, I'll have to pay \$15 for the set-up fee. So you subtract this from 100, which leaves me \$85 for the shirts. If each shirt costs \$8, since I know that 10 times \$8 = \$80 I can buy 10 shirts. The \$5 left over is not enough to buy another shirt.</i></p> | <p>You might ask:</p> <ul style="list-style-type: none"> <li>• <b>How did you get \$103?</b></li> <li>• <b>Why didn't you try 10.5 shirts?</b></li> <li>• <b>If you purchase 10 shirts with \$100, how much money will be left over?</b></li> <li>• <b>Why did you begin by subtracting \$15 from the total amount of money?</b></li> <li>• <b>Is there another way you could find how many shirts you could print for \$85?</b></li> </ul> | <ul style="list-style-type: none"> <li>• Looking at 100 shirts rather than a cost of \$100.</li> <li>• Forgetting the set-up fee, i.e., dividing \$100 by 8.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>What are we trying to find?</b></li> <li>• <b>What do the columns represent in the table?</b></li> <li>• <b>How much of the \$100 will you be able to use to print the t-shirts? What else will you have to pay for (one-time fee)?</b></li> </ul> |
| E<br>X<br>P<br>L<br>O<br>R<br>E |  |   |   |  |

| Phase  | Possible Solutions  | Possible Questions  | Misconceptions/Errors  | Questions to Address Misconceptions/Errors  |
|--|---|---|--|---|
| <b>E<br/>X<br/>P<br/>L<br/>O<br/>R<br/>E</b> | <p>Evaluating the variable expression for various numbers of shirts:<br/> <math>15 + 8(10) = 95</math>; <math>15 + 8(11) = 103</math><br/> <i>Therefore you could only purchase 10 shirts. You'd have \$5 left (or you'd need \$3 more if you wanted to purchase 11 shirts).</i></p> <p>Using the graph:<br/> <i>If I look at my graph and go to \$100 I can go over to the line. I hit the line here. It's between 10 and 11 shirts. So I don't have enough to buy 11 shirts so I can only buy 10.</i></p> | <p>You might ask:</p> <ul style="list-style-type: none"> <li>• <b>Tell me what you did.</b></li> <li>• <b>Why didn't you try 10.5?</b></li> <li>• <b>Can you write an equation that says that the cost of N shirts is \$100?</b></li> </ul> | <ul style="list-style-type: none"> <li>• Students might evaluate the expression for <math>N = 100</math>.</li> <li>• Not knowing that they must select the smaller number of shirts.</li> <li>• Only finding an approximate answer.</li> </ul> | <ul style="list-style-type: none"> <li>• <b>What are we trying to find? What information have we been given?</b></li> <li>• <b>What does the N represent in the expression?</b></li> <li>• <b>Why did you select 11 shirts? Let's try your answer and see if it works. Why do you think it didn't work? So how many shirts can you buy?</b></li> <li>• <b>You say that it is "about 10 shirts". How can you check to find out exactly how many shirts you will be able to buy?</b></li> </ul> |

## Share, Discuss, and Analyze

**Orchestrating the mathematical discussion: a possible Sequence for sharing student work, Rationale and Mathematical Ideas to achieve the goals of the lesson, and possible Student Responses that demonstrate understanding.**

**Revisiting the Mathematical Goals of the Lesson:**

- An algebraic rule can be written to describe the relationship between two variables in a pattern or context.
- A linear function has a constant rate of change.
- A linear relationship can be represented by an equation of the form  $y = mx + b$  where  $m$  and  $b$  have a regular and predictable meaning in the context, table, graph, and equation.
- Reason mathematically, build arguments to support or refute hypotheses, use and make connections among a variety of mathematical representations.

| Phase  | Possible Sequencing of Student Work   | Rationale and Mathematical Ideas  | Possible Questions and Student Responses   |
|--|---|---|--|
| <b>S<br/>H<br/>A<br/>R<br/>E<br/><br/>D<br/>I<br/>S<br/>C<br/>U<br/>S<br/>S<br/><br/>A<br/>N<br/>A<br/>L<br/>Y<br/>Z<br/>E</b> | <ul style="list-style-type: none"> <li>• Begin with two tables that you identified as you monitored students' explorations. The tables should have correct calculations, should begin with zero, five or ten shirts, and should have consistent increments. Pick two tables that used different increments if possible (i.e., 5 and 10).</li> </ul> | <p>Beginning with a discussion of how the cost of the order was calculated helps all students to enter the conversation and surfaces the issue of the coefficient and rate.</p> <p>By beginning with two tables with consistent although different, increments, patterns will become apparent. Opening with a general discussion about those patterns will provide an entry point for many students. Key mathematical ideas may also surface that you can build upon later.</p> | <ul style="list-style-type: none"> <li>• <b>How did you determine the cost of each order?</b> <ul style="list-style-type: none"> <li>• <i>I took 5 shirts and multiplied it by 8 and added 15.</i></li> <li>• <i>I started with 15 dollars and then I added 8 times the number of shirts.</i></li> </ul> </li> <li>• <b>How did you know to multiply the number of shirts by 8?</b> <ul style="list-style-type: none"> <li>• <i>Because it says \$8 per shirt which means each shirt is \$8. The one-time fee is added on separately. You only pay that once.</i></li> </ul> </li> <li>• <b>What patterns do you see in the tables?</b> <ul style="list-style-type: none"> <li>○ <i>I see that the numbers are in order in both columns.</i></li> <li>○ <i>I see that the number of shirts goes up by ten (five) each time.</i></li> <li>○ <i>I see that the price goes up by \$80 each time. It's always the same.</i></li> <li>○ <i>In MY table the price goes up by \$40 and the number of shirts goes up by 5.</i></li> </ul> </li> <li>• <b>Why does the price go up the same amount each time? Did it matter that our number of shirts went up by 10s (or 5s)?</b> <ul style="list-style-type: none"> <li>○ <i>Because when you figure out the amount it goes that way.</i></li> <li>○ <i>Yes. Because each time you're buying 10 (5) more shirts and they cost \$8 a shirt. So that's \$80 (\$40).</i></li> </ul> </li> </ul> |

| Phase  | Possible Sequencing of Student Work   | Rationale and Mathematical Ideas  | Possible Questions and Student Responses  |
|--|---|---|---|
| <b>S<br/>H<br/>A<br/>R<br/>E<br/><br/>D<br/>I<br/>S<br/>C<br/>U<br/>S<br/>S<br/><br/>A<br/>N<br/>A<br/>L<br/>Y<br/>Z<br/>E</b> | <ul style="list-style-type: none"> <li>Add a group's graph to the discussion – one that has correct scales.</li> <li>Reflect on the systematic nature of the tables.</li> </ul> | <p>This lesson will lay the foundation for the ideas of <b>linear functions, slope and y-intercept</b>, which will be developed in future lessons. By linking this to the graph students will see a visual representation, and will come to understand why it is called "LINEAR".</p> <p>It is important to make explicit the need to organize data in a systematic way so that patterns become apparent.</p> | <ul style="list-style-type: none"> <li><b>What patterns do you see in this graph?</b> <ul style="list-style-type: none"> <li><i>The points are all in a straight line.</i></li> <li><i>The points go up by the same amounts.</i></li> </ul> </li> <li><b>Will the patterns in the tables and the graph always continue that way? Why?</b> <ul style="list-style-type: none"> <li><i>The cost will keep going up the same way since the shirts will cost \$8 each no matter how many you buy.</i></li> <li><i>Our points will keep going up by the same amount because the shirts always cost \$8.</i></li> <li><i>Sometimes they give a discount if you buy a lot of shirts, maybe if you buy more 1000 they'll only charge you \$5 so it wouldn't keep going that way.</i></li> </ul> </li> <li><b>That would make a great problem to work on later, Maria. Let's remember that one – put it in our parking lot and call it "Maria's T-Shirts".</b></li> <li><b>We call this type of relationship a LINEAR RELATIONSHIP. What do you think LINEAR means?</b> <ul style="list-style-type: none"> <li><i>Is it because it makes a straight line?</i></li> <li><i>The points are all lined up?</i></li> </ul> </li> <li><b>Some of you started your tables out maybe 1, 2, 3, 5, 10, 20, 50. Would you have found a pattern like they did?</b> <ul style="list-style-type: none"> <li><i>No, because we didn't go up by the same amount at first. Later we changed our table and counted by 10s. It made it easier because when we saw the pattern we just started adding 80 each time – we didn't have to keep on calculating the cost of the shirts.</i></li> </ul> </li> <li><b>If you took your design in for them to work on but didn't order any shirts yet, how much would ZERO shirts cost? Why? Where do (would) you show that in your table?</b> <ul style="list-style-type: none"> <li><i>I would still have to pay \$15 for the one-time fee. I would have to put zero shirts at the top of my table. There's still a pattern.</i></li> </ul> </li> </ul> |

| Phase  | Possible Sequencing of Student Work   | Rationale and Mathematical Ideas   | Possible Questions and Student Responses  |
|--|---|--|---|
| <p style="text-align: center;">S<br/>H<br/>A<br/>R<br/>E</p> <p style="text-align: center;">D<br/>I<br/>S<br/>C<br/>U<br/>S<br/>S</p> <p style="text-align: center;">A<br/>N<br/>A<br/>L<br/>Y<br/>Z<br/>E</p> | <ul style="list-style-type: none"> <li>• Continue with a table in which students extended the table.</li> <br/> <li>• Connect to a student who used an equation.</li> <li>• Ask a student to share, and explain, his/her equation.</li> </ul> | <p>Continuing with another table will provide students with a connection to the previous discussion.</p> <p>Students should realize that using the method of adding rows to the table or extending the line on the graph would take a long time to find the cost for 750 shirts. This is a motivation for evaluating the expression for <math>n = 750</math>.</p> <p>By introducing the equation, you will be able to link directly to the mathematical sentences and will allow the notion of <b>VARIABLE</b> to be strengthened.</p> | <ul style="list-style-type: none"> <li>• <b>Where do we see the cost for ZERO shirts on the graph?</b> <ul style="list-style-type: none"> <li>○ <i>Zero shirts is right here. The line is here – so we see that zero shirts costs \$15.</i></li> </ul> </li> <li>• <b>You are pointing to where the line crosses the Y-AXIS – we call this the Y-INTERCEPT. The Y-INTERCEPT is \$15.</b></li> <br/> <li>• <b>How did you use the table to find the cost for 150 shirts? I saw someone add the amount for 100 shirts and the amount for 50 shirts. Can we find the cost that way? Why or why not?</b> <ul style="list-style-type: none"> <li>○ <i>That would not work because you'd be including the \$15 base fee twice – once for 100 shirts and once for 50 shirts.</i></li> </ul> </li> <li>• <b>So, how can we use the table to find the price for 150 shirts or 750?</b> <ul style="list-style-type: none"> <li>○ <i>You would keep adding 10 shirts and \$80 to each row (or 5 shirts and \$40) until we get to 150 shirts and \$1215 but that would take too long for 750 shirts.</i></li> </ul> </li> <li>• <b>What would be another way to find the cost of shirts? Did anyone use a different method to find the cost of 150 shirts?</b> <ul style="list-style-type: none"> <li>○ <i>I figured out that you can just start with 15 and then add that to whatever I get when I take the number of shirts times \$8.</i></li> </ul> </li> <li>• <b>How can we write that in math symbols?</b><br/>Students might write <math>C=15+8*N</math> or <math>C= 8*N+15</math>.</li> <li>• <b>Explain your equation for us and tell us how you came up with it.</b> <ul style="list-style-type: none"> <li>○ <i>I know that you have a start-up cost of \$15 so you add that, and then I know that each shirt costs \$8 so you have to multiply that by N.</i></li> </ul> </li> <li>• <b>What does N represent? Why do we multiply N by 8 and add 15?</b> <ul style="list-style-type: none"> <li>○ <i>That is how many shirts they ordered. We multiply by 8 because EACH SHIRT costs \$8; we add \$15 because that is added once to each order.</i></li> </ul> </li> </ul> |

| Phase  | Possible Sequencing of Student Work  | Rationale and Mathematical Ideas  | Possible Questions and Student Responses   |
|--|--|---|--|
| <b>S<br/>H<br/>A<br/>R<br/>E<br/><br/>D<br/>I<br/>S<br/>C<br/>U<br/>S<br/>S<br/><br/>A<br/>N<br/>A<br/>L<br/>Y<br/>Z<br/>E</b> | <p>Discuss a common misconception.</p> <p>Have students reflect on the meaning of the various parts of the equation.</p> | <p>It is important to discuss common errors and misconceptions. Until you have established an environment in the classroom where it is OK to discuss one's mistakes publicly, it is safer to say, "I heard someone say." That way the IDEA is discussed, not the student.</p> <p>Use the terms <b>CONSTANT</b> and <b>COEFFICIENT</b> in relation to the context and the expression.</p> <p><b>Note:</b> the <b>COEFFICIENT</b> is the numeric factor of the term <math>8N</math>. The <b>CONSTANT</b> is the term with no variables.</p> | <ul style="list-style-type: none"> <li>• <b>Why did you use a letter to represent the number of shirts?</b> <ul style="list-style-type: none"> <li>○ <i>Where they wrote 20 and 50 I wrote N, because I wanted to be able to talk about any number of shirts. We can use a letter to stand for any number.</i></li> </ul> </li> <li>• <b>We call these letters VARIABLES because they can stand for different numbers – they VARY.</b></li> <li>• <b>I heard someone say that <math>C=15N + 8</math> [write on board] was the equation for Custom Shirts. Do you agree or disagree? Why?</b> <ul style="list-style-type: none"> <li>○ <i>I disagree because that would be a different problem. What they wrote says that EACH shirt costs \$15 because they are multiplying 15 and N, since they're adding \$8 on one time so they're saying \$8 is the one-time fee. They have it backwards.</i></li> </ul> </li> <li>• <b>Let's look at <math>15 + 8N</math>. We said the N is called a VARIABLE because it represents the number of shirts we want to purchase. What do the 8 and the 15 mean?</b> <ul style="list-style-type: none"> <li>○ <i>The 15 is a one-time set-up fee. The 8 is the cost of one shirt that we have to multiply times the number of shirts.</i></li> </ul> </li> <li>• <b>We call the 15 the CONSTANT and the 8 a COEFFICIENT. The 15 is the fee that gets added on and the 8 is the price of printing each shirt that is multiplied times the number of shirts.</b></li> </ul> |

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| S<br>H<br>A<br>R<br>E<br><br>D<br>I<br>S<br>C<br>U<br>S<br><br>A<br>N<br>A<br>L<br>Y<br>Z<br>E | <ul style="list-style-type: none"> <li>Have students evaluate the algebraic expression to determine the cost of orders of various numbers of shirts.</li> <li>Ask students to find the number of shirts that can be ordered for \$100 by working backwards, supported by a verbal explanation.</li> </ul> <p><b>CLOSURE</b></p> <ul style="list-style-type: none"> <li>Have students reflect on the mathematics of the lesson; find links to math that they have explored before; think of tasks that might be related to the big ideas of the lesson.</li> </ul> | <p>This will provide more practice in evaluating expressions. Order of operations will be linked to the context of the task.</p> <p>Students will work backwards, making sense of the steps for “undoing” their calculation. This will later be linked formally to the steps for solving a multi-step equation.</p> <p>It is important for students to step back and reflect on the ideas that surfaced and to situate their learning within past experiences, and to think forward to ways that they might build on these ideas in future tasks. This helps them to focus on the interconnectedness of mathematical ideas.</p> | <ul style="list-style-type: none"> <li><b>Explain how you would find the cost of 750 shirts using the equation. 1000 shirts.</b> <ul style="list-style-type: none"> <li><i>I would use my equation and put in 750 or 1000 for N, and then do the calculations.</i></li> </ul> </li> <li>(Call on students who explained their solution verbally, and working backwards) <b>How did you find out how many shirts you could order for \$100?</b> <ul style="list-style-type: none"> <li><i>I looked at my table and saw that 10 shirts cost \$95. I don't have enough money to buy 11 shirts which would cost \$8 more.</i></li> <li><i>I took \$15 from \$100 and got \$85. I know that <math>8 \times 10</math> is 80, so I could buy 10 shirts. I'd have \$5 left over.</i></li> </ul> </li> <li><b>Why did you first subtract 15 from 100 before you divided by 8?</b> <ul style="list-style-type: none"> <li><i>Because I knew I had to spend \$15 for the one-time fee, so I wouldn't have all of the \$100 to use to print the shirts.</i></li> </ul> </li> <li><b>So how could we look at someone's equation and tell right away what the one-time fee is? How can we tell what the cost per shirt is?</b> <ul style="list-style-type: none"> <li><i>The cost per shirt is what you multiply by N, the one-time fee is what you add on.</i></li> <li><i>Since the cost per shirt is for EACH shirt you have to multiply by the number of shirts.</i></li> </ul> </li> </ul> <p>Pose the following question and allow time for students to discuss it in small groups prior to the end of class. This will prepare them for their homework problem:</p> <ul style="list-style-type: none"> <li><b>What would happen to the prices for Custom T-Shirts if you changed the set-up cost? What would happen to the price if you changed the cost per shirt?</b></li> </ul> <p><b>HOMEWORK:</b><br/> <b>Fancy T-Shirts charges a one-time fee of \$18 to make the design plus \$5 for each t-shirt printed. How will their prices compare to the Custom T-Shirt prices? Explain.</b></p> |



**CLOSURE:**

How could we look at someone's equation and tell right away what the one-time fee is? How can we tell what the cost per shirt is?

**Homework:**

- Fancy T-Shirts charges a one-time fee of \$18 to make the design plus \$5 for each t-shirt printed. How will their prices compare to the Custom T-Shirt prices? Explain.