WEST VIRGINIA
DEPARTMENT OF EDUCATION

MATHEMATICS

GRADE 7

Planning a Pizza Party

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Task Title: Planning a Pizza Party
Grade or Content Area: 7th-grade math
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Original Task Creator: Illustrative Mathematics
Quarter: 1

Rationale for Lesson and Associated Tasks

7th-grade students are planning a pizza party celebration. Students must determine what they need for the party, where they will purchase supplies, and how much supplies cost. They must also determine which quantities are fixed and which are variable while staying within a $75 budget.

This task invites 7th-grade students to experiment with expressions and equations to model a situation. The students will think about relevant quantities, whether they might be fixed or variable, and how they might relate to one another. Students use numbers and variables to present quantities and relationships. The task also draws attention to the idea of **constraints** and how to represent them. There is no one correct set of expressions or equations governing the potential quantities at the pizza party. The focus is on the modeling process itself – identifying relevant quantities, making assumptions, creating a **model,** and evaluating the model. Discussions are built-in to foster an environment of collaboration and active thinking and listening. Encourage students to share their ideas and questions during these times.

Lesson and Associated Tasks Overview

Planning a Pizza Party Preparation* (Click here)
Planning a Pizza Party Lesson* (Click here)
Planning a Pizza Party Practice* (Click here)
** Review all components thoroughly.*

For Grade 7 students, this lesson and associated tasks may serve as an introduction to expressions, equations, and inequalities. This lesson also serves as an introduction to fixed and variable quantities as well as creating constraints for a real-world situation. It is important to connect the items students choose for their pizza party to expressions, equations, and inequalities based on constraints students identify.

This lesson and associated tasks are scheduled to be completed over 3 class periods.

Day 1

1. Review variables and equations using Launch activity found in "*Planning a Pizza Party*"
2. Introduce "*Planning a Pizza Party*". Provide students with *the Cost Plan* document
3. Provide students with pizza restaurant menus and a flyer from a discount store
4. Determine a cost plan for the pizza party

Day 2

1. Review changing quantities and finding constraints using real-world situations (suggestions in the teacher notes).
2. Introduce task for day 2: determining changing quantities and constraints for the pizza party. Provide students with the *Cost Plan 2* document to record information.
3. Determine items that could have varying values for the pizza party and write an equation for each item.
4. Determine constraints for the pizza party and write an equation or inequality to represent each.
5. Students write equations to determine the cost per person using variables for changing values

Day 3

1. Gallery walk using the rubric to determine which party will be used as the classroom celebration.
2. Complete individual assessment – 10 problems *Translating Real World Problems into Equations*

West Virginia College- and Career-Readiness State Standards

Cluster: Solve real-life and mathematical problems using numerical and algebraic expressions and equations.

M.7.9

Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), **using tools strategically**. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies.

M.7.10

Use variables to represent quantities in a real-world or mathematical problem and construct simple equations and inequalities to solve problems by reasoning about the quantities.

a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach.

b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem.

Mathematical Habits of Mind (MHM)

*While several MHM are listed, the MHMs in bold font are the focus of the lesson and associated tasks.

MHM1. Make sense of problems and persevere in solving them.
MHM2. Reason abstractly and quantitatively.
MHM4. Model with mathematics.
MHM5. Use appropriate tools strategically.
MHM6. Attend to precision.

Mathematics Teaching Practices to Support Student Growth

- Implement tasks that promote reasoning and problem-solving.
- Facilitate meaningful mathematical discourse.
- Support productive struggle in learning mathematics.
- Elicit and use evidence of student thinking.

Essential Understandings

- Quantities in a situation can be represented by expressions with constants and variables.
- Equations can be written to represent situations with quantities that may vary or not vary based upon the criteria provided.
- A constraint is a limitation on the possible or reasonable values a quantity could have and can be represented by equations (or inequalities).

Set-up Phase

1. Become an Expert Regarding All Lesson and Associated Task Content

It is essential that the teacher, become familiar with all "*Planning a Pizza Party"* materials. This lesson comes with many associated tasks, the use of each may vary depending on the time frame available for the lesson and student levels of engagement and understanding. Reviewing, analyzing, and completing all tasks prior to the implementation with students is imperative for classroom success.

2. Establish Small Groups

The "*Planning a Pizza Party*" tasks promote both individual and small group thinking. Students will explore the meaning of algebraic expressions and equations and contribute to meaningful small group conversations regarding algebraic expressions and equations relating to needed items for the pizza party.

Skill levels, leadership skills, and personalities are all considered when creating small groups, preferably 3 students in a group. Small group collaboration works best when students have been provided previous opportunities to work together on a regular basis. Weeks of teacher observation of student behavior will be extremely helpful when creating small groups for this lesson and associated tasks. Taking notes regarding leadership skills, personalities, the ability to take criticism, to question, and to think deeply about a task or problem will enable teachers to make sound decisions regarding small group placement. When creating the groups, all these factors help to eliminate the potential situation in which one student takes the lead and makes the decisions for the group. In this scenario, one student is gaining all the benefits of the task, while others do not. If a student is not engaged in conversation, this lesson and associated tasks will not be beneficial in helping all students to have a meaningful discussion about the mathematics involved nor in analyzing the relationships inherent to the tasks. Students will be working both individually and together when placed in small groups (e.g. three students) to complete this lesson and associated tasks.

3. Develop Open-Ended Questions

Teachers should create a list of open-ended questions designed to support and scaffold the lesson and associated tasks for their students. These questions should purposefully direct students towards provided information, previously learned content, and similarities and differences in their work. Some questions might include:

- What do you know specific to the task?
- What do you need to know specific to the task?
- What information is required to address the task?
- What assumptions did you make?
- Which quantities can change, and which quantities do not change?
- How can we compare or represent different quantities?
- Are the variables clearly defined?
- What equations do you need?
- Is there more than one expression (or equation) that can correctly represent the situation?
- What operations is your equation telling you to perform?
- Can you give an example that makes the equation true?
- How do you represent amounts or totals?

*Additional questions are provided in the Lesson Guide as well.

4. Gather Materials

- Computer and presentation device (required for teacher usage)
- Internet access (test prior to implementation with students)

- Handouts: *Cost Plan* and *Cost Plan* 2 (provide a copy of each handout for each student)
- Menus from pizza restaurants (provide a copy of the menu for each small group)
- Flyer to gather prices for other party needs (provide a copy of the flyer for each small group)
- Calculators (one per student)
- Chart paper (or another method for students to share information for small group pizza party plans)
- Markers
- Class Generated Rubric for Gallery Walk
- Individual assessment: 10 problems *Translating Real World Problems into Equations* (provide a copy for each student unless using clicker quiz or projecting from the front of the room)

5. Anticipated Common Student Misconceptions

- Students guess the costs and number of items rather than calculating what they need.
- Students may not realize the difference between a quantity that does change and a quantity that does not change.
- Students may confuse the number of pizzas and the number of students.
- Students may not include the cost total of the party when calculating cost per student.
- Students may not understand what cost per student means.
- Students may incorrectly translate a written description into an inequality. For example, the greatest number of students in a class would be 20 might mistakenly written as $s > 20$ instead of $s < 20$.

Explore Phase

Prior to teaching this lesson and the associated activities, the following content should be reviewed (e.g. as "bell ringers" prior to the introduction of this lesson):

- Translate a written description into an algebraic expression.
- Interpret the meaning of an algebraic expression.
- Use inequality symbols to describe a given problem.
- Define and use vocabulary terms variable and constant.

Prior Instruction/Knowledge:

During grade six, students study equations and inequalities and methods for solving them. In grade seven, students build on this understanding and use the arithmetic of rational numbers as they formulate expressions and equations in one variable and use these equations to solve problems.
As students become familiar with multiple ways of writing an expression, they also learn that different ways of writing expressions can serve varied purposes and provide different ways of visualizing a problem.

Please review the following:

Educators Guide for Mathematics: Grade 7 (pages 25-32, pdf pages 27-34) (click here)

Prerequisite Skills

- Model or compute with integers using multiplication or division in number and word problems
- Translate between models or verbal phrases and algebraic expressions
- Solve two-step linear equations and inequalities and graph solutions of the inequalities on a number line

Supporting Skills

- Evaluate algebraic expressions in number and word problems
- Determine the rate of change

- Convert measures of length, area, capacity, weight, and time expressed in each unit to other units in the same measurement system in number and word problems

Impending Skills

- Solve linear equations using the associative, commutative, distributive, and equality properties and justify the steps used
- Use appropriate units to model, solve, and estimate multi-step word problems
- Write a problem given a simple linear equation of inequality

Source: *The Quantile Framework for Mathematics*
https://metametricsinc.com/educators/quantile-for-educators/
2020 MetaMetrics Inc.

Implementation Phase

Day 1

- Review variables and equations using Launch activity found in "*Planning a Pizza Party".*
- Introduce "*Planning a Pizza Party"*. Provide students with *the Cost Plan* document.
- Provide students with pizza restaurant menus and a flyer from a discount store.
- Determine a cost plan for the pizza party.
- Determine a cost per person for the pizza party.

Day 1 Teacher Notes:

1. Students complete the launch in small groups. Project questions from the Launch using 1.1 Main Dish and Some Side Dishes (click here). To determine student understanding, ask students the following questions after completing the launch (click here).
   Q#1: What is an equation? What does it tell us?
   Q#2: What is an example of an equation that only contains variables?
   Q#3: What is an example of an equation that only contains constants?
   Q#4: What is an example of an equation that contains both variables and constants?
   Q#5: What is an example of an equation that has both multiplication and addition in the equation?
2. Introduce "Planning a Pizza Party". Working in small groups, students discuss what supplies they need for the pizza party and what information they need to know in order to plan the pizza party. Set a time limit for the class to discuss the following questions are open-ended questions to ask students as the teacher guides small groups in the discussion: What do you know specific to the class (number of attendees, total money spent)? What do you need in terms of food and drink, paper products, and decorations? Where will you locate information such as prices for food, drink, paper products, and decorations? What questions need to be addressed for the task to be completed? What information is required to address the task? (3-4 minutes)
3. Provide students with pizza restaurant menus and a flyer with costs for paper products and decorations for student use while planning the cost for the pizza party. Determine the maximum amount students can spend for the party (suggested amount - $75). Providing students with menus is suggested in order to avoid students becoming distracted while surfing the internet. **Do not** let students guess prices! If possible, use menus from several pizza restaurants as it will make determining the best pizza party more interesting. Creating a flyer of costs for paper products and decorations will allow students to use realistic values.
   Download or pick up pizza restaurant menus before beginning the task. Teachers may need to create a flyer of prices for paper products and decorations from a local discount store. As much as possible, give each small group a menu for a different pizza restaurant.
4. Students calculate the cost for their pizza party and record information on the *Cost Plan* document. The teacher may need to repeat some of the suggested questions in #2 to make sure students have included every item in their cost plan. It is not acceptable for students to list only the total cost.

Students must create an equation for each item and then an equation for the total. This is necessary for Day 2 when variables will be substituted into the equations for varying quantities. Students are permitted to use calculators for determining totals.

Example: In a small group, students decide they need 1 package of plates ($2.79 each), 2 packages of cups ($3.79 each), and 2 packages of napkins ($1.99 each) for their paper products based on a class of 20 students. Their equation could be:

$2.79

Dixie Ultra Disposable Printed Paper Plates

20 ct

$3.79

Chinet Cut Crystal Plastic Cups

18 ct / 14 oz

$1.99

Kroger® Entertainment Essentials Beverage Napkins 24 Count - Pup Birthday White

24 pk

$1 \cdot \$2.79 + 2 \cdot \$3.79 + 2 \cdot \$1.99 = p$ p = paper products

$\$14.35 = p$

Students need to include an explanation for how they determined the number of packages for each of the paper products they are using for the pizza party.

Create the *Cost Plan* document prior to beginning this task. The *Cost Plan* document should include the following information: items needed for the class celebration pizza party; how many you need of each item; cost per unit of each item; total cost of each item; equation of each item; calculate cost per person for the pizza party (in #5 below); and calculate cost per square inch for 2 different pizza sizes (in #6 below).

5. Students calculate the cost per student for their pizza party.

As the teacher circulates among students, use the following questions to prompt student thinking as they determine their cost per student: How many students did you use for your cost plan? What values did you use to find the total cost for your party? What does cost per person mean?

6. For groups with impending skills: determine the cost per square inch for at least **2** different pizza sizes. If small groups finish cost plan and cost per person correctly, determine the cost per square inch for at least 2 different pizza sizes. To prompt student thinking, it may be helpful to ask the following questions: What does square inch refer to? What shape is the pizza? What size(s) do you need to know? How do you find square inches? How do you find the cost per square inch?

Day 2

- Review changing quantities and finding constraints using real-world situations (suggestions in the teacher notes).
- Introduce task for day 2: determining changing quantities and constraints for the pizza party. Provide students with the *Cost Plan 2* document to record information.
- Determine items that could have varying values for the pizza party and write an equation for each item.
- Determine constraints for the pizza party and write equations (or inequalities) to represent each constraint.
- Students write equations to determine the cost per person using variables for changing values.

Day 2 Teacher Notes:

1. Students work in small groups to determine the changing values and find an expression to represent the changing values for each of the following situations. Discuss answers as a whole group to determine student understanding.

Q#1: Matthew is training for a marathon and runs 4 miles per day for the first week. He continues his training by increasing the daily distance by a mile each of the weeks before the marathon.

Q#2: The price of a visit to the local dentist is $30. If any cavities are found, there is an additional charge of $150 for each cavity.

Q#3: At the local skating rink, it costs $6 to rent skates and $4 for each hour skated.

Situations can be projected or given to students as a document. Below are suggested answers to guide student discussion.

Q#1: Matthew is training for a marathon and runs 4 miles per day for the first week. He continues his training by increasing the daily distance by 1.5 miles each of the weeks before the marathon.

A#1: changing value would be the number of weeks Matthew has trained (which does change the number of miles Matthew runs). $4 + 1.5w$ w = weeks Matthew trains

Q#2: The price of a visit to the local dentist is $30. If any cavities are found, there is an additional charge of $150 for each cavity

A#2: changing value would be the number of cavities found. $\$30 + \$150c$ c = number of cavities

Q#3 At the local skating rink, it costs $6 to rent skates and $4 for each hour skated.

A#3: Changing value would be the number of hours skated. $\$6 + 4h$ h = hours skated

2. Working in small groups, students determine the constraints and write an equation for the following situations. Students share answers to determine his or her understanding before returning to the pizza party activity.

Q#1: Marion was planning a birthday party. Her cake costs $45 and she can spend a total of $100 for the party.

Q#2: Mandy was planning a Christmas party. She can invite at most 15 friends to the party.

Q#3: Sandy wants to order some technology for her new computer from *Computers Are Us*. She would like them to ship the order to her home. Sandy's order must be at least $150 in order to receive free shipping from *Computers Are Us*.

The above situations can be projected or given to students as a document. Below are suggested answers to guide student discussion.

Q#1 Marion was planning a birthday party. Her cake costs $45 and she is can spend a total of $100 for the party.

A#1: $100 total for party $45 + p + d \leq 100$ p = pizza ($) d = drinks ($)

Q#2 Mandy was planning a Christmas party. She can invite at most 15 friends to the party.

A#2: 15 friends invited to party $f < 15$ f = number of friends

Q#3: Sandy wants to order some technology for her new computer from Computers Are Us. She would like them to ship the order to her home. Sandy's order must be at least $150 in order to receive free shipping from Computers Are Us.

A#3: $150 order amount to receive free shipping $c \geq 150$ c = cost

3. Provide students with *Cost Plan 2* document. Students record equations on this document. Create the *Cost Plan 2* document prior to beginning the task. Include the following in the document: changing values for the pizza party; constraints for the pizza party; equations with variables used to find the cost for each item; equation with variables to find the total cost for the party; equations (or inequalities) with constraints; the equation for cost per person; the equation for finding the cost per square inch.

4. As a whole group, students discuss what can affect the number of items needed for the pizza party. Use the following questions to guide the discussion: What factors could cause the price of the pizza to change? What factors could change the number of students attending the pizza party? How does the number of students attending the pizza party affect the number of items purchased for the pizza party?

5. Working in small groups, students discuss items chosen for their pizza party and determine if it is an item whose quantity will vary or not.
   For example, students in a small group plan for each attendee to eat 2 pieces of pizza. Each large pizza has 8 pieces. How does the attendance on the day of the party affect the number of pizzas purchased?
6. As a whole group, students discuss ways to handle the need for part of a pizza or part of a package of cups. The discussion should include rounding to the nearest integer as well as purchasing pizza by the slice.
7. Students write equation(s) with variables to determine the costs of pizza, drinks, chosen sides, paper products, and decorations for their party. Record the equations on Cost Plan 2 document.
   Example: Students in a small group plan for each attendee to eat 2 pieces of pizza. Each large 1 topping pizza has 8 pieces and costs $10. The equations for this information could be:
   $n = \left(\frac{2s}{8}\right)$ n = number of pizzas rounded up to the nearest integer s = number of attendees
   $p = \$10n$ p = cost of pizza
   **2s may not always be divisible by 8 without a remainder, discuss with students the need to round up to the nearest integer.
   Some questions to ask students as the teacher circulates around the room include: are the variables clearly defined? Does the item have a fixed cost, or does it vary? What equations do you need? Is every item for the pizza party represented by an equation? How do you represent the total cost of the pizza party? Does each of the pizzas cost the same amount? What items will be purchased in packages (such as plates)?
   As a whole group discusses, as prompt with the following question: what constraints would apply to the party? Some suggested responses include budget allotment (suggest $75), attendees, and any other constraints based on chosen items for the party
8. Working in small groups, students write equations (or inequalities) to represent constraints including the number of students at the party and the cost of the party. Record equations on *Cost Plan 2* document. Here are some questions to ask students as the teacher circulates about the room: How many attendees do you expect to come to the party? What is the maximum number of attendees that could come to the party? What is the total amount of money you can spend? What is the least amount of money you could spend and have pizza and drinks for the entire class? Are there any fees based on what you order? How does this impact the planning for your pizza party?
9. Working in small groups, students analyze their constraint inequalities by completing the following for each constraint. Verbally restate the constraint using the equation (or inequality). For example, the greatest number of students that can come to the party is 30. State an example that is true and an example that is false for each constraint. For example, s = 28 (true statement) and s = 31 (false statement).
10. Working in small groups, students write the equation for the cost per person using a variable(s) for changing values.
11. For small groups with impending skills, write equations for cost per square inch using variables for the changing values for two different pizza sizes.

Day 3

Gallery walk using the rubric to determine which party will be used as the classroom celebration.

- Complete individual assessment – 10 problems *Translating Real World Problems into Equations*

Day 3 Teacher Notes:

Students determine the information for small group charts by answering the following questions as a whole group. What information should be included on the chart? What information needs to be defined on the chart? Which equations should be included on the chart? Record information to be

included on the small group chart on a whiteboard or project information for students to reference as they work. Emphasize including and labeling all equations and inequalities used to create the total cost as well as constraints determined by the group.

1. Working in small groups, create a chart with information and equations for the pizza party that will be used during the gallery walk.
2. Whole group discussion to determine a short rubric to be used as students complete the gallery walk. Suggestions for rubric: Are the variables defined? Are all items for the party included in an equation? Is the total equation clearly defined? Are all items (pizza amounts, drinks, additional sides, paper products, and decorations) clearly defined? Define criteria to determine the best pizza party (does it have to be the cheapest party)? Post or project the rubric for the students to use as they complete the gallery walk
3. Individual Assessment - *Translating Real World Problems into Equations*
   Students individually complete the following assessment: complete problems 1 – 5 using practice one (click here) and complete problems 6 – 10 by writing an equation or inequality for the 5 quantities and constraints listed below (click here).

quantities	constraints
• the number of guests • the cost of food and drinks • the cost of birthday cake • the cost of entertainment • the total cost	• 20 people maximum • \$5.50 per person • \$40 for a large cake • \$15 for music and \$27 for games • no more than \$180 total cost

quantities	constraints
• the number of guests • the cost of food and drinks • the cost of birthday cake • the cost of entertainment • the total cost	• $n \leq 20$ • $5.50n$ • 40 • $15 + 27$ • $C \leq 180$

Share, Discuss, and Analyze Phase

Essential Understanding #1*: Quantities in a situation can be represented by expressions with constants and variables.*

Share – Students are given the task of planning a pizza party for a class celebration. In small groups, students discuss the following: What they know specific to their class (number of attendees, total money to be spent)? What do they need in terms of food and drink, paper products, and decorations? Location of information such as prices for food, drink, paper products, and decorations. What questions need to be addressed for the task to be completed? What information is required to address the task?

Discuss – Using each item a small group chooses for the party (pizza, drinks, cups, etc.), students answer the following questions in their small group:

Q#1: Is the item best represented with a constant, variable, or both? For example, there may be a \$10 delivery fee which would be a constant value (a large pizza with one topping could be \$10, therefore 10*p* represents the number of large pizzas needed for the party).

Q#2: What does each variable represent? For example, *p* represents the number of pizzas.

Analyze – Students working in small groups determine if each expression clearly represents an item (and its quantity) for the party. Students also translate each of their expressions into words and determine if their expression correctly defines the mathematical process needed to determine its cost.

Essential Understanding #2: *Equations can be written to represent situations with quantities that may vary or not vary based upon the criteria provided.*

Share – Students discuss what can affect the number of items that are needed for the pizza party (number of attendees, total dollars available for the party).

Students discuss if items chosen for the pizza party have a quantity that will vary or not vary. Why do you think the quantity will vary? For example, students in a small group plan for each attendee to eat 2 pieces of pizza. Each large pizza has 8 pieces, but the number of attendees could change based on attendance at school that day. This also determines the number of pizzas needed for the party.

Discuss – Students in small groups write equations that represent items for the pizza party after determining values that vary and those that do not vary. Additionally, they determine any additional variables needed based on their discussion of quantities of items needed.

The equations for the example in the share section could be:

$n = \left(\frac{2s}{8}\right)$ n = number of pizzas rounded up to the nearest integer s = number of attendees

$p = \$10n$ p = cost of pizza

**2s may not always be divisible by 8 without a remainder, discuss with students the need to round up to the nearest integer.

Analyze – Students analyze the equations they have written by answering the following questions:

Q#1: Are the variables in each equation clearly defined?

Q#2: Does the item have a fixed cost, or does it vary?
Is every item in the pizza party represented by an equation?

Q#3: When the equation is tested with the values from day 1, is the answer reasonable? If not, the equation must be revised.

Essential Understanding #3: *A constraint is a limitation on the possible or reasonable values a quantity could have and can be represented by equations (or inequalities).*

Share – In small groups, students discuss: How many attendees do you expect to come to the party? What is the maximum number of attendees that could come to the party? Does each of the pizzas cost the same amount of money? What is the total amount of money you can spend? What is the least amount of money you could spend and have pizza and drinks for the entire class? What items will be purchased in packages (such as plates)? Are there any fees based on what you order? How does this impact the planning for your pizza party?

Discuss – Student groups work together to create equations and inequalities based on each of the constraints discussed in the above questions. For example, if there are 20 students in the class, then the inequality $s \leq 20$ represents the constraint for the maximum number of students attending the party. For example, an order must be at least \$25 to qualify for free delivery could be represented by $c \geq 25$

Analyze - Student groups work together to analyze the equations and inequalities by describing each in words. Then state an example that is true and an example that is false for each equality and inequality. For example, verbally restate the constraint using the equation (or inequality) - the greatest number of students that can come to the party is 30. For example, state an example that is true and an example that is false for each constraint - $s = 28$ (true statement), $s = 32$ (false statement)