Outcomes
- To translate problems in context to algebraic equations
- To learn to solve equations using a balance approach

Overview
In this final session participants learn to solve equations using manipulatives. Then they explore how to write situations as algebraic equations and how to solve them algebraically. Through this process, they develop an understanding of the procedures for solving equations. This session completes the progression from concrete to abstract, from models to tables, graphs and finally to equations.
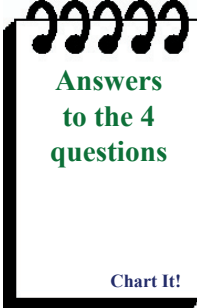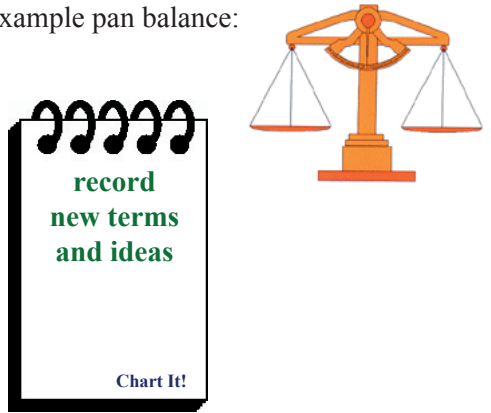
Time

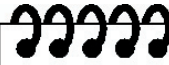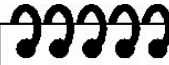|	
5–10 minutes	The session begins with a discussion on the assignment from the previous session.
10–15 minutes	Participants review their understanding of the relationship of models, tables, rules and graphs.
30-40 minutes	Participants solve equations using the idea of a pan balance. They translate the problems into algebraic equations and use mathematical notation to record their steps.
10–15 minutes	Participants solve equations related to the problems from the first session.
15-20 minutes	Participants use their understanding of the balance approach to solve more complex equations.
5–10 minutes	Connections are made to the current school curriculum program.
10–15 minutes	Closing activities for the class involve reflection and celebration.

Materials

Facilitator	**Transparencies (Eng. & Spanish)**
• Overhead graphing calculator (optional) • Transparency of graph paper • Overhead cubes or tiles • Sentence strips from previous sessions • Charts from previous session • Copies of student work about solving equations at different grade levels in the local school district (optional)	*BLM 33: Mystery Bags*
Participant	**Handouts (English & Spanish)**
• Chart paper (have available if needed) • Scissors, 1 per participant • Graphing calculators, 1 per participant (optional) • Cubes or tiles (to represent weights) • Certificates of Completion, 1 per participant (optional) • Balance Scale, 1 per table (optional but very helpful)	**One per participant for class** *BLM 33: Mystery Bags* *BLM 34: Bags of Gold* *BLM 35: Familiar Algebraic Equations* *BLM 36: Solving Algebraic Equations*

Activities

Preparation of Classroom	Notes
1. Copy **Mystery Bags** on cardstock. Cut into cards. Put out 4 cards for each participant, colored tiles and scissors. 2. Display charts from previous sessions.	Having a pan balance at each table is optional, but wil help participants who are unfamiliar with how balances work.

Discussion of Homework (5-10 minutes)	
1. Ask participants to share their work from **Equations and Problem Solving** with their group. 2. Ask for volunteers to share their work with the class using overhead transparent graph paper.	The discussion of the homework is used to review the important mathematical ideas from the previous session.

A Look Back (5-10 minutes)	
1. Display the sentence strip cards from the last session. 2. Ask the participants to discuss the following in small groups: • *How do you find an equation from a table?* • *How do you complete a table from an equation?* • *How do you graph an equation?* • *How do you get a graph from a table?* 3. Have participants share their answers with the class and record their thoughts on **Chart It!**. 4. Tell participants that in this session they will learn to solve equations. This is a concept that their children learn about throughout their education.	**Answers to the 4 questions** Chart It!

Bags of Gold (30-40 minutes)	
1. Have a brief discussion about a pan balance. You may want to draw a balance and ask participants what they know about the drawing. Record new terms and ideas on **Chart It!**. 2. Distribute a copy of **Bags of Gold** to each participant. 3. Read aloud or ask for a volunteer to read the introduction aloud. 4. Tell participants that they can use the cut-out **Mystery Bags** cards and the colored tiles to work the problems.	Example pan balance: **record new terms and ideas** Chart It!

Activities

Bags of Gold (continued)	Notes
5. Have participants work in pairs for about 20 minutes on the problems. Let them know that there are different approaches to solving these problems. They should record their strategies on the worksheet and be ready to share them. 6. As participants work on the problems, walk around helping those who need it and challenging others with questions similar to the following: *Can you prove that your answer is correct?* *What if there were __ bags instead of __ bags?* *Why are the answers for numbers 6 and 7 different?* 7. Have groups present solutions using transparent manipulatives on the overhead projector. Ask: *Does everyone agree with this?* *Talk to your partner and explain what you understand about this approach.* *Did anyone do this another way?* *How can we be sure that the answer is correct?* **Processing the Problems Algebraically** 8. Help the participants assign a variable by asking: *If we were to assign a variable to represent the amount of gold in each bag, what might it be?* 9. Record the variable that the class decides to use for the amount of gold in a bag so that this same variable can be used for each of the problems. 10. Help participants write an algebraic equation for the situation. Ask: *How can we write an equation for the first problem using __ to represent the amount of ounces of gold in each bag?* 11. Help participants record the solvintg of the equation by asking: *How did ___ solve this equation using the pan balance?* If a participant says that the 56 ounces has to be shared or cut into four, then ask: *What operation is that? Probe with: Are you adding 4 to 56, subtracting 4 from 56, multiplying 4 and 56 or dividing 56 by 4?* *How can we write that?*	Notice that number 6 has no correct solution and number 7 has an infinite amount of solutions. As groups are working try to be aware of their approaches and use that information to determine which group(s) should present first. Leave the more sophisticated approaches for the last. **b = amount of ounces of gold in each bag** **Chart It!** **$4b = 56$** **$4b/4 = 56/4$** **$b = 14$** **Chart It!**

Activities

Bags of Gold (continued)	Notes

• *You have 4 bags and 4 piles of lead weights. So, you have 4 groups on each side of the scale. So, how many ounces are allotted to each bag ?* (14)
 	
12. Show how to write each step of the solution. Comment about keeping balance in the equation just as on the pan balance. Since this is an equation then one side has the same value as the other side. To keep this balance whatever is done to one side must also be done to the other side.
 	
13. Have participants try this process on the second problem.
 	
14. Have a presentation on writing an algebraic equation and solution to number 2.
 	
15. Give participants about 10 minutes to write the equation and the solution steps for the next 5 problems.
 	
16. Determine what is needed in terms of whole group discussion or presentations on this work based upon your interactions and findings as you work with the groups.
	Answers:
	  1. $4b = 56$
	     $b = 14$
	  2. $b + 36 = 80$
	     $b = 44$
	  3. $10b + 20 = 100$
	     $b = 8$
	  4. $2b + 18 = 3b$
	     $b = 18$
	  5. $8b + 65 = 3b + 120$
	     $b = 11$
	  6. $5b + 12 = 5b + 15$
	     no answer
	  7. $12b + 8 = 12b + 8$
	     all real numbers
	
	Walk around to answer questions and be aware of which problems are causing disequilibrium. (#s 6 & 7 usually need discussion.)

Familiar Algebraic Equations (10-15 minutes)	
1. Distribute **Familiar Algebraic Equations.** 2. Discuss the first question with 89 birds to verify that the participants understand what needs to be done. 3. Let the participants work at their own pace as you facilitate the learning in the individual groups. 4. Follow with presentations by the participants.	If some participants need to be challenged, have them solve these equations using a graphing calculator. For the first problem, • graph $y = 2x + 1$ • use the trace button to find the value for x • use the table function to find the value for x If there is not sufficient time to present all problems, select the problems to be presented based on those that elicited different strategies, were particularly challenging, or gave AHAs.

Activities

Solving Equations (15-20 minutes)	Notes
1 Ask participants: *So, what does it mean to solve an equation?* 2. Give groups about 1 minute to discuss this. 3 Lead a whole class discussion on what it means to solve an equation. Record the ideas from each group on the **Chart It!**. 4. Ask: *What are some things that you want to remember when you are solving equations.* a) Have individuals write their ideas b) Have small groups share c) Record ideas from the entire class 5. Distribute **Solving Algebraic Equations** and let participants know how much time they have to complete these. 6. Write the solutions on a chart paper for participants to check their answers and answer any questions. 7. Tell them that students need to formulate a general process for solving equations. Have them discuss in their groups what they now know about the process of solving equations. 8. After participants share their ideas, tell them that the process of solving equations gets more and more complex. The discovery of the concepts involved, as we have done in this course, is important. The next step is to develop and uderstand procedures for more complex situations.	The participants should come to the conclusion that solving an equation is finding the value of the variable in the equation. record ideas **Chart It!** Answers: 1. x = 7 2. m = 12 3. y = -7 4. b = -1 5. n = 5.5 6. a = 10 7. n = -26 8. p = 2.5 9. g = 1 10. no answer
School Connection (5-10 minutes)	
1. This is a good time to discuss that their children will spend a lot of time solving equations from the time that they are very young. Show them some equations that are used in the lower grades and compare to those used in upper grades. Have either boxes or triangles for the variables. 2. Bring in copies of work done at different grade levels in the local school district.	Examples: $8 + \triangle = 12$ $3 + 7 = \square + 4$ $6 + 2y = 20$ Try to find specific examples of equation solving that occur in the adopted series of the district. Distribute copies of these.

Activities

Closure (15 minutes)	

1. Since this is the last session it should be a time to celebrate all the learning accomplishments and the friendships made.
 	
2. Tell participants that since this is the last session, you want them to think about all their experiences from this class. The following are possible ways to accomplish this. Choose one for this session.
    a) Display transparencies used in the sessions and have participants talk about or write about what they learned. For example, display the first transparency of the table showing relationships. Follow this with whole group sharing.
    b) Have a list of terms used throughout the session and ask groups to share what they know about each.
    c) Review the NCTM or state Algebra content and process standards.
    d) Display chart papers from all the sessions and have participants reflect on what they learned. Follow this with whole group sharing.
 	
3. Celebrate the accomplishments of the class by using one or more of the ideas suggested at the right.
 	
4. Make any announcements about future activities for the participants.
 	
Optional:
5. Hand out Certificates of Completion.
	It works well to have the participants acknowledge each other's accomplishments. Some suggestions are:
	• Giving pats on the back around the room.
	• Having a small treat for each term they know something about.
	• Handing out a balloon or a flower to each person as they share something about the sessions.