Begin a supportive year-long relationship of math learning
Understand how a problem-based lesson looks and feels

ALGEBRA 1 LESSON PLAN

Family Math Night

HANDOUT 1: Family Night Lesson Plan
HANDOUT 2: Warm-up and Activity
HANDOUT 3: Family Materials
HANDOUT 4: Condensed Lesson Plan

Illustrative® Mathematics
LEARN MATH FOR LIFE

Learning Goals:

- Begin a supportive year-long relationship of math learning.
- Understand how a problem-based lesson looks and feels.
- Understand the connection between what students are learning in class and the family support materials.
- Understand how to access the student and family materials.

Algebra 1 Lesson Plan, Unit 2, Lesson 1

Time	Activity	Teacher Notes
10 minutes	**Framing** What does it mean to you to "do math"?	• Ask participants to write down 2–3 words or phrases they would use to describe what it means to do math. This could be based on their own experiences. • Ask if anyone would like to share. Record and display their words or phrases for all to see. • Tell them after we do the activities, we will revisit this list.
10 minutes Handout 2	**Warm-up: A Main Dish and Some Side Dishes** Here are some letters and what they represent. All costs are in dollars. • m represents the cost of a main dish. • n represents the number of side dishes. • s represents the cost of a side dish. • t represents the total cost of a meal. 1. Discuss with a partner: What does each equation mean in this situation? a. $m = 7.50$ b. $m = s + 4.50$ c. $ns = 6$ d. $m + ns = t$ 2. Write a new equation that could be true in this situation.	• Tell participants this is the first lesson in the second unit. • Give each participant a copy of the handout. • Tell families that this warm-up helps anchor student thinking with equations and variables as they work with a more abstract task later in the same lesson.
20 minutes Handout 2	**Activity: How Much Will It Cost?** Imagine your class is having a party. Work with your group to plan what to order and to estimate what the party would cost. 1. Record your group's plan and cost estimate. What would it take to convince the class to go with your group's plan? Be prepared to explain your reasoning.	• Arrange families into several small groups or tell them to work with 3–4 people near them. • If necessary, explain the terms "expression," "equation," and "inequality" using examples such as $3c$, $2n + 1 = 8$, and $p < 20$.

	2. Write down one or more expressions that show how your group's cost estimate was calculated. 3. a. In your expression(s), are there quantities that might change on the day of the party? Which ones? b. Rewrite your expression(s), replacing with letters the quantities that might change. Be sure to specify what the letters represent.	● After the groups have had time to work together, ask for any ideas the groups can share. For each idea, ask if the group had an equation or inequality that could represent the idea. ● If needed, help groups write equations or inequalities to represent constraints (like $n < 30$ for n representing the number of students in the class) and costs (like $\frac{2n}{8} \cdot c$ for c representing the cost of a cheese pizza with 8 slices)
10 minutes Handout 3	**Family Materials** **Unit 2, Lesson 1 Student Lesson Summary** Expressions, equations, and inequalities are *mathematical models*. They are mathematical representations used to describe quantities and their relationships in a real-life situation. Often, what we want to describe are constraints. A constraint is something that limits what is possible or what is reasonable in a situation. For example, when planning a birthday party, we might be dealing with. . . **Unit 2 Family Materials** In this unit, students analyze equations using variables to represent unknown values. For example, a recipe may call for 4 cups of vegetables. If you are going to use mushrooms *(m)*, green beans, *(g)*, and broccoli *(b)*, you might write $m + g + b = 4$ to represent the number of cups of each vegetable you plan to use. $5n + 10d = 150$ may represent the number of dimes and nickels you could use to pay $1.50 at a parking meter. For this situation, we can see that using more dimes to make $1.50 means that we can use fewer nickels, and vice-versa. A graph allows us to see the relationship between dimes and nickels even more clearly. As you move toward the right side of the graph, you are using more nickels and fewer dimes. As you move up the graph. . .	● Tell participants that each lesson has a summary which highlights key ideas, vocabulary, and often worked examples. ● Give each participant a copy of the student lesson summary for this lesson and the family materials for the unit. ● Tell them as they read to underline ideas they touched on in the warm-up and activity today. ● Give them time to read the lesson summary. ● Explain the goals of the family materials, and ask families to read through them and try the task with their students in the next few days. ● Tell them this is the format used for the family materials for every unit. ● Pull up the curriculum website and show families how to access the family and student materials. ● Take them on a tour of the lesson they worked with.

10 minutes	**Closing** What might it mean for students to “do math”?	• Revisit the original framing question. • Ask participants, “Based on this experience, how might students describe doing math this year?” • Highlight any differences from earlier words given during the launch of the lesson.
Modifications	**45 minute session:** Consider reducing the warm-up, activity, and closing sections by 5 minutes each. This can be done by only focusing on two or three of the equations during the warm-up activity, not writing a new equation, making the main activity less open ended (for example, by giving a budgeted amount for the pizza party), and not revisiting the earlier words from the launch during the close. We suggest you do not shorten the time for the family support materials overview. **30 minute session:** Consider cutting the warm-up altogether and reducing the launch, activity, family support materials, and closing sections by 5 minutes each. **More than 1 hour:** Consider giving participants more time to explore the curriculum resources and brainstorm a list of ways these resources could help them support their child at home.	

UNIT 2, LESSON 1

Planning a Party

Algebra 1

1.1 Warm-up

A Main Dish and Some Side Dishes

Here are some letters and what they represent. All costs are in dollars.

- m represents the cost of a main dish.
- n represents the number of side dishes.
- s represents the cost of a side dish.
- t represents the total cost of a meal.

1. Discuss with a partner: What does each equation mean in this situation?
   a. $m = 7.50$
   b. $m = s + 4.50$
   c. $ns = 6$
   d. $m + ns = t$
2. Write a new equation that could be true in this situation.

1.2 Activity

How Much Will It Cost?

Imagine that your class is having a party.

Work with your group to plan what to order and to estimate what the party would cost.

"Party Balloons Isolated" by Petr Kratochvil. CC0.

1. Record your group's plan and cost estimate. What would it take to convince the class to go with your group's plan? Be prepared to explain your reasoning.
2. Write down one or more expressions that show how your group's cost estimate was calculated.
3. a. In your expression(s), are there quantities that might change on the day of the party? Which ones?

   b. Rewrite your expression(s), replacing with letters the quantities that might change. Be sure to specify what the letters represent.

Are You Ready for More?

Find a pizza place near you and ask about the diameter and cost of at least two sizes of pizza. Compare the cost per square inch of the sizes.

Student Lesson Summary

Expressions, equations, and inequalities are mathematical **models**. They are mathematical representations used to describe quantities and their relationships in a real-life situation. Often, what we want to describe are constraints. A **constraint** is something that limits what is possible or what is reasonable in a situation.

For example, when planning a birthday party, we might be dealing with these quantities and constraints:

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

We can use both numbers and letters to represent the quantities. For example, we can write 42 to represent the cost of entertainment, but we might use the letter n to represent the number of people at the party and the letter C for the total cost in dollars.

We can also write expressions using these numbers and letters. For instance, the expression $5.50n$ is a concise way to express the overall cost of food if it costs \$5.50 per guest and there are n guests.

Sometimes a constraint is an exact value. For instance, the cost of music is \$15. Other times, a constraint is a boundary or a limit. For instance, the total cost must be no more than \$180. Symbols such as <, >, and = can help us express these constraints.

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

Equations can show the relationship between different quantities and constraints. For example, the total cost of the party is the sum of the costs of food, cake, and entertainment. We can represent this relationship with:

$$C = 5.50n + 40 + 15 + 27 \qquad \text{or} \qquad C = 5.50n + 82$$

Deciding how to use numbers and letters to represent quantities, relationships, and constraints is an important part of mathematical modeling. Making assumptions—about the cost of food per person, for example—is also important in modeling.

A model such as $C = 5.50n + 82$ can be an efficient way to make estimates or predictions. When a quantity or a constraint changes, or when we want to know something else, we can adjust the model and perform a simple calculation, instead of repeating a series of calculations.

UNIT 2

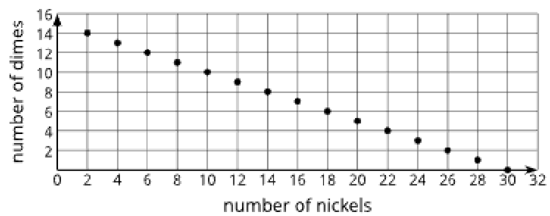
Linear Equations and Systems

Algebra 1

In this unit, students analyze equations using variables to represent unknown values. For example, a recipe may call for 4 cups of vegetables. If you are going to use mushrooms (m), green beans (g), and broccoli (b), you might write $m + g + b = 4$ to represent the number of cups of each vegetable you plan to use.

$5n + 10d = 150$ may represent the number of dimes and nickels you could use to pay $1.50 at a parking meter. For this situation, we can see that using more dimes to make $1.50 means that we can use fewer nickels, and vice-versa.

A graph allows us to see the relationship between dimes and nickels even more clearly. As you move toward the right side of the graph, you are using more nickels and fewer dimes. As you move up the graph, you are using more dimes and fewer nickels.



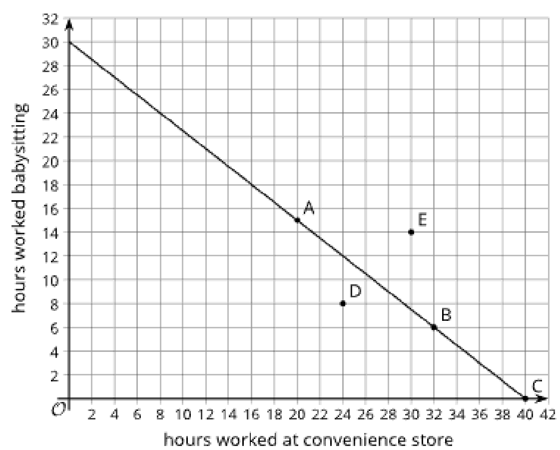
Each point on the graph represents a combination of nickels and dimes that totals $1.50. For example, if you use 8 nickels, you will need 11 dimes.

Here is a task for you to try with your student:

Priya is saving money to go on a trip. The cost of the trip is $360. She has a job at a convenience store, where she earns \)9 per hour, and she sometimes babysits for a family in her neighborhood, for which she earns $12 per hour.

The equation $9x + 12y = 360$ represents all the combinations of hours Priya could work at each job to earn a total of $360. Here is a graph showing those combinations:

1. What are the coordinates of point A?
2. What does it tell us about the number of hours Priya worked at each job?
3. Answer the same questions about points B and C.
4. Point D is not on the line. How should we interpret point D?
5. Point E is not on the line. How should we interpret point E?



Solution:

1. $(20, 15)$
2. Priya works 20 hours at the convenience store and 15 hours babysitting.
3. Point B: $(32, 6)$. Priya works 32 hours at the convenience store and 6 hours babysitting. Point C: $(40, 0)$. Priya works 40 hours at the convenience store and does not babysit at all.
4. Priya does not make enough money. She works 24 hours at the convenience store and 8 hours babysitting. She has made only $312, because $24 \cdot 9 + 8 \cdot 12 = 312$.
5. Priya makes more than enough money: $438. She works 30 hours at the convenience store and 14 hours babysitting. Her total earnings are $30 \cdot 9 + 14 \cdot 12 = 438$.

Algebra 1, Unit 2, Lesson 1: Planning a Party

Lesson Goals

- Comprehend the term "constraint" to mean a limitation on the possible or reasonable values a quantity could have.
- Use variables and the symbols =, <, and > to represent simple constraints in a situation.
- Write expressions with numbers and letters to represent the quantities in a situation.

Lesson Narrative

This opening lesson invites students to experiment with expressions and equations to model a situation. Students think about relevant quantities, whether they might be fixed or variable, and how they might relate to one another. They make assumptions and estimates, and use numbers and letters to represent the quantities and relationships. The lesson also draws attention to the idea of constraints and how to represent them.

There is not one correct set of expressions or equations governing the potential quantities involved in the situation. The focus is on the modeling process itself—identifying relevant quantities, making assumptions, creating a model, and evaluating the model (MP4).

Making internet-enabled devices available gives students an opportunity to choose appropriate tools strategically (MP5).

1.1 Warm-up: A Main Dish and Some Side Dishes (5 minutes)

Activity Narrative

This warm-up elicits the idea that an equation can contain only letters, with each letter representing a value. It also reminds students that an equation is a statement that two expressions are equal, and that different expressions could be used to represent a quantity. Later in this lesson and throughout the unit, students will create, interpret, and reason about equations with letters representing quantities.

Launch

Arrange students in groups of 2. For the last question, ask each partner to come up with a new equation.

Student Task Statement

Here are some letters and what they represent. All costs are in dollars.

- m represents the cost of a main dish.
- n represents the number of side dishes.
- s represents the cost of a side dish.
- t represents the total cost of a meal.

1. Discuss with a partner: What does each equation mean in this situation?
    a. $m = 7.50$
    b. $m = s + 4.50$
    c. $ns = 6$

d. $m + ns = t$

2. Write a new equation that could be true in this situation.

Student Response

1. Sample response:
   - A main dish costs $7.50.
   - A main dish costs $4.50 more than a side dish.
   - Ordering *n* side dishes at *s* dollars each costs $6.00.
   - The total cost of the meal is the cost of a main dish plus the cost of *n* side dishes at *s* dollars.

2. Sample responses:
   - $n = 2$
   - $m - s = 4.5$
   - $m + 6 = 13.5$

Activity Synthesis

Invite students to share their interpretations of the given equations and the new equations they wrote. Then discuss with students:

- "What is an equation? What does it tell us?" (An equation is a statement that an expression has the same value as another expression.)
- "Can equations contain only numbers?" (Yes.) "Only letters?" (Yes.) "A mix of numbers and letters?" (Yes.)
- "The last question asked you to write an equation that could be true. Could this equation be true: $m + 5 = t$? How do you know?" (It could be. If *m* is 7.50 and *t* is 12.50, then the equation is true.)
- "When might the equation be false?" (If *m* is 7.50 and *t* is anything but 12.50, or if the value of *t* is not 5 more than *m*, then it is false.)
- "One equation tells us that a main dish is $7.50. Another equation tells us that it is equal to the expression $s + 4.50$. Could both be true? Are they both appropriate for expressing the cost of a main dish?" (Yes. The first one tells us the price in dollars. The second tells us how the price compares to a side dish.)

1.2 Activity: How Much Will It Cost? (20 minutes)

Activity Narrative

This activity prompts students to create expressions to represent the quantities and relationships in a situation and engages them in mathematical modeling.

Students plan a party and present a cost estimate. To do so, they need to consider relevant variables, make assumptions and estimates, perform calculations, and adjust their thinking along the way (MP4). Some students may choose to perform research and revise their models as they gather new information. Making internet-enabled devices available gives students an opportunity to choose appropriate tools strategically (MP5). There are many possible solutions to the task.

As students discuss their ideas, monitor for those who:

- Find and use actual data or exact values (for example, count the number of students in the class, research the cost of a large pizza at a nearby shop, or quickly survey the class for topping preferences).
- Estimate quantities based on prior knowledge (for example, the cost of a large pizza in a recent purchase, or the number of slices they and their friends generally consume at lunch time).
- Make assumptions about behaviors, preferences, or quantities (for instance, assume that a certain percentage of the class prefers a certain topping).

Launch

Ask students if they have ever been in charge of planning a party. Solicit a few ideas of what party planners need to consider. Ask students to imagine being in charge of a class party. Explain that their job is to present a plan and a cost estimate for the party.

Arrange students in groups of 4. Provide access to calculators and, if feasible and desired, access to the internet so they can research prices. Students can also make estimates based on prior experience, refer to printed ads, or use their personal device to look up pricing information.

Limit the time spent on the first question to 7–8 minutes and pause the class before students move on to subsequent questions. Give groups of students 1–2 minutes to share their proposals with another group. Then, select a few groups who used contrasting strategies (such as those outlined in the *Activity Narrative*) to briefly share their plans with the class. Record or display their plans for all to see.

Next, ask students to complete the remaining questions. If needed, give an example of an expression that can be written to represent a cost calculation.

Student Task Statement

Imagine your class is having a party.
Work with your group to plan what to order and to estimate what the party would cost.

1. Record your group's plan and cost estimate. What would it take to convince the class to go with your group's plan? Be prepared to explain your reasoning.
2. Write down one or more expressions that show how your group's cost estimate was calculated.
3.
    a. In your expression(s), are there quantities that might change on the day of the party? Which ones?
    b. Rewrite your expression(s), replacing the quantities that might change with letters. Be sure to specify what the letters represent.

Student Response

Sample response:

1. There are 28 people in the class.
    a. If each person gets 2 slices of pizza, $28 \cdot 2$ or 56 slices are needed.
    b. One pizza has 8 slices, so 7 pizzas are needed.
    c. A large cheese pizza is $11 and a large pepperoni pizza is $13.
    d. Many students prefer cheese, so let's order 4 cheese pizzas and 3 pepperoni pizzas. 4(11) + 3(13) = 83.
    e. Tax is about 8%, and 8% of $83 is $6.64, so the total cost would be about $90.
2. Number of pizzas: $(28 \cdot 2) \div 8$. Cost of pizzas, excluding tax: 4(11) + 3(13). Total cost including tax: 83 + 83(0.08).
3.
    a. Some students might be absent on the day of the party, so the number of students might change. The pizza shop might have a special deal on pizzas, so the cost per pizza might change.
    b. Number of pizzas: $(n \cdot 2) \div 8$, where *n* is the number of students. If the number of pizzas is not going to change, the cost of pizza: 4*c* + 3*p*, where *c* is the cost per cheese pizza and *p* is the cost per pepperoni pizza.

Activity Synthesis

Invite groups who did not previously share their plans to share the expressions they wrote and explain what the expressions represent. After each group shares, ask if others calculated the costs the same way but wrote different expressions.

As students present their expressions, record the quantities that they mention and display them for all to see. Some examples:

- the number of students in the class
- the number of food items per person
- the cost of delivery

Briefly discuss the quantities that students anticipate would change (and therefore would replace with letters).

Explain to students that the expressions they have written are examples of mathematical models. They are mathematical representations, of a situation in life, that can be used to make sense of problems and solve them. We will look more closely at how expressions could represent the quantities in a situation like party planning, which involves certain conditions or requirements.