



INDIGENOUS WISDOM: CENTURIES OF PUEBLO IMPACT IN NEW MEXICO

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HIGH SCHOOL CURRICULUM

2nd Edition

Title of Unit: Seeking Balance to Meet the Needs of Our Communities through the Mathematics of Solving

Content Area: Mathematics - Algebra II

Grade Level: 9-12

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Section A: Introductory Materials

Name: Regina Jojola Lucero

Title of Unit: Seeking Balance to Meet the Needs of Our Communities through the Mathematics of Solving Systems of Linear Equations

Content Area: Mathematics - Algebra II

Grade Levels: Grades 9-11

Rationale:

On August 10, 1965 the Housing and Urban Development Act of 1965 expanded their federal housing programs. HUD was created (Housing and Urban Development) on September 9, 1965. As a result, on April 1968 the Fair Housing Act was enacted to ban discrimination in housing. Then in 1988 The Indian Housing Act gave HUD new responsibilities for housing the needs of Native Americans and Alaskan Indians. The Housing and Community Development Act allowed the sale of public housing to resident management corporations.

Although the purpose of the HUD program was to develop housing in urban areas, its introduction to the Pueblo People had both its pros and cons. HUD provided opportunities and funding for new homes to be built on the reservation. Multiple families living in one home could now be reduced because of HUD.

Prior to HUD, Pueblos were built in a community setting where everyone lived very closely. Often times you could not see where one house ended and another began; in fact, multiple dwellings would look like one long, continuous home. This was the way of life in the Pueblos, a very tight community of people working together to live and prosper. This type of community built a strong nucleus, where it would take a village to raise a child. However, once the HUD was introduced, stipulations and rules began to dismantle the core nucleus of the Pueblo. Homes began to be built outside the "village" and in rural areas of the reservation. The closeness of the tightly woven community began to fall apart. The Pueblo People had to learn to preserve who they were despite the distances created by this new program.

Many families were in need of housing on the reservation and HUD has given them the opportunity to own a home despite their low income. HUD had become a very prominent part of the housing structure on the reservations. In this math unit, we will concentrate on the planning and budgeting of building a subdivision to house the tribal members. There will be a certain amount of money allotted for the project and a specified amount of acreage for the subdivision. We will concentrate on simple portions of the budget, although there are other costs associated with planning such as engineering, consulting fees, and utilities. We will solely focus on the total cost amount for constructing certain types of homes and the amount of acreage they will need. These types of decisions are made by the housing departments in the Pueblos. In this unit we will determine if we can stay within our budget and acreage to meet the needs of our community, maximizing our efforts to offer equal opportunities to all members.

The biggest core value addressed in this unit is Service. Although it is healthy to live as a one-unit family, it is also important to love, care for, and help our neighbors. While HUD has certainly allowed for more comfortable living conditions and helped the community and its members by providing shelter, we as a Native People must always follow our roots and stay connected. Along with Service, another core value addressed in this unit is Compassion.

Balance is also a core value addressed because we must maintain equilibrium of the ecosystem and humanity, utilizing our resources wisely.

Unit Goals:

1. Students will be able to use systems of equations to model problems, given constraints in the community.
2. Students will be able to solve systems of equations by substitution.

The focus of this unit is to solve systems of linear equations using substitution. When tribes build homes, they have a budget and must use land that is scarce but essential to create shelter for its members. Students will get a history of HUD and its effects on Native American communities. They will learn about the restrictions that tribes must abide by to meet the requirement to sustain balance for all entities. Students will model problems with constraints related to construction through a system of equations. This unit will tap into the schema of students by having them create equations with one or two variables, graph their representations to create a visual, solve systems of equations with substitution, and finally, justify their solutions using mathematics and graphs.

Standards:

Common Core Standards	Common Core Standards for Mathematical Practice
HSF-IF.B.4 HSF-IF.C.9 HSF-LE.A.2 HSF-LE.B.5	CCSS.MATH.PRACTICE.MP1 CCSS.MATH.PRACTICE.MP2 CCSS.MATH.PRACTICE.MP3 CCSS.MATH.PRACTICE.MP4 CCSS.MATH.PRACTICE.MP5 CCSS.MATH.PRACTICE.MP6 CCSS.MATH.PRACTICE.MP7

Section B: Lesson Plan One

Title: Modeling through a System of Equations

Duration: 60 minutes

Grade Level: Grades 9 - 11

Learning Objectives:

1. Students will be able to translate a real- life context into mathematical expressions and equations.
2. Students will be able to write an algebraic equation with two variables from a real life context.

Prerequisites Knowledge and Skills:

1. Variables
2. Constants
3. Rate of change
4. Labeling a graph (axes)

Materials and Resources:

1. Station cards
2. Graph paper; markers; rulers; and index cards

Guiding Questions:

1. How does one use variables to represent unknown quantities in a word problem?
2. What are the basic features of the x-y plane, including the labels for the axes?

Core Value: Balance

Procedure:

- Bell Ringer (8 minutes):
 - Students work independently for 5 minutes before turning to their shoulder partner and discussing for three minutes. Teacher calls on students to share their responses and reasoning.

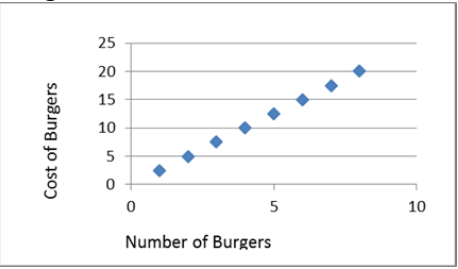
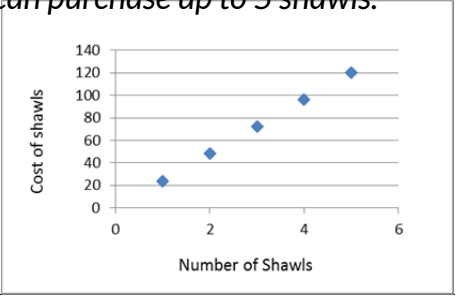
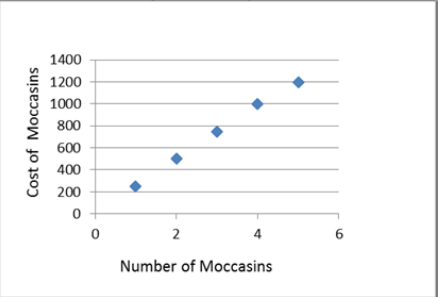
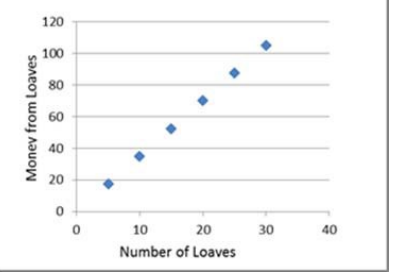
Questions:

- What is a variable in mathematics?
- Write an algebraic expression to represent the cost of buying sandwiches when the store charges five dollars per sandwich.
- Activity (20 minutes):
 - Students write equations with one variable before solving and graphing them.
 - Students work in groups and visit each station to complete the assigned tasks.

Station #1: Billy has \$20 dollars, how many fiesta burgers can he buy if they are \$2.50 per burger?
Station #2: Sarah is purchasing shawls for gifts during the holidays, she has \$125 dollars to spend how many shawls can Sarah purchase if they cost \$24.00?
Station #3: Aaron wants to purchase moccasins for \$250 a pair, they have several colors so he saved \$1200, how many moccasins can Aaron purchase?
Station #4: Jenny is baking bread and going to sell them. She is charging \$3.50 per loaf and would like to make \$100. How much would she have to make?

- When students have completed the tasks, the teacher calls on the students to present solutions and share multiple strategies.

Sample student responses for this activity:

<p>Billy has \$20 dollars, how many fiesta burgers can he buy if they are \$2.50 per burger?</p> $2.50b = 20 \quad b = \frac{20}{2.50} \quad b = 8$ <p>Billy can purchase up to 8 fiesta burgers.</p> 	<p>Sarah is purchasing shawls for gifts during the holidays, she has \$125 dollars to spend how many shawls can Sarah purchase if they cost \$24.00?</p> $24s = 125 \quad s = \frac{125}{24} \quad s = 5.2$ <p>Sarah can purchase up to 5 shawls.</p> 
<p>Aaron wants to purchase moccasins for \$250 a pair, they have several colors so he saved \$1200, how many moccasins can Aaron purchase?</p> $250m = 1200 \quad m = \frac{1200}{250} \quad m = 4.8$ <p>Aaron can purchase 4 moccasins.</p> 	<p>Jenny is baking bread and going to sell them. She is charging \$3.50 per loaf and would like to make at least \$100. How much would she have to make?</p> $3.50l = 100 \quad l = \frac{100}{3.50} \quad l = 28.57$ <p>Jenny would have to make 29 loaves to at least \$100.</p> 

- Writing equations with two variables (20 minutes):
 - In pairs, students work on the two situations for 10 minutes.
 - Students group with another pair to share methods and strategies.
 - Teacher walks around and facilitates a whole group discussion on general approaches to writing math sentences from word problems.
 - What were the two variables in each equation and how did you represent them?
 - What operations did you use to create an equation?

Situation #1: Patrick and Susan are going to the grocery store to purchase items for their Native American pie fillings. They are purchasing pumpkin filling and apple filling. The pumpkin filling is \$1.25 per can and the apple filling is \$2.00. They were given \$25 dollars to spend. Write an equation for the situation. Explain your process using academic vocabulary.

Situation #2: Your donation to the Pueblo feast day is bread and cookies. Your budget is \$100 dollars. The bread is 3.50 a loaf and the cookies are \$10 a dozen. Write an equation to represent this situation. Explain your process using academic vocabulary.

Lesson Plan Two

Title: Writing an equation with two variables and graphing the situations

Duration: 60 minutes

Grade Level: Grades 9 - 11

Learning Objectives:

1. Students will be able to write an equation with two variables from a real-life scenario.
2. Students will be able to represent the equation graphically on the x-y plane.

Prerequisite Knowledge and Skills:

1. Writing an equation
2. Slope
3. Graphing

Materials and Resources:

1. Large poster size graph paper; markers; rulers
2. Calculators
3. Sticky note

Guiding Questions:

1. How does one assign labels to the x or y-axis?
2. How does one scale a math equation on the x-y plane?
3. Can there be more than one solution to a math equation?

Core Values: Balance, compassion, service

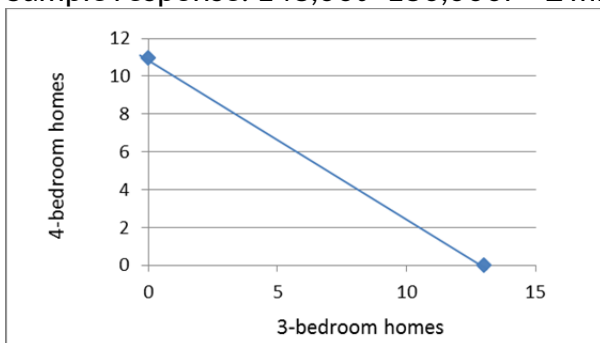
Procedure:

- Bell Ringer (5 minutes): Encourage students to share their thinking with the class and use their responses to explain the concept of solving mathematical equations.
 - Solve $2x+5y = 10$ if $y=0$. ($x=5$)
 - Solve $x + y = 5$. How many solutions exist? What are they? $(0,5)(1,4)(2,3)(3,2)(4,1)(5,0)$
- Introduction (30 minutes):
 - Teacher reads the rationale of this unit, introducing the activity with the history of HUD housing.
 - Teacher provides students with a scenario and students work in groups of four to write equations drawn from the scenario, graphing those equations on the x-y plane.
 - Students hang their posters to show their work and have a gallery walk. Each group is given post-it notes to comment on other presentations.
 - Context of the scenarios: *When Housing is making decisions to build a new subdivision, they often face certain constraints. HUD gives the Pueblos funding to build homes. Some things that Housing has to consider are the number of bedrooms in each home and the amount of acreage available to build on.*

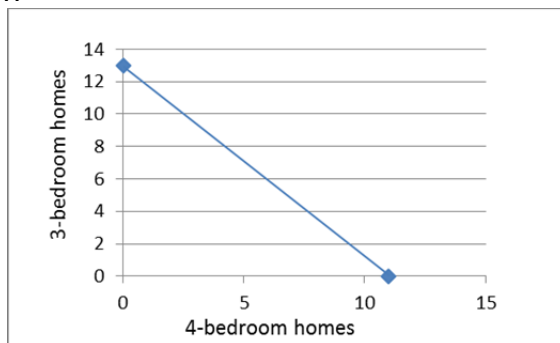
Scenario #1

The cost of a three-bedroom home is \$148,000 per home. The cost of a 4-bedroom home is \$180,000 per home. The budget is 2 million dollars. Write an equation to model the number of homes to buy within the budget and graph the equation on the x-y plane.

Sample response: $148,000t + 180,000f = 2 \text{ million}$



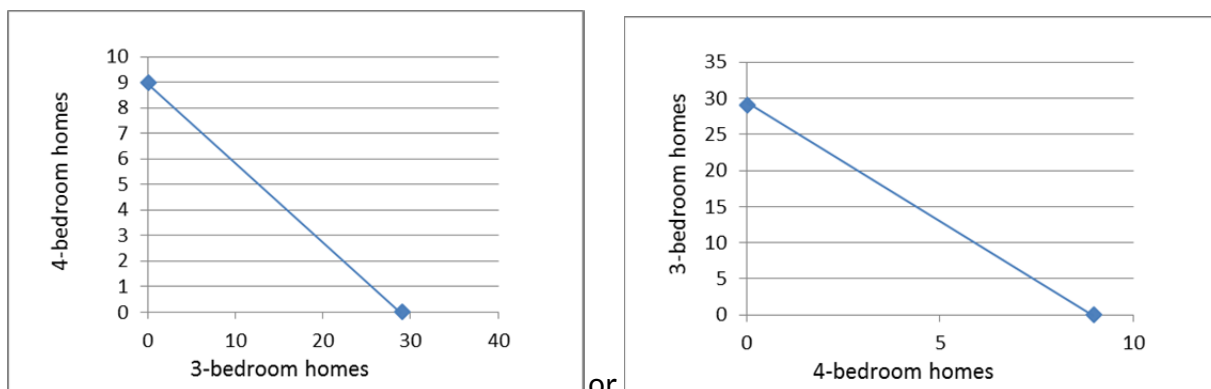
or



Scenario #2

To build a three-bedroom home the acreage needed is .25 (1/4th of an acre); to build a four-bedroom the acreage needed is .75 (3/4th of an acre). The acreage allowance for this project is 7.25 (7 ¼ the acre) . Write an equation to model the number of houses to build within the available acreage and graph the equation on the x-y plane.

Sample response: $.25t + .75f = 7.25$



- Whole group discussion on the gallery walk (10 minutes):
 - Teacher may ask the following probing questions:
 - What kind of variables did people use?
 - How did they set up an equation using the budget or acreage?
 - How did they decide to label the x or y-axis?
 - How did you check on whether your equation makes sense?
 - How did you graph your equation?
 - Students write their questions on post-it notes and place them in a box or on a parking lot.
 - Sample student questions: Why are labels of the axes different on some of the graphs? What is the dependent and independent variable?

Lesson Plan Three

Title: Solving Equations of Housing

Duration: 90 minutes

Grade Level: Grades 9 - 11

Learning Objectives:

1. Students will be able to solve systems of linear equations using substitution.
2. Students will be able to analyze graphs to represent equations.
3. Students will be able to interpret solutions and justify decisions.

Prerequisite Knowledge and Skills:

1. Graphing
2. Solving an equation for one variable

Materials and Resources:

1. Calculators
2. Graphs from the previous day
3. Scenario cards; sticker dots

Guiding Questions:

1. What do you notice about both equations and their variables?
2. How would you compare and contrast the two equations?

Core values: Balance, Compassion and Service

Procedure:

- Bell ringer (3 minutes):
 - Teacher clarifies the questions in the box or parking lot from the previous day.
- Introduction (15 minutes):
 - Each group is given colored dots and 6 scenarios. Students place their dots on their graph and justify whether the scenario satisfies the budget or acreage allowed in the situation, both graphically and mathematically.
 - Six scenarios:
 1. 4-four bedroom homes and 3- three bedroom homes
 2. 2-four bedroom homes and 7-three bedroom homes
 3. 3-four bedroom homes and 5-three bedroom homes
 4. 5-four bedroom homes and 5-three bedroom homes
 5. 3-four bedroom homes and 8 three bedroom homes
 6. 6-four bedroom homes and 2-three bedroom homes
 - Students place the dots on the graph coinciding with the situation given on the scenario cards.
 - Once all groups are finished, each group picks a scenario to discuss and shares with the class.
- Activity to solve a system of linear equations (10 minutes):
 - Teacher models the procedure to solve a system of linear equations using substitution.

Modeling procedure:

1. Given a system of $2x-3y=-2$ and $4x+y=24$
2. Rewrite $4x + y = 24$ as $y=24-4x$.
3. Substitute $24 - 4x$ for y in the first equation.
4. $2x-3(24-4x)=-2$
5. To simplify, $2x-72+12x=-2$
6. Now $14x=-2+72$
7. $x = \frac{70}{14}$

8. $x = 5$

9. To solve for y using $x = 2$, $4(5) + y = 24$

10. $20 + y = 24$

11. $y = 4$

12. The solution is $(x, y) (5, 4)$

- Activity (35 minutes): Teacher instructs students to take out their equations for the two scenarios on the three and four bedroom homes and the acreage equation.
 - Given the funds that HUD has given the tribe, the housing department needs to find the exact number of three and four bedroom homes they can build that is within their budget and acreage allowance. Using the two equations, solve by substitution and round to the nearest whole number. What does this data mean? Justify your answer.

Sample student response:

1. $148,000t + 180,000f = 2,000,000$

2. $.25t + .75f = 7.25$

$F=8$ and $T = 5$

The exact number of three bedroom homes would be 5 three bedroom houses and 8 four bedroom houses to stay within the constraints given. Yes, there are several combinations of homes to stay within the constraints, but by using substitution an exact number can be determined.

Assessment:

- Teacher facilitates group presentations of their findings.
- Teacher may ask the following questions:
 - Does it matter what axis is labeled what (dependent and independent)?
 - How many possible solutions are there?
 - Does housing have to go with exactly one outcome?
 - What do you find about the number of houses that meet the constraint as a point on the x - y plane from the graphs?

Modifications:

1. Peer coaching
2. Timing accommodations: Take more time to complete a task; Have extra time to process oral information and directions
3. Organization skills accommodations: Mark texts with a highlighter
4. Provide visual aids; Use pictures or graphics
5. Show a model of the end product (such as a completed math problem or finished quiz)
6. Allow the student to use a calculator without penalty

Extension:

- Teacher can have students research their own area federal housing programs and how they set budgets.
- Teacher can give a practice task with a different constraint.
- Teacher can challenge students to study the method of elimination and share the procedure with the class.

Culminating activity:

- Take a field trip to a local Pueblo to see their new housing development and observe the distances from the core village.
- Ask students to create a scenario with different constraints, such as engineering consulting fees, utilities, and costs related to inspections.