

At RPDP, we support educators through professional development. Professional development can occur in a variety of ways: Entire staff trainings, grade level meetings, one-on-one support, etc. We collaborate with administrators and teachers regarding the developing and strengthening math content knowledge, use of best practices in the classroom, we model lessons, and provide support for the use of quality instructional materials.

Providing educators with quality resources in regards to instructional materials is a continuous priority. We provide this support through math content overviews, the use of instructional materials, further practice/skill development materials, and through quality assessments/tasks. As we work to create these resources for educators, we may recommend other quality resources from time to time.

In recent years, some states have received funds to create quality instructional materials for ALL educators for ALL states to access. We have selected some of those materials that we believe support our vision of quality instructional materials that support teachers in providing a solid mathematical foundation for students. For more elementary math resources please visit Rpdp.net .





Math Detectives!

Using Properties of Operations to Find Change Unknown Grade One Mathematics

First graders will explore the mathematics behind having unknowns in “change positions” in equations. They will create situation equations that represent what occurs in a story problem. Students will use properties of operations to rearrange equation components to create solution equations. In this unit students will gain an understanding of addition and subtraction, the relatedness of the two operations, and the meaning of the equal sign. This unit is meant as a bridge between student proficiency with typical result unknown problem types and the much more difficult start unknown problems.

These Model Curriculum Units are designed to exemplify the expectations outlined in the MA Curriculum Frameworks for English Language Arts/Literacy and Mathematics incorporating the Common Core State Standards, as well as all other MA Curriculum Frameworks. These units include lesson plans, Curriculum Embedded Performance Assessments, and resources. In using these units, it is important to consider the variability of learners in your class and make adaptations as necessary.



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Table of Contents

Stage 1 Desired Results.....	4
Stage 2 - Evidence	6
Stage 3 – Learning Plan.....	8
Lesson One: Dragons and Worms	10
Lesson Two: Speeding Cars	17
Lesson Three: Detective Journals.....	23
Lesson Four: True or False Clues	32
Lesson Five: Missing Parts.....	37
Lesson Six: Apple Tree Mysteries	43
Lesson Seven: Detective Practice in Centers	51
Lesson Eight: CEPA#1 Card Thief	55
Lesson Nine: Equation Match Mystery	59
Lesson Ten: Cookie Jar Mystery.....	64
Lesson Eleven: Zoo Mysteries	71
Lesson Twelve: CEPA#2 Math Buddies	77



Table of Contents

Unit Plan	p. 3
Lesson One: Dragons and Worms	p. 10
Lesson Two: Speeding Cars	p. 17
Lesson Three: Detective Journals	p. 21
Lesson Four: True or False Clues	p. 28
Lesson Five: Missing Parts	p. 32
Lesson Six: Apple Tree Mysteries	p. 36
Lesson Seven: Detective Practice with Centers	p. 42
Lesson Eight: CEPA #1 : Card Thief	p. 46
Lesson Nine: Equation Match Mystery	p. 49
Lesson Ten: Cookie Jar Mystery	p. 53
Lesson Eleven: Zoo Mysteries	p. 58
Lesson Twelve: CEPA #2: Math Buddies	p. 63
CEPA Rubric	p. 70



Stage 1 Desired Results

<p>ESTABLISHED GOALS G</p> <p>(See Chart on p. 183 MCFM)</p> <p>Represent and solve problems involving addition and subtraction.</p> <p>1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, <u>with unknowns in all positions</u>, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.</p> <p>Understand and apply properties of operations and the relationship between addition and subtraction.</p> <p>1.OA.3. Apply properties of operations as strategies to add and subtract.² <i>Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)</i></p> <p>1.OA.4 Understand subtraction as an unknown-addend problem. <i>For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.</i></p> <p>Work with addition and subtraction</p>	<p>Transfer</p> <p><i>Students will be able to independently use their learning to...</i></p> <p>Students will be able to independently use their learning to... Interpret and persevere in solving complex mathematical problems using strategic thinking and expressing answers with a degree of precision appropriate for the problem context.</p>		
	<p>Meaning</p>		
	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 60%; vertical-align: top;"> <p>UNDERSTANDINGS</p> <p><i>Students will understand that...</i></p> <p>U1 There is a connection between counting and addition and subtraction.</p> <p>U2 An equation represents a mathematical situation that describes a context and can have an unknown in any position.</p> <p>U3 Addition and subtraction are inverse operations and relate to each other.</p> <p>U4 The equal sign signifies that the two sides of an equation have the same value.</p> </td> <td style="width: 40%; vertical-align: top;"> <p>ESSENTIAL QUESTIONS Q</p> <p>E1 How do counting and properties of operations help us add and subtract?</p> <p>E2 How can I use the link between addition and subtraction to solve different types of problems?</p> <p>E3 How do equations help us make sense of a problem and discover what unknown is missing?</p> </td> </tr> </table>	<p>UNDERSTANDINGS</p> <p><i>Students will understand that...</i></p> <p>U1 There is a connection between counting and addition and subtraction.</p> <p>U2 An equation represents a mathematical situation that describes a context and can have an unknown in any position.</p> <p>U3 Addition and subtraction are inverse operations and relate to each other.</p> <p>U4 The equal sign signifies that the two sides of an equation have the same value.</p>	<p>ESSENTIAL QUESTIONS Q</p> <p>E1 How do counting and properties of operations help us add and subtract?</p> <p>E2 How can I use the link between addition and subtraction to solve different types of problems?</p> <p>E3 How do equations help us make sense of a problem and discover what unknown is missing?</p>
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<i>Students will know...</i>	<i>Students will be skilled at...</i> S		



equations.

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? $6 = 6$, $7=8-1$, $5+2=2+5$, $4+1=5+2$*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP1 Make sense of problems and persevere in solving them.

SMP2 Reason abstractly and quantitatively.

SMP3 Construct viable arguments and critique the reasoning of others.

SMP4 Model with Mathematics

RI.2.1 Ask and answer such questions as who, what, when, where, why, how, and demonstrate understanding of key details in a text.

RI.2.2 Recount stories and determine the central message.

K1 Mathematical situations can call for unknowns in varying locations in an equation.

K2 Different mathematical problems call for different types of equations to solve them.

K3 One can add addends in any order and find the same sum.

K4 Subtraction can be solved using addition, and addition can be solved using subtraction.

K5 Academic vocabulary including: addition, subtraction, add to, take from, put together, take apart, unknown, equation, symbol, total, addend, situation equation, solution equation, counting on, counting back, change

S1 Writing a situation equation* to represent a change unknown, addend unknown, and difference unknown problems.

S2 Add and subtract within 20 to solve word problems using objects, drawings and solution equations*.

S3 Using the Commutative property of addition as a solution equation.

S4 Counting on or back to solve subtraction problems efficiently.

S5 Making two sides of equation equal.

*Note:

A **situation** equation models the problem type situation. This equation may not immediately lead to the answer.

A **solution** equation is a related equation that demonstrates strategy use and leads to the answer.

The solution equation may or may not be the same as the situation equation. This construct is designed to help children use properties of operations to solve problems.



	unknown, addend unknown, difference unknown, related facts, true, false, equal sign, join, separate, and strategies.	<u>Progressions for the Common Core State Standards in Mathematics</u> ; The Common Core standards Writing Team, 5.29.2011; commoncoretools.wordpress.com
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Stage 2 - Evidence

Evaluative Criteria	Assessment Evidence
<p>Are students able to use strategies to find change unknown?</p> <p>Are students able to explain their thinking?</p> <p>Are students able to use mathematical strategies to find, explain and defend a solution to a change unknown problem?</p>	<p>CURRICULUM EMBEDDED PERFORMANCE ASSESSMENT (PERFORMANCE TASKS)</p> <p>PERFORMANCE TASK A: <u>Card Thief!</u></p> <p>You are a card detective and your job is to discover how many cards a card thief has taken. For each turn, one partner will be the detective and one will be the thief. Take your pack of 20 cards and throw them in the air. The detective must close his/her eyes. The thief quietly and quickly takes all the face-up cards. The detective must use his/her math skills to solve the mystery of how many cards have been taken without counting.</p> <p>Use the recording sheet to document and solve your case. Show all your work and be sure to write an equation. Check your answers by counting on or back. Now trade jobs and repeat the process.</p> <p><u>Teacher notes:</u> The number of cards may vary to differentiate instruction. Two color counters can be used in place of cards, but the context of the problem will need to be adjusted.</p> <p>Results from CEPA #1 should be used as a guide to provide teachers with information to be used to differentiate instruction. The recording</p>



	<p>sheet should be prepared in advance and include: space for an equation and work.</p> <p>PERFORMANCE TASK B: <u>Math Buddy</u> You have been asked by your teacher to check your math buddy's work. First, solve your problem and write only your answer on the back of the recording sheet. Trade problems with your buddy who will check your work.</p> <p>Next, work on your buddy's problem to check your buddy's answer. Solve your buddy's problem using both pictures and equations. Decide if your math buddy was correct and defend your answer. (SMP 3 Construct a viable argument and critique the reasoning of others.)</p>
<p>Are students able to write a situation equation to represent the change unknown, addend unknown, and difference unknown in story problems?</p> <p>Are students accurately using objects, drawings, and solution equations to solve story problems within 20?</p> <p>Can students use inverse operations to check answers?</p>	<p>OTHER EVIDENCE: Exit slips Solving story problems and writing equations to match Work with related facts focused on the commutative property Quiz: Are equations true or false for a given problem? Defending answers in group talks Explaining story problems, filling out a story maps if necessary</p>



Stage 3 – Learning Plan

Summary of Key Learning Events and Instruction

Assumed grade one prior knowledge: Finding *result unknown* and *total unknown* in story problems using objects, pictures and equations.

1. **Overview:** The unknown can be in the “change” position. Use counting on and back strategies to solve change unknown in add to and take from story situations. Introduce meaning and use of equal sign. *(Please refer to chart on p. 183 of Massachusetts Curriculum Frameworks for Mathematics (MCFM) for clarification)*

Objective: Students will be able to solve change unknown in add to and take from story situations using objects and pictures.

2. **Overview:** Use commutative property with counting strategies to find **change unknown** (including add to and take from) and **addend unknown** (including put together and take apart) using objects and pictures. *(Please refer to chart on p. 183 of MCFM for clarification)*

Objective: Students will be able to solve change unknown and addend unknown from story situations using objects and pictures.

3. **Overview:** Translate finding change unknown, addend unknown, and difference unknown problems with objects and pictures to equations. Emphasize meaning and use of equal sign.

Objective: Students will be able to write equations to represent change unknown, addend unknown, and difference unknown problems.

4. **Overview:** Determine if equations involving addition and subtraction are true or false. (Commutative property such as $5+2=2+5$) Quiz.

Objective: Students will be able to show and explain how and why two sides of an equation are equal.

5. **Overview:** Subtraction can be seen as an *unknown addend* problem and can be solved by using addition. (related facts)

Objective: Students will be able to create a situation equation to model a problem, and use related facts to create a solution equation.

6. **Overview:** Subtraction can be seen as an *unknown addend* problem and can be solved by using addition and



decomposition.

Objective: Students will be able to decompose numbers within an equation to facilitate solving.

7. **Overview:** Application/synthesis of lessons 1 – 6 with explaining thinking and applying discourse.

Objective: Students will be able to model and solve *change unknown* and *addend unknown* problem situations with objects, pictures, and equations.

8. **Overview:** CEPA #1 Students will construct arguments using objects, pictures, and equations to make sense change unknown, addend unknown, and difference unknown story problems.

Objective: Students will be able to demonstrate their ability to use strategies to find *change unknown*, and explain their thinking.

9. **Overview:** Match an equation to a story with *change unknown*, *addend unknown* or *difference unknown*. Discuss varied solutions.

Objective: Students will be able to match an equation to a story with change unknown or addend unknown. Discuss varied solutions.

10. **Overview:** Students will construct arguments using objects, pictures, and equations to make sense of *change unknown*, *addend unknown*, and *difference unknown* story problems.

Objective: Students will be able to explain how and why they used properties of operations/inverse operations to translate the situation equation into a solution equation.

11. **Overview:** Write a story to match an equation with *change unknown*, *addend unknown* or *difference unknown*. Defend their solutions using objects, pictures, or equations.

Objective: Write a story that matches a situation equation and explain why the equation models the story with *change unknown*, *addend unknown* or *difference unknown*, and be able to solve and explain their solution.

12. **Overview:** CEPA #2

Objective: Students will be able to demonstrate their ability to use strategies to find change unknown in addition and subtraction situations, and explain their reasoning to a partner.

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Lesson One: Dragons and Worms

Brief Overview: Students will learn that the unknown can be in the “change” position. They will use counting on and back strategies to solve *change unknown* problems in *add to* and *take from* story situations. Students will be introduced to the meaning and use of the equal sign. (Please refer to chart on p.183 of *Massachusetts Curriculum Frameworks for Mathematics* for clarification.) As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: Finding result unknown, total unknown, and both addends unknown in story problems using objects, pictures and equations.

Estimated Time: 45+ minutes

Resources for Lesson:

Chart on p. 183 of *Massachusetts Curriculum Frameworks for Mathematics*

Objects

Laminated + - and = cards (see attached)

Sets of change unknown story problems, join and separate (see attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Lesson #: 1 *Dragons and Worms*

Time (minutes): 45+

By the end of this lesson students will know and be able to:

Solve change unknown in *add to* and *take from* story situations using objects and pictures.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, **with unknowns in all positions**, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.4. Understand subtraction as an unknown-addend problem. For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? $6 = 6$, $7 = 8 - 1$, $5 + 2 = 2 + 5$, $4 + 1 = 5 + 2$

SMP4: Model with mathematics

Instructional Resources/Tools

Chart on p. 183 of *Massachusetts Curriculum Frameworks for Mathematics*

Objects, such as cubes

Laminated + - and = cards

Sets of change unknown story problems, join and separate

Anticipated Student Preconceptions/Misconceptions

Unknowns always follow the equal sign.

Equal sign means “here comes the answer.”



What students need to know and are able to do coming into this lesson (including language needs): Finding result unknown, total unknown, and both addends unknown in story problems using objects, pictures and equations.

As students arrive they vote on 2 statements as true or false:

Unknowns always follow the equal sign.

Equal sign means “here comes the answer.”

Instructional Tips/Strategies/Suggestions:

- Partner strong readers with struggling readers
- Provide partners with a laminated card equal sign, plus sign, and minus sign. See samples attached.
- Provide a five box template for struggling learners or special education students (one box for equal sign). See samples attached.

Pre-Assessment

- Teacher observation of focus problem
- Results to be used to differentiate instruction

Lesson Details (including but not limited to:)

Lesson Opening

Introduce the unit:

In math we have been solving result unknown problems. We're ready to use what we've learned to work on new challenges! We are going to become math detectives to solve some mysteries.

Have a discussion about what detectives do: find clues, solve mysteries, document their findings, argue their case, and find unknowns!

So today, we are going to begin solving challenging math mysteries!

Focus Problem for Lesson One:

Display a join change unknown problem such as:

There were 3 pencils on the table. The teacher put some more on the table. Now there are 8. How many pencils did the teacher put on the table with the other 3? (SMP.2: Model with mathematics.)

For ELL, teachers may first introduce the problem without numbers.

Activation:



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First have students model the add to change unknown problem on the board as a result unknown problem with objects. There were 3 pencils on the table. The teacher put 5 more on the table. Now how many are on the table? (SMP.4: Model with mathematics.) Tell students that detectives usually work with a partner to help them solve mysteries, and like detectives, they too need partners. Students **turn to partners and talk** about the story behind the result unknown problem, and why their model is an accurate depiction of the problem.

Ask students to discuss the purpose of the equal sign with a partner. Ask if $3+5=8$ is the same as $5+3=8$ and $8=3+5$?

Share briefly.

Introduce the same problem rearranged to a change unknown.

There were 3 pencils on the table. The teacher put some more on the table. Now there are 8. How many pencils did the teacher put on the table with the other 3?

How is this problem different? Students work with buddy on rug to model the new problem with cubes. (SMP.4: Model with mathematics.)

Choose one example of student work. Ask students how they solved the problem. Students are asked to agree or disagree with the model chosen and defend their answer by using counting on and counting back strategies (SMP3 Con. Ask if anyone has a different perspective.

Demonstrate the new model chosen with change unknown, and emphasize the meaning of the equal sign.

Draw model of situation, and solution using pictures and the equal sign.

Student Application

Introduce and read a new problem with *add to change unknown*. Have students work with a buddy to model the *add to change unknown* problems with objects and pictures. (See sample worksheet and operations cards.) When proficient, move to *take from change unknown*. Circulate to ask students how the equation helps them make sense of the problem to discover what unknown is missing? Ask students to explain their reasoning. Choose students with different strategies to share.

Lesson Closing

Reflection/Integration:

Orchestrate a “share out” of problems that prompts higher order thinking and debate. Use noted responses and explanations collected during the activity to deliberately push students to develop an argument and work together to make meaning.

- *Who has an answer to share?*
- *How did you decide on your answer?* (SMP3 Construct viable arguments and critique the reasoning of others.)
- *What does the “5” mean in the story?*
- *Why did you place the equal sign card where you did?*



- *Who can use their mat to show the story situation?*

Tomorrow, we are going to practice being good detectives and work with our partners to help the police to count and catch speeding cars.

Name:

Date:

PROBLEM

6 slippery worms hid under a rock. Some more slippery worms joined them. Then there were 10 slippery worms hiding under a rock. How many worms joined them under the rock?

Show your work using objects:



--	--

Answer the question

Name:

Date:

PROBLEM

16 dragons sat on a hill. Some flew away. 4 dragons were left sitting on the hill. How many dragons flew away?

Use objects to show your work



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Answer the question

	$+$		$=$	
--	-----	--	-----	--



	-		=	
--	---	--	---	--

Lesson Two: Speeding Cars



Brief Overview: Students will use the commutative property with counting strategies to solve problems with find *change* unknown (including add to and take from) and *addend unknown* (including put together and take apart) using objects and pictures. (Please refer to chart on p. 183 of *Massachusetts Curriculum Framework for Mathematics* for clarification) As you plan, consider the variability of learners in your class and make adaptations as necessary.)

Prior Knowledge Required: Counting on (preferably from larger number) and counting back

Estimated Time: One class period

Resources for Lesson: Chart on p. 183 of *Massachusetts Curriculum Frameworks for Mathematics*



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #2: Speeding Cars

Overview: Students will use the commutative property with counting strategies to solve problems with find *change* unknown (including add to and take from) and *addend unknown* (including put together and take apart) using objects and pictures. (Please refer to chart on p. 183 of *Massachusetts Curriculum Framework for Mathematics* for clarification). As you plan, consider the variability of learners in your class and make adaptations as necessary.

By the end of this lesson students will know and be able to:

Solve *change unknown* and *addend unknown* from story situations using objects and pictures.

Essential Question addressed in this lesson:

How do counting and properties of operations help us add and subtract?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, **with unknowns in all positions**, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.4. Understand subtraction as an unknown-addend problem. For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.

G4 1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? $6 = 6$, $7 = 8 - 1$, $5 + 2 = 2 + 5$, $4 + 1 = 5 + 2$

SMP4 Model with mathematics



Instructional Resources/Tools

- Poster: *Does my answer make sense?*
- chart paper for student work
- chart on p. 183 of MCFM
- cubes, counters etc
- laminated + - and = cards
- sets of change unknown story problems, join and separate

Anticipated Student Preconceptions/Misconceptions

- Counting the number you are counting on or back from.
- Unknowns always follow the equal sign.
- Equal sign means “here comes the answer.”

Instructional Tips/Strategies/Suggestions:

- Some children may need numbers to add within 10.
- Reread problem to poor readers, and have them retell to partner before starting.
- Provide a 5 box template for struggling learners or special education students (one box for equal sign) See sample attached in Lesson 1.

Pre-Assessment: During warm up: have students count a large and small set totaling 20 cubes. Tell them that the larger pile has 13 cubes. Take note to see how students count to see if they count all. Make a note of students who have trouble counting, and students who count all. Make a note to call on these students during discussion.

What students need to know and are able to do coming into this lesson (including language needs):

- Check that all children understand the vocabulary used, such as “missing”, “on” and “back”
- Counting on (preferably from larger number) and counting back

Lesson Details



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Lesson Opening

Introduction to the Lesson:

Yesterday, we learned about how detectives work, and the tools they use. Today we are going to practice being good detectives and work with our partners to help the police to count and catch the speeding cars.

Focus Problem for Lesson Two:

Display one of the 3 types of problems (add to *change unknown*, take from *change unknown*, or *addend unknown*) such as:
I had 5 cubes on my desk. We can see three. The rest are under the cup. How many are under the cup?

Activation:

Show poster, "Does my answer make sense?"

Tell students that good detectives ask themselves many questions, and one of these important questions that math detectives ask themselves is, "Does my answer make sense?"

Remind students that when they are finished solving a problem to ask themselves if their answer makes sense.

During the Lesson

Use the focus problem: *Now, be detectives and figure out with your partner how many are hiding.* Have students *turn* to partners *and talk* about solving the problem.

Students share their strategies using vocabulary such as "I counted on from..." and "I counted back from..."

Student Application

14 cars were driving on the track. 5 were speeding, and the rest were not. How many cars were not speeding?

Read the problem (above) to students. Detective pairs work on the problem with objects and show their work on chart paper with pictures. Circulate and ask students if $14-5=$ is the same as $5-14=$ (SMP4 Model with mathematics.)

If students write $5-14$, ask them if their answer makes sense. Ask them to demonstrate using objects. *Can you show it with your cubes?*



Circulate and select students with different strategies to share in the summary discussion.

Lesson Closing

Reflection/Integration:

Students hang chart paper up round room. Detective pairs share thinking, defend their reasoning to the class.

Have students use language starters such as:

“I agree” “I have a different perspective” “I heard ___ say” “This reminds me...” “I don’t understand” “I want to add”



Lesson Three: Detective Journals

Brief Overview: The focus of this lesson is to translate finding *change unknown*, *addend unknown*, and *difference unknown* problems with objects and pictures to equations. Throughout the lesson there will be an emphasis on the meaning and use of the equal sign. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: Model *change unknown*, *addend unknown*, and *difference unknown* story problems with objects and pictures.

Estimated Time: 45+ minutes

Resources for Lesson:

- detective journals (composition books)
- chart paper
- chart on p. 183 of MCFM
- cubes, counters etc
- laminated + - and = cards
- set of change unknown, addend unknown and difference unknown story problems (see attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #3: *Detective Journals*

Overview: The focus of this lesson is to translate finding *change unknown*, *addend unknown*, and *difference unknown* problems with objects and pictures to equations. Throughout the lesson there will be an emphasis on the meaning and use of the equal sign. As you plan, consider the variability of learners in your class and make adaptations as necessary.

By the end of this lesson students will know and be able to:

Write equations to represent change unknown, addend unknown, and difference unknown problems.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of *adding to*, *taking from*, *putting together*, *taking apart*, and *comparing*, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? $6 = 6$, $7 = 8 - 1$, $5 + 2 = 2 + 5$, $4 + 1 = 5 + 2$

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP3 Construct viable arguments and critique the reasoning of others.

Instructional Resources/Tools

- detective journals (composition books)
- chart paper
- chart on p. 183 of MCFM



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- cubes, counters etc.
- laminated + and - = cards
- set of change unknown, addend unknown and difference unknown story problem (see samples attached)

Anticipated Student Preconceptions/Misconceptions

- Incorrectly counting the number you are counting on or back from.
- Unknowns always follow the equal sign.
- Equal sign means “here comes the answer.”
- Student confuses situation and solutions equations. (see Stage One Skills section)
- Language of “how many more” and “how many fewer” do not signal comparison.

Instructional Tips/Strategies/Suggestions:

Reread the problem to struggling readers if necessary, and have them retell the story to a partner before starting.

Provide a five box template for struggling learners or special education students (one box for equal sign) See sample in Lesson 1

Pre-Assessment

Teacher observation of focus problem

Results to be used to differentiate instruction

What students need to know and are able to do coming into this lesson (including language needs):

- Model *change unknown*, *addend unknown*, and *difference unknown* story problems with objects and pictures.
- Counting on (preferably from larger number) and counting back.

Lesson Details

Lesson Opening

Introduce the detective journal to the students: *Today, we are going to begin using a notebook just like detectives do. We will call these our detective journals. Detectives often write clues in a book to help them solve problems. Today we are going to use our ‘detective journals’ to write our clues. Numbers are easy ways to write clues instead of pictures.*



Focus Problem for Lesson Three:

Display one of the 3 types of problems (*change unknown, addend unknown, difference unknown*)

I had 2 apples. Mom gave me some more. Now I have 7 apples. How many apples did my mom give me?

Activation:

Show poster, "Does my answer make sense?" Remind students how important it is as good detectives to ask ourselves questions to find clues.

Tell students when our answer does not make sense we know we need to go back and think again about our solution.

Teacher reviews the meaning of the equal sign.

During the Lesson

Show students the following problem on a chart.

I had 2 apples. Mom gave me some more. Now I have 7 apples. How many apples did Mom give me?

Students work with a partner to write an equation. Choose a pair of students to draw their model on the chart.

Write the numbers under the drawing to create a situation equation. *This equation shows what happens in the story. We call it a situation equation.*

Model writing in a detective journal the situation equation:

$$2 + n = 7$$

Have students work with partner to solve the problem. Choose a pair of students to come and draw their model on the chart.

Use the student pair's work to demonstrate the solution equation:

$$n = 7 - 2$$

Ask: *Are these equations the same?* Have students compare and discuss the equations. (SMP3: Construct viable arguments and critique the reasoning of others.)

Circle the solution equation- *This equation shows how the problem was solved. It is called the solution equation.*

Student Application



9 boys ran around as werewolves for Halloween. Some ran away. There were 3 boys left dressed as werewolves. How many ran away?

Read the problem (above) to students. Have detective pairs work on the problem with objects and show their work in journals with both pictures and situation equations that match.

When finished, students should choose one of the 3 types of problems to work on. They paste the problem into their detective journal, and work with their partner to solve the problem with pictures and situation equations.

Circulate to see that students are able to represent their problem with a situation equation that matches their pictures.

Select students who use different strategies to solve the problem to share during the summary discussion to provoke thinking about situation vs. solution equations. (For clarification see lesson 5)

Lesson Closing

Reflection/Integration:

Explain to students that when numbers get much bigger, it is easier to write equations to solve problems than to draw pictures. As students share equation work (selected by teacher) prompt others to join in using language starters such as:

- “I agree”
- “I have a different perspective”
- “I heard ___ say” “This reminds me of..”
- “I don’t understand”
- “I want to add”

After detective pairs have shared, draw attention to the 2 types of equations (situation equation and solution equation) used to solve the problem. Point out that both methods produced the correct answer, and that subtraction can be solved by using addition.

Tomorrow we will be using clues to discover which equations are true or false.



Resources for Lesson 3

Name:

Date:

Problem:

I have 6 markers. You have 13 markers. How many more markers do I have?

Write an Equation

Show your work

Answer the question



Name:

Date:

Problem:

11 kites were flying in the sky. Some more kites flew by. Then 18 kites were flying in the sky.
How many kites flew by?

Write an Equation

Show your work

Answer the question



Name:

Date:

Problem:

9 tomatoes grew on the vine. The dog ate some, and then there were 5. How many tomatoes did the dog eat?

Write an Equation

Show your work

Answer the question



Name:

Date:

Problem:

7 pencils are on the table. 4 have erasers, the rest do not. How many pencils do not have erasers?

Write an Equation

Show your work

Answer the question



Lesson Four: True or False Clues

Brief Overview: In this lesson, students will work to determine if equations involving addition and subtraction are true or false (Commutative Property such as $5+2=2+5$). As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: Specific math vocabulary related to an explanation. (i.e., understanding and communicating the meaning of the mathematical symbols they use). As you plan, consider the variability of learners in your class and make adaptations as necessary.

Estimated Time: 45+ minutes

Resources for Lesson:

- Unifix cubes
- Pan balance/ number balance (if available- 1 per pair)
- Recording sheet- see sample attached



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Lesson 4: True and False Clues

Time (minutes): 45+

Overview: In this lesson, students will work to determine if equations involving addition and subtraction are true or false (Commutative Property such as $5+2=2+5$).Quiz.

By the end of this lesson students will know and be able to:

Show and explain how and why 2 sides of an equation are equal.

Essential Question addressed in this lesson:

How do counting and properties of operations help us add and subtract?

Standard(s)/Unit Goal(s) to be addressed in this lesson):

G2 1.OA.3. Apply properties of operations as strategies to add and subtract.² Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition).

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. For example, which of the following equations are true and which are false? $6 = 6$, $7=8-1$, $5+2=2+5$, $4+1=5+2$

SMP3: Construct viable arguments and critique the reasoning of others.

Instructional Resources/Tools

- Unifix cubes
- Pan balance/ number balance (if available- 1 per partnership)
- Recording sheet- see sample attached

Anticipated Student Preconceptions/Misconceptions

- Unknowns always follow the equal sign.



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What students need to know and are able to do coming into this lesson (including language needs):

Specific math vocabulary related to an explanation. (i.e., understanding and communicating the meaning of the mathematical symbols they use)

Instructional Tips/Strategies/Suggestions:

Differentiation ideas: adjust the numbers and equations as necessary to make problems accessible

Emphasize equals as “the same as”

Partner like abilities together

Pre-Assessment

Teacher observation of focus problem. Results to be used to differentiate instruction.

Lesson Details

Lesson Opening

Yesterday, we began using numbers to record our clues. Today, Math Detectives we are going to examine our clues. Some of our number clues might be true, and some might be misleading. We call that false. A math detective’s job is to find out. Today you will be looking at equations, it will be your job to discover which equations are true and which are false. You will back up your answer with proof using your detective journals to collect evidence.

Introduce simple true/false equation examples to help explain what a true/false equation is.

Focus Problem for Lesson Four:

Simple equations:

$$5+2=7 \quad 4+1=6 \quad 8=10-1$$

Less familiar equations:

$$3+4=4+3 \quad 8=8$$

Activation:

Post the *simple* true and false equations on the board. Have students decide which are true and which are false. They must explain the reason for their choice. (SMP3: Construct viable arguments and critique the reasoning of others.)



Move on to *less familiar* equations (see above).

(on the rug) Have students *turn and talk* to partners. Highlight one or two conversations that provoke further whole class discussion. Look for explanations that include use of the Commutative Property. Ask students to explain the meaning of the equal sign. (SMP3: Construct viable arguments and critique the reasoning of others). Have students briefly share their thinking.

During the Lesson

Select an equation from the chart and model it using a pan balance, math balance or Unifix cube tower to demonstrate equality of two sides. Tell students that they will get a list of clues to examine (with a partner). See the student worksheet sample. This can be inserted into the “Detective Journal”.

Student Application

Students work with partners to decide whether an equation is true or false. Their job is to model the equation with pan balance etc. to prove their answer. Circulate noting interesting or novel solutions and explanations that can be used to orchestrate an effective summary discussion. Look for explanations that include use of Commutative property.

Suggested guiding questions:

How did you decide that this equation is true/false?

How can you use your tools to prove it? Show me.

How can you draw your thinking?

Have students meet on rug to share results. Students who finish may be challenged with a problem with a missing addend such as $3+4 = _ + 2$

Lesson Closing

Reflection/Integration:

Orchestrate a share out with prompts for high-level thinking and debate. Use noted responses and explanations collected during the activity to deliberately push students to argue and work together to make meaning. Suggested prompt: *John and Maya had an interesting time with this. Tell us what you discovered...* Examples from part 2 of the worksheet can also be used.

Tomorrow, we will be using what we know about addition to help us solve subtraction mysteries.



Resources for Lesson 4

Sample Detective Journal page

Examining Equations

Name _____

1. Circle true or false.

Prove it.

Draw a picture that shows you are right.

Be ready to explain your thinking.

$$5+6 = 6+7$$

True or False

2. Write a true equation.

Prove it.

Draw a picture that shows you are right.

Be ready to explain your thinking.

$$\square \quad \square \quad = \quad \square \quad \square$$



Lesson Five: Missing Parts

Brief Overview: In this lesson, students learn that subtraction can be seen as an *unknown addend* problem and can be solved by using addition (related facts). As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: Addition facts to 10/20

Estimated Time: One class period

Resources for Lesson:

- Chart paper/easel for whole class activation and reflection
- Tools for modeling problem situations: Unifix cubes, two sided counters, tiles, number line
- Part –Part-Whole Mat
- Paper or white boards for recording



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #5: *Missing Parts*

By the end of this lesson students will know and be able to:

To create a situation equation to model a problem, and use related facts to create a solution equation.

Essential Question addressed in this lesson:

How can I use link between addition and subtraction to solve different types of problems?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1. Use addition and subtraction within 20 to solve word problems involving situations of *adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions*, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.4. Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP2 Reason abstractly and quantitatively

Instructional Resources/Tools

- Tools for modeling problem situations: unifix cubes, two sided counters, tiles number line
- Part Part- Mat (a sheet of paper with a line drawn down the middle)

Anticipated Student Preconceptions/Misconceptions

- Students confuse situation and solution equations. (See Stage One Skills section.)
- Turn-Around facts are the only related facts.



- Subtraction means “take away” only.

What students need to know and are able to do coming into this lesson (including language needs):

Addition facts to 10/20

Instructional Tips/Strategies/Suggestions:

Differentiation ideas: adjust the numbers and equations as necessary to make problems accessible

Pre-Assessment:

Teacher observation of focus problem. Results to be used to differentiate instruction.



Lesson Details

Lesson Opening

We have investigated our number clues. Some of our number clues were true, and some were misleading. Today let's think about if there is more than one equation you can use to solve any problem. Facilitate a brief discussion about situation equations and solution equations. (See Lesson 3) In our work today, math detectives, we are going to find the missing part of an equation. We have worked hard at learning our addition facts. We are going to use this knowledge to help us solve subtraction problems.

Focus Problem for Lesson Five:

Eight squirrels are scampering in the woods. Some scoot up a tree. Five run under a bush. How many squirrels scoot up the tree?

Activation:

Post the number story on an easel. Have students use counters and a part-part mat to model the *story situation*. (i.e. students count out 8, use the part-part mat to separate the tiles into two parts.) Watch to see if they determine the missing part. Ask students if they can write an equation that describes the story. Watch to see if they write a situation equation $8 - ? = 5$ or a solution equation $5 + ? = 8$ or $8 - 5 = ?$. Discuss how the counters and mats can be used to model both addition and subtraction equations. Help students make the connection between the two operations. (SMP.2: Reason abstractly and quantitatively.)

During the lesson

Tell students that they will play a Missing Part Game (to help focus on the connection between addition and subtraction) with a partner and their mats.

Model how to play the game:

Using a known fixed number of tiles (counters) one detective separates the tiles into two parts on the mat, and covers one side with a sheet of paper. The other detective says a subtraction sentence. ("eight minus five- [visible part] is three [covered part]") The covered part can be uncovered for the students to self-check. Students then record both the subtraction and addition equations in their Detective Journals.



Student Application

Students play missing part game in same ability partnerships. Teacher monitors as students work. The following questions are designed to identify students' engagement with SMP2: Reason abstractly and quantitatively.

1. Do they understand the task at hand? *Why do you think that might be right? How can you decide?*
2. Notice student's mathematical thinking: *Tell me what you are doing? How does your mat connect to your equation?*
3. Provide appropriate support: *What do you know? What have you tried so far?*
4. Provide extensions: Increase the fixed number, write a number story to match the subtraction equation.
5. Decide which students you will call on during summary reflection. Look for students with strong understandings of inverse operations to share.

Lesson Closing

Reflection/Integration:

Ask: *How can you solve a subtraction problem by adding?* Discuss how two equations can be written for the same situation.

Discuss situation and solution equations. Orchestrate a share out with prompts for high-level thinking and debate. (see above)

Use noted responses and explanations collected during the activity to deliberately push students to argue and work together to make meaning. Ask students to compose Missing Part stories for a given equation.

Tomorrow, we are going to solve some Apple Tree Mysteries. We will work to solve subtraction problems using addition and decomposition.



Resources for Lesson 5

Sample Part -Part Whole Mat



Lesson Six: Apple Tree Mysteries

Brief Overview: In this lesson, students will learn that subtraction can be seen as an unknown addend problem and can be solved by using addition and decomposition. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required:

- Combinations to make ten.
- Subtract within 10.
- Teen numbers are one ten and some more.

Estimated Time: One class period

Resources for Lesson:

Counters

Ten Frames (two per student or working partnership)

Apple Tree Mystery Worksheet (see attached)

White boards and markers or paper and pencil for recording equations



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #6: *Apple Tree Mysteries*

By the end of this lesson students will know and be able to:

Decompose numbers within a subtraction equation to facilitate solving problems.

Essential Question addressed in this lesson:

How can I use the link between addition and subtraction to solve different types of problems?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.3 Apply properties of operations as strategies to add and subtract.² *Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)*

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? $6 = 6$, $7 = 8 - 1$, $5 + 2 = 2 + 5$, $4 + 1 = 5 + 2$*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP1 Make sense of problems and persevere in solving them



Instructional Resources/Tools Counters

- Ten Frames (two per student or working partnership)
- Apple Tree Mystery Worksheet
- White boards and markers or paper and pencil for recording equations
- Anticipated Student Preconceptions/Misconceptions
- Students confuse story (situation) and solution equations. (see Stage One Skills section)
- Addition and subtraction are related.
- Part-part whole relationships of numbers through ten not understood
- The Equal sign signals the answer in an equation

Instructional Tips/Strategies/Suggestions:

Differentiation ideas: adjust the numbers and equations as necessary to make problems accessible.

Encourage mathematical discourse through respectful disagreements, and explanations.

Pre-Assessment

Teacher observation of focus problem. Results to be used to differentiate instruction.

What students need to know and are able to do coming into this lesson (including language needs):

- Combinations to make ten
- Understand place value of teen numbers
- Add/Subtract within ten.

Lesson Details

Lesson Opening

Yesterday, we found the missing part of an equation. Detectives, today we are going to solve some Apple Tree Mysteries. Let's use teen numbers to see if we can discover new strategies that help us subtract.



Focus Problem for Lesson Six:

Together two apple trees have 17 apples. Some fall out. Now the two apple trees have 9 apples together. How many apples fell out of the two trees?

Activation:

Ask: *What is a teen number?*

Students turn and talk using ten frame models to explain.

Revoice students' explanations that include the idea of ten and some more or a full frame and some more in a brief discussion.

During the Lesson

Post the focus problem:

Together 2 apple trees have 17 apples. Some fall out. Now the two apple trees have 9 apples together. How many apples fell out of the two trees?

Tell the students that each ten frame represents a tree. Students will work in pairs to solve and then record two equations to model the math. (SMP1: Make sense of problems and persevere in solving them.)

As children work, circulate around the room looking for both flawed and accurate solutions to highlight in the reflection component of the lesson.

Look for pairs of students that used the strategies listed below. Have them share with the class.

Decomposition ($17=9+8$) and

Associative property. $17= (10+7) = (9+1)+7$

If students are successful with the focus problem, students can move on to additional problems on attached sample worksheet.

Student Application

Students work to solve apple tree stories in same ability partnerships. Circulate to monitor students determine if the children understand the task at hand and inquire into their mathematical thinking:



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Why do you think that might be right? How can you decide?

Tell me what you are doing? How do your ten frames connect to your equation?

Is this your situation or solution equation? How do you know?

Be sure to probe for associative property thinking $17=(10+7) = (9+1)+7$

The following questions are helpful for providing additional support: *What are your clues from the mystery? What have you tried so far?*

Provide extensions for students who are ready for more challenge: Increase the fixed number, create your own apple tree mystery for the class to solve, etc.

Lesson Closing

Gather the “detectives” together in a group to reflect on their work. Have the selected detectives share the two solution strategies outlined above. If one strategy was not used, present it as an option.

Review *Situation* equations and *Solution* equations.

Tomorrow, we will practice all the detective skills we have learned so far (explicitly name the skills).

Discuss how two equations can be correct for the same mystery.



Resources for Lesson 6

Apple Tree Mysteries (Sample Worksheets)

Name _____

Problem

There were 15 apples in two trees. Some fell out. Now there were 6 apples in the two trees. How many apples fell out of the two trees?

Picture

Situation Equation

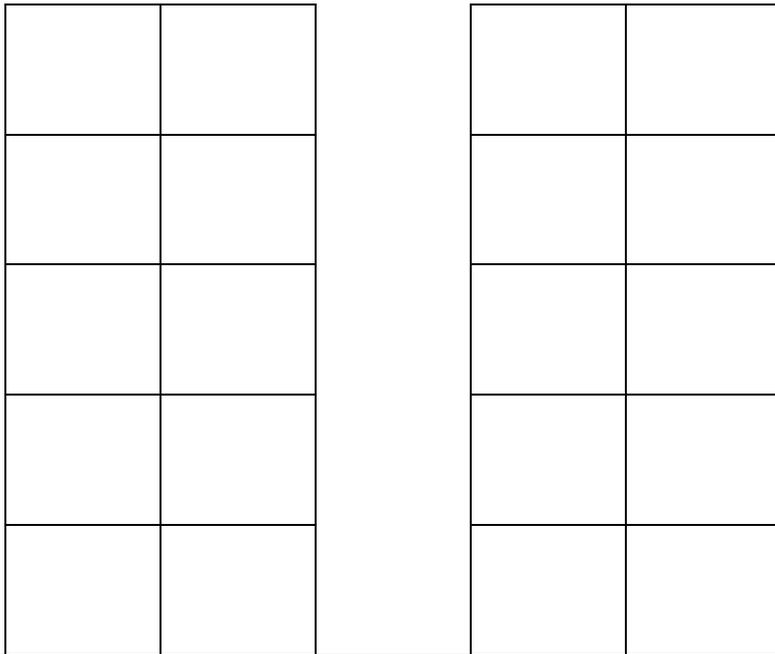
Solution Equation



Problem

There were 19 apples in two trees. Some apples fell out. Now there were 7 apples in the two trees. How many apples fell out of the two trees?

Picture



Situation Equation

Solution Equation



Resources for Lesson 6

Name _____

Problem

There were 12 apples in two trees. Some apples fell out. Now there were 3 apples in the two trees. How many apples fell out?

Picture

Situation Equation

Solution Equation



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Lesson Seven: Detective Practice in Centers

Brief Overview: This lesson is a synthesis of lessons 1 – 6 in which students will model and solve change unknown, addend unknown, and difference unknown problem situations with objects, pictures, and equations. They will continue to apply discourse and justify their thinking. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: Unknowns can be in the change position. Two sides of an equation must be equal to be true.

Estimated Time: 45 + minutes

Resources for Lesson:

- Story Problem formats from lessons 1-3
- Tools and Activities materials from lessons 4-6
- Four work stations prepared based on the previous lessons



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #7: Detective Practice in Centers

By the end of this lesson students will know and be able to:

Model and solve change unknown, addend unknown, and difference unknown problem situations with objects, pictures, and equations.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.3 Apply properties of operations as strategies to add and subtract.² *Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)*

1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? $6 = 6$, $7 = 8 - 1$, $5 + 2 = 2 + 5$, $4 + 1 = 5 + 2$*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP1 Make sense of problems and persevere in solving them

SMP3 Construct viable arguments and critique the reasoning of others

SMP4 Model with mathematics



Instructional Resources/Tools

- Counters Number balance, pan balance and/or Unifix Cubes from lesson 4
- Part-Whole Mats lessons 1-3
- Mats and covers from lesson 5
- Double Ten frames lesson 6
- Detective Journals

Anticipated Student Preconceptions/Misconceptions

- Students confuse situation and solution equations. (see Stage One Skills section)
- Equal sign signals “the answer

Instructional Tips/Strategies/Suggestions:

- Students can be assigned to centers or they can rotate through them. This is a good opportunity to formatively assess students understanding with concepts in this unit that have been introduced. It can also serve as practice.
- Story problems and numbers may be modified to meet individual student’s needs.
- While children work in centers, circulate asking probing questions to clarify and extend student thinking
- Detective Journals may be used to collect “exit ticket” information on student understanding.

Pre-Assessment

Review students’ Detective Journals for formative information regarding student understanding.

What students need to know and are able to do coming into this lesson (including language needs):

- Unknowns can be in the change position
- Two sides of an equation must be equal to be true.

Lesson Details

Lesson Opening



All great Detectives need to practice their skills. Today you are going to work in centers to practice our skills (specify the skills). You will continue to collect evidence in your Detective Journals.”

During the Lesson

In advance, prepare 4 work stations based on the previous lessons.

The majority of time for this lesson is spent working at centers.

1. *Story Problem Center*: Students work to solve the previously introduced story structures. (Use any story problem structures from lessons 1-3). SMP.1: Make sense of the problems and persevere in solving them.
2. *Equation Center*: Using a number balance, pan balance, and/or Unifix Cubes to model true equations as in lesson 4. (SMP.4: Model with mathematics)
3. *Missing Part Game*: from lesson 5
4. *Apple Tree Mysteries*: from lesson 6

Students rotate through the centers as determined by teacher. Observe students to determine level of students’ understanding. Use discussion prompts from earlier lessons.

Lesson Closing

Gather students on the rug and orchestrate a discussion around some learning or misconception noticed while the students were working in centers. Have students share out what they did in the centers and explain their mathematical thinking.

Tomorrow, we will work catch a card thief. Explain the specific mathematical skills of the next lesson.



Lesson Eight: CEPA#1 Card Thief

Brief Overview: In this lesson, students will complete the first CEPA, *Card Thief*, in which children will demonstrate their ability to use strategies to find change unknown, and explain their thinking.

Prior Knowledge Required:

Unknowns can be in the change position

Two sides of an equation must be equal to be true.

Estimated Time: 45+ minutes

Resources for Unit:

- Sets of 20 playing cards for each pair of students
- Recording sheet (see sample attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #8: CEPA 1 Card thief

By the end of this lesson students will know and be able to:

Demonstrate their ability to use strategies to find change unknown, and explain their thinking.

Essential Question addressed in this lesson:

How do counting and properties of operations help us add and subtract?

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.3 Apply properties of operations as strategies to add and subtract.² *Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)*

1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP3 Construct viable arguments and critique the reasoning of others

Instructional Resources/Tools

- Cards



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- *Card Thief!* Sheet

Instructional Tips/Strategies/Suggestions:

- Differentiate instruction by varying the number of cards.
- Results from CEPA #1 should be used as a guide to provide teachers with information to differentiate instruction.

What students need to know and are able to do coming into this lesson (including language needs):

- Unknowns can be in the change position.
- Two sides of an equation must be equal to be true.

Note: the Card Thief Game by design incorporates SMP3: Construct viable arguments and critique the reasoning of others.



CEPA 1 Card Thief!

Detective: _____

Throw	Number of Cards Thief Left	Situation Equation	Solve and Show your Work	Number of Cards Thief Stole
1				____ cards Checked by: ____
2				____ cards Checked by: ____
3				____ cards Checked by: ____



Lesson Nine: Equation Match Mystery

Brief Overview In this lesson, students will match a situation equation to a story with change unknown or addend unknown and explain why it models the story. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required: That mathematical situations call for unknowns in varying locations in an equation.

Estimated Time: 45+ minutes

Resources for Unit: Sample sheet of problems to copy onto card stock and cut (see attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #9: *Equation Match Mystery*

Overview:

Students will match a situation equation to a story with change unknown or addend unknown and explain why the equation models the story.

By the end of this lesson students will know and be able to:

Match a situation equation and explain why it models a story with change unknown or addend unknown.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP2 Reason abstractly and quantitatively

SMP4 Model with mathematics



Instructional Resources/Tools

Sample sheet of problems to match with equations (see attached)

Anticipated Student Preconceptions/Misconceptions

Students confuse situation and solutions equations.

What students need to know and are able to do coming into this lesson (including language needs):

Different mathematical problems call for different types of equations to solve them.

Instructional Tips/Strategies/Suggestions:

It may be beneficial to number problems and put equations on different colored cards to facilitate discussion. (e.g. *"I put problem 1 with the green equation because..."*)

Pre-Assessment

Teacher observation of story problems- results should be used to inform and differentiate instruction.

Lesson Details

Lesson Opening

Today detectives, we are going to match our problems to our clues! You will be given a story problem and you have to choose the correct situation equation to model the problem. Who remembers what a situation equation is? Review the difference between a situation equation and a solution equation (refer to the note in the skills section of stage 1. Although they mathematically may be equal, only the situation equation truly represents what is happening in the story.

Display an addend unknown problem (SMP.4: Model with mathematics.) such as:

There are 7 chocolate chip cookies in the cookie jar. There are also some sugar cookies. There are 11 cookies altogether in the jar.
How many sugar cookies are in the jar?
Which equation describes this problem's situation?



$$11 - 7 = ? \quad 7 + ? = 11 \quad ? + 7 = 11$$

Detectives use clues from their crime scenes to figure out what happened. As math detectives we are going to use clues to decide which situation equation matches our problem, and then we need to explain why.

Have students work in pairs to decide which equation describes the situation of the problem.

Have students share their clues and defend their choices. (SMP2 Reason abstractly and quantitatively.) To promote rich dialogue, provide discussion prompts that challenge students' thinking such as: *All the choices have the correct numbers! But this equation also gives you an answer of 4.* Be sure to discuss that $11 - 7 = ?$ Could be used as a solution equation, but is not a situation equation. (SMP4 Model with mathematics.)

Student Application:

Have groups/pairs of student detectives match the appropriate equations to the story problems on cards. An example set of cards is attached to cut and use. Please note that the numbers in the stories are the repetitive to increase difficulty.

As students work, teacher circulates to prompt explanation and dialogue. Ask questions such as: *"How do you know that matches? Can you defend your choice?" "Why wouldn't this other option work? Can you explain why for me?"*

The teacher circulates and notes interesting or novel solutions and explanations that can be used to orchestrate an effective summary discussion.

Lesson Closing

Orchestrate a "share out" which prompts higher order thinking and debate. Use noted responses and explanations collected during the activity to deliberately push students to argue and work together to make meaning. (See question prompts from previous lessons.)

Tomorrow, detectives we are going to use mathematical clues to find the unknown and solve mysteries.



Resources for Lesson 9

Copy onto card stock and cut

Problems	Situation Equation Options
I have 8 markers. My friend has some too. We put all of our markers in a box and there are 17. How many markers does my friend have?	$8 + ? = 17$
I have 17 grapes in my lunchbox. I ate some at snack time. Then I have 8 grapes left at lunch time. How many grapes did I eat at snack?	$17 - ? = 8$
I have 3 bananas. I have some apples. I have 12 pieces of fruit in my fruit bowl. How many apples do I have?	$3 + ? = 12$
I have 12 baseball cards. I gave some to Jose. Now I have 3 baseball cards. How many cards did I give to Jose?	$12 - ? = 3$
I have 8 stickers on my book. Suzie gives me some more stickers. Now I have 14 stickers on my book. How many stickers did Suzie give me?	$8 + ? = 14$
I have 14 yummy doughnuts to share with the class. Some are chocolate. 8 are jelly. How many are chocolate?	$14 - ? = 8$



Lesson Ten: Cookie Jar Mystery

Brief Overview: In this lesson, students will construct arguments using objects, pictures, and equations to make sense of change unknown, addend unknown, and difference unknown story problems. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required:

Specific math vocabulary related to an explanation. (ie, understanding and communicating the meaning of the symbols they use)

Estimated Time: One class period

Resources for Unit:

Sample Problems for detective journal (see attached)

Cubes/objects for students needing to “act out” problems.



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #10: Cookie Jar Mystery

By the end of this lesson students will know and be able to:

Explain how and why they used properties of operations/inverse operations to translate their situation equation into a solution equation.

Essential Question addressed in this lesson:

How can I use link between addition and subtraction to solve different types of problems?

Standard(s)/Unit Goal(s) to be addressed in this lesson:

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.3 Apply properties of operations as strategies to add and subtract.² *Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)*

1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP1 Make sense of problems and persevere in solving

SMP2 Reason abstractly and quantitatively

SMP3 Construct viable arguments and critique the reasoning of others

Instructional Resources/Tools

- Sample problems for detective journal
- Cubes/objects for students needing to “act out” problems



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Anticipated Student Preconceptions/Misconceptions

- Students confuse situation and solutions equations. (see Stage One Skills section)
- Unknowns always follow the equal sign.

What students need to know and are able to do coming into this lesson (including language needs):

Specific math vocabulary related to an explanation. (ie, understanding and communicating the meaning of the mathematical symbols they use)

Instructional Tips/Strategies/Suggestions:

Differentiation: provide appropriate scaffolding and supports to assist students with explanations as needed
Provide lines for related facts so students may prove that their two equations are related.
Have cubes or other objects available to students who need to “act out” scenarios.

Pre-assessment:

Teacher observation of the focus problem- use the results for formative purposes.

Lesson Details

Lesson Opening

Yesterday, we matched our stories to situation equations. Today detectives, we are going to use clues to find the unknown and then solve mysteries.

Focus Problem for Lesson Ten:

Display a change unknown problem such as:

I have 15 stickers. Some children do wonderful math work today and I give some away for rewards. At the end of my lesson I only have 6 stickers left!

Write an equation that matches my story. (situation equation)

Write an equation that you could use to solve for the answer. (solution equation)



Activation:

Review the difference between a situation equation and a solution equation: *Although they may be mathematically equal, only the situation equation truly represents what is happening in the story. But, perhaps, other equations are easier to solve.*

Detectives use clues from their crime scenes to do two things. First, they document what happened. (situation equations) Second, they use their evidence to solve the crime. (solution equations) Today, we are going to use the evidence we find to do both. We will document what happens by writing a situation equation that describes what happened. Then we will use what we know about the relationship between addition and subtraction in a solution equation to solve the problem.

During the Lesson

Use the focus problem to have students create an accurate situation equation to *describe* what is happening in the problem. ($15 - ? = 6$) Have students explain why this accurately depicts what happened. (SMP.3: Construct viable arguments and critique the reasoning of others.)

Ask children how they would solve this problem... Re-write the situation equation into solution equations as they explain. For example, if a student suggested *I would start at 6 and count up to 15* the equation would be $6 + ? = 15$. If a student suggests *I would count back 6 from 15* the equation would be $15 - 6 = ?$. These are solution equations that we use to *solve*. Point out to the students that no matter where the ? is in the equation, it still replaces the solution to the problem – the 15 and 6 are always there as well.

Discuss with students how the situation and solution sentences are related. *Why does this work?* Model and discuss how addition and subtraction are inverse operations. Use the concept of related facts to bolster your explanation. (SMP.2: Reason abstractly and quantitatively.)

Student Application:

In pairs have the student detectives solve story problems with two equations: a situation equation that describes the scene and a solution equation that they use to solve the problem. In addition, they need to justify their thinking. They may use a fact family to prove that inverse operations can be used. (SMP.1: Make sense of problems and persevere in solving them.) See attached sample problems.

As students work, circulate to prompt explanations and dialogue. Ask questions such as: *How do you know that describes the situation? Can explain to me why this solution equation would work? What are some other equations you could use to solve this problem?*



Note interesting or novel solutions and explanations that can be used to orchestrate an effective summary discussion.

Lesson Closing

Orchestrate a “share out” which prompts higher order thinking and debate regarding the use of inverse operations. Use noted responses and explanations collected during the activity to deliberately push students to critique and work together to make meaning.

Tomorrow, I am going to give you the equation clues, and you will write the mathematical mystery stories.



Resources for Lesson 10

Sample problems:

- 1) My mom had 13 cookies in the cookie jar. My brother and his friends snuck in and took some! Later, at dinner there were only 4 cookies in the jar. How many cookies did my brother and his friends take?

Situation Equation: _____ (DESCRIBES the scene)

Solution Equation: _____ (Helps you SOLVE the problem)

Solution: My brother and his friends took _____ cookies from the jar.

Why does changing your situation equation to your solution equation not change the answer? Prove it is OK.

Draw a picture to show what happens in the problem.



Resources for Lesson 10

(Continued)

2) I had 5 pencils on my desk. I went to lunch and when I came back someone had left some more on my desk. Now I have 14. How many pencils did someone leave on my desk during lunch?

Situation Equation: _____ (DESCRIBES the scene)

Solution Equation: _____ (Helps you SOLVE the problem)

Solution: Someone left ____ pencils on my desk during lunch.

Why does changing your situation equation to your solution equation not change the answer? Prove it is OK.

Draw a picture to show what happens in the problem.



Lesson Eleven: Zoo Mysteries

Brief Overview: In this lesson, students will write a story to match an equation with change unknown, addend unknown or difference unknown. They will explain why the equation models the story using pictures or objects then solve. As you plan, consider the variability of learners in your class and make adaptations as necessary.

Prior Knowledge Required

Mathematical situations call for unknowns in varying locations in an equation.

Estimated Time: 45+ minutes

Resources for Unit:

Sample problem sheet for detective journal (see attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #11: Zoo Mysteries

Overview:

In this lesson, students will write a story to match an equation with change unknown, addend unknown or difference unknown. They will explain why the equation models the story using pictures or objects then solve. As you plan, consider the variability of learners in your class and make adaptations as necessary.

By the end of this lesson students will know and be able to:

Write a story that matches a situation equation, and explain why the equation models the story with change unknown, addend unknown or difference unknown, and be able to solve and explain their solution.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson):

G1 1.OA. Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

G3 1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP 2 Reason abstractly and quantitatively.



Instructional Resources/Tools (list all materials needed for this lesson)

Sample problems for detective journal

Anticipated Student Preconceptions/Misconceptions

- Students confuse situation and solutions equations. (see Stage One Skills section)
- Unknowns always follow the equal sign.
- Equal sign means “here comes the answer.

What students need to know and are able to do coming into this lesson (including language needs):

That mathematical situations can call for unknowns in varying locations in an equation.

Instructional Tips/Strategies/Suggestions:

Differentiation: for struggling students, provide a writing template, writing prompt, and/or sentence frames to support their thinking and writing. To make the task more complex do not provide a context for students.

Pre-Assessment:

Teacher observation of focus problem- results should be used to differentiate instruction.

Lesson Details

Lesson Opening

Yesterday, we described the mathematical mysteries with a situation equation, and solved the stories with a solution equation.

Today, detectives, I am going to give you some mathematical clues about what happened and you need to write the story!

Focus Problem for Lesson Eleven:

Display an *add to/take from, change unknown* problem such as:

Write a math story about grapes that matches this equation?

$$9 + ? = 14$$



Draw a picture to show your story matches the equation.

Solve the problem and explain your answer. (SMP 2 Reason abstractly and quantitatively.)

Activation:

Imagine you walk into your house and there was water all over the floor of the kitchen. You may create a story about how the water got there – such as: The pipe under the sink broke and leaked all over the floor. You would have to investigate further to see if your story matches the clues. Today we are going to have math clues in the form of equations and you have to write a math story to match the situation. (SMP 2 Reason abstractly and quantitatively.)

During the Lesson

Use the focus problem to model creating a story about grapes that matches the situation equation. Demonstrate how to draw a picture to match. Finally, use inverse operations to create a solution equation and solve. (SMP 2 Reason abstractly and quantitatively.)

Explain that you are going to provide equation clues and one item that must be in the story (like the grapes). They need to write a story, draw a picture and then solve the mystery.

Student Application: (See attached sample problems.)

As students work circulate to prompt explanations and dialogue. Ask questions such as: *How do you know that your story describes the situation? Explain to me how your picture matches your equation. What are some other equations you could use to solve this problem?*

Students write stories in their Detective Journals.

Circulate and note interesting or novel solutions and explanations that can be used to orchestrate an effective summary discussion.

Lesson Closing

Facilitate a “share out” which prompts higher order thinking and debate regarding use of different story structures to match the same equation. Use noted responses and explanations collected during the activity to deliberately push students to critique and work together to make meaning.

Tomorrow, you and a math buddy will solve mystery stories and check each other’s equation detective work.



Resources for Lesson 11

Sample problems:

$$7 + ? = 15$$

Write a story about **zebras** to match the equation above:

Write a solution equation and solve your problem. _____

Draw a picture to match your story and solution.

Resources for Lesson 11 (con't)

$$11 - ? = 6$$

Write a story about **monkeys** to match the equation above:

Write a solution equation and solve your problem. _____

Draw a picture to match your story and solution.



Lesson Twelve: CEPA#2 Math Buddies

Brief Overview This is the second CEPA for this unit. Students will demonstrate their ability to use strategies to find change unknown in addition and subtraction situations, and explain their reasoning to a partner.

Prior Knowledge Required That mathematical situations call for unknowns in varying locations in an equation.

Estimated Time: One class period

Resources for Unit:

Problems One and Two (see attached)

Rubric (see attached)



Content Area/Course: Mathematics Grade One

Unit: Using Properties of Operations to Find Change Unknown

Time (minutes): 45+

Lesson #12: CEPA #2: Math Buddy

Overview:

Students will demonstrate their ability to use strategies to find change unknown in addition and subtraction situations, and explain their reasoning to a partner.

By the end of this lesson students will know and be able to:

Demonstrate their ability to use strategies to find change unknown in addition and subtraction situations, and explain their reasoning to a partner.

Essential Question addressed in this lesson:

How do equations help us make sense of a problem and discover what unknown is missing?

Standard(s)/Unit Goal(s) to be addressed in this lesson (type each standard/goal exactly as written in the framework):

1.OA.1 Use addition and subtraction within 20 to solve word problems involving situations of adding to, taking from, putting together, taking apart, and comparing, with unknowns in all positions, e.g., by using objects, drawings, and equations with a symbol for the unknown number to represent the problem.

1.OA.3 Apply properties of operations as strategies to add and subtract.² *Examples: If $8 + 3 = 11$ is known, then $3 + 8 = 11$ is also known. (Commutative property of addition.) To add $2 + 6 + 4$, the second two numbers can be added to make a ten, so $2 + 6 + 4 = 2 + 10 = 12$. (Associative property of addition.)*

1.OA.4 Understand subtraction as an unknown-addend problem. *For example, subtract $10 - 8$ by finding the number that makes 10 when added to 8. Add and subtract within 20.*

1.OA.7 Understand the meaning of the equal sign, and determine if equations involving addition and subtraction are true or false. *For example, which of the following equations are true and which are false? $6 = 6$, $7=8-1$, $5+2=2+5$, $4+1=5+2$*



1.OA.MA9 Write and solve number sentences from problem situations that express relationships involving addition and subtraction within 20.

SMP1. Make sense of problems and persevere in solving them

SMP2 Reason abstractly and quantitatively

SMP3 Construct viable arguments and critique the reasoning of others

SMP4 Model with mathematics

Instructional Resources/Tools (list all materials needed for this lesson)

See Resources for the recording sheet for this lesson.

Anticipated Student Preconceptions/Misconceptions

Students confuse situation and solutions equations. (See Stage One Skills section.)

Instructional Tips/Strategies/Suggestions

Pair students with same ability.

What students need to know and are able to do coming into this lesson (including language needs)

Mathematical situations may call for unknowns in varying locations in an equation.

Lesson Details

Lesson Opening

You have been thinking as mathematical detectives for the last three weeks, and today you are going to work with another detective to see if you both arrive at the same answer to a problem.

During the Lesson

Use a simple problem to model for students how to use assessment worksheet.

Have students turn to a partner to explain directions before beginning.



Student Application

Students will work in pairs. First Detective 1 will solve problem 1 and Detective 2 will solve problem 2. They will each solve their problems independently. (SMP.1: Make sense of problems and persevere in solving them.) Detective 1 will write the answer to problem 1 at the top of their partner's sheet labeled Problem 2. Likewise Detective 2 will write the answer to problem 2 at the top of their partner's sheet labeled Problem 1.

Each student will then solve the problem previously solved by their partner and give a thumbs-up symbol if they agree, and a thumbs down symbol if they disagree. (SMP.3: Construct viable arguments and critique the reasoning of others.)



Resources for Lesson 12

Problem 1

Detective 1:

Date:

14 butterflies are flying in the garden. Some butterflies land on a flower. 6 butterflies are still flying. How many butterflies landed on a flower? (This problem requires the student to reason abstractly and quantitatively: SMP.2)

Solve using pictures and equations (SMP.4: Model with mathematics.):



Detective 1's Answer to problem 1:
How many butterflies landed on a flower?

Detective 2:

Date:

14 butterflies are flying in the garden. Some butterflies land on a flower. 6 butterflies are still flying. How many butterflies landed on a flower? (This problem requires the student to reason abstractly and quantitatively: SMP.2)

Solve using pictures and equations (SMP.4: Model with mathematics.):

Do you agree or disagree?



DISAGREE X

AGREE



Page B

Problem 2

Detective 2 Name:

Date:

There were 8 frogs on a log. Some more frogs hopped on the log. Now there are 17 frogs on the log. How many frogs hopped on?

Solve using pictures and equations:



Detective 2's Answer to Problem 2:
How many frogs hopped on?

Detective 1 Name:

Date:

There were 8 frogs on a log. Some more frogs hopped on the log. Now there are 17 frogs on the log. How many frogs hopped on?

Solve using pictures and equations:

Do you agree or disagree?

DISAGREE X

AGREE



Rubric for Card Thief and Math Buddies

	Novice	Apprentice	Expert
Use of Problem Solving Strategies	Student uses an ineffective strategy or uses strategy of counting all.	Student uses an effective strategy such as counting on or counting back.	Student uses an effective novel strategy.
Explains Reasoning	Student's work does not demonstrate mathematical reasoning related to the problem.	Student's work demonstrates mathematical reasoning	Student's work clearly demonstrates mathematical reasoning others can follow.
Models mathematics	Student uses objects to model mathematics.	Student uses pictures to model mathematics.	Student models problems with a situation equation with change unknown.
Computes	Student has major inaccuracies in computation.	Student has minor inaccuracies such as miscounting	Student is accurate

