

# ***The Kentucky Numeracy Project***

**Session 6 – Advanced Addition and Subtraction**

**April 21, 2011**



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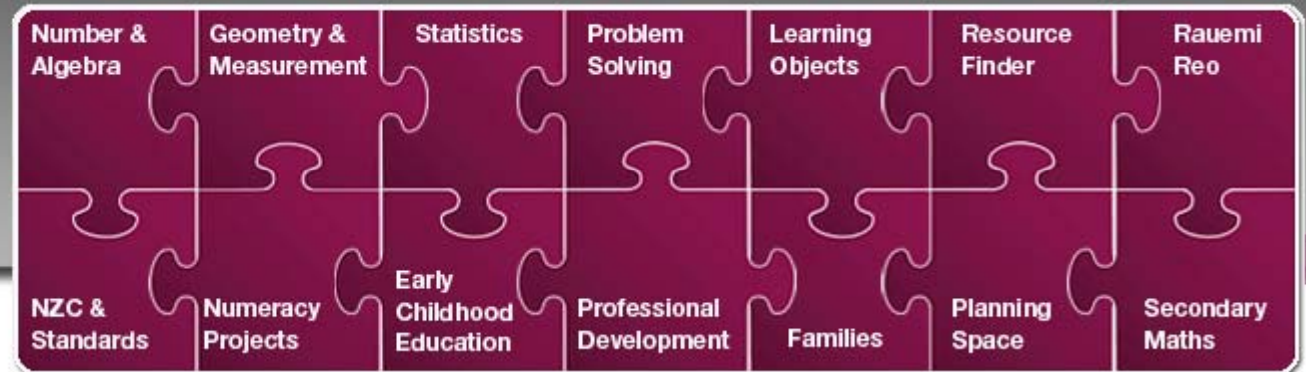


## Excerpts from the grade-level introductions

**Kindergarten:** Students choose, combine, and apply **effective strategies** for answering quantitative questions, ... (page 9).

**First Grade:** They use properties of addition to add whole numbers and to **create and use increasingly sophisticated strategies** based on these properties (e.g., “making tens”) to solve addition and subtraction problems within 20. By comparing a variety of solution strategies, children build their understanding of the relationship between addition and subtraction (page 13).

**Second Grade:** ... they **develop, discuss, and use efficient, accurate, and generalizable methods to compute sums and differences of whole numbers** ... (page 17).



- Units of work
- Rauemi Reo
- NZC and Standards
- Numeracy Projects
- Professional Development**
- Accelerating Learning
- High Achieving Students
- Secondary
- Early Childhood Education
- Families
- Information Centre

## News

<http://nzmaths.co.nz>



The [Accelerating Learning in Mathematics \(ALiM\) project](#) aims to accelerate the mathematical performance of low performing students. This section contains resources relating to the ALiM project.



### National Standards support

A [series of interactive modules](#) has been developed to help teachers and other education professionals work with the National Standards in reading, writing and mathematics and their illustrations.



### National Standards Illustrations

A collection of [illustrations of the National Standards for Mathematics](#) are being developed. This section currently contains illustrations of six mathematics tasks. Each task includes annotated student work samples illustrating aspects of several standards.



### 2009 Numeracy Research Compendium

The papers in [Findings From the New Zealand Numeracy Development Projects 2009](#) look at a variety of aspects of the NDP. They are roughly grouped under the categories of student achievement and professional learning. Results from the primary, secondary and Māori-medium projects are all included.




## Professional Development

This section of the site provides information to support teachers' professional understanding of mathematics teaching and also information to develop their content knowledge of mathematics.

[Online PD](#): modules on the Number Framework (assessment, programme planning and teaching ideas for each stage).

[Representational framework](#): student responses at different Number Framework stages to questions on the three strategy domains.






[Illustrations and the National Standards](#): modules developed to help teachers and other education professionals work with the National Standards and the illustrations in reading, writing and mathematics.

[Effective Pedagogy in Pāngarau/Mathematics: Best Evidence Synthesis Iteration \(BES\)](#) 

[Numeracy references](#)

[Content tutorials for teachers](#)

[Tertiary fees funding support](#)

-  [Units of work](#)
-  [Rauemi Reo](#)
-  [NZC and Standards](#)
-  [Numeracy Projects](#)
-  **[Professional Development](#)**

[Online PD](#)

[Representational Framework](#)

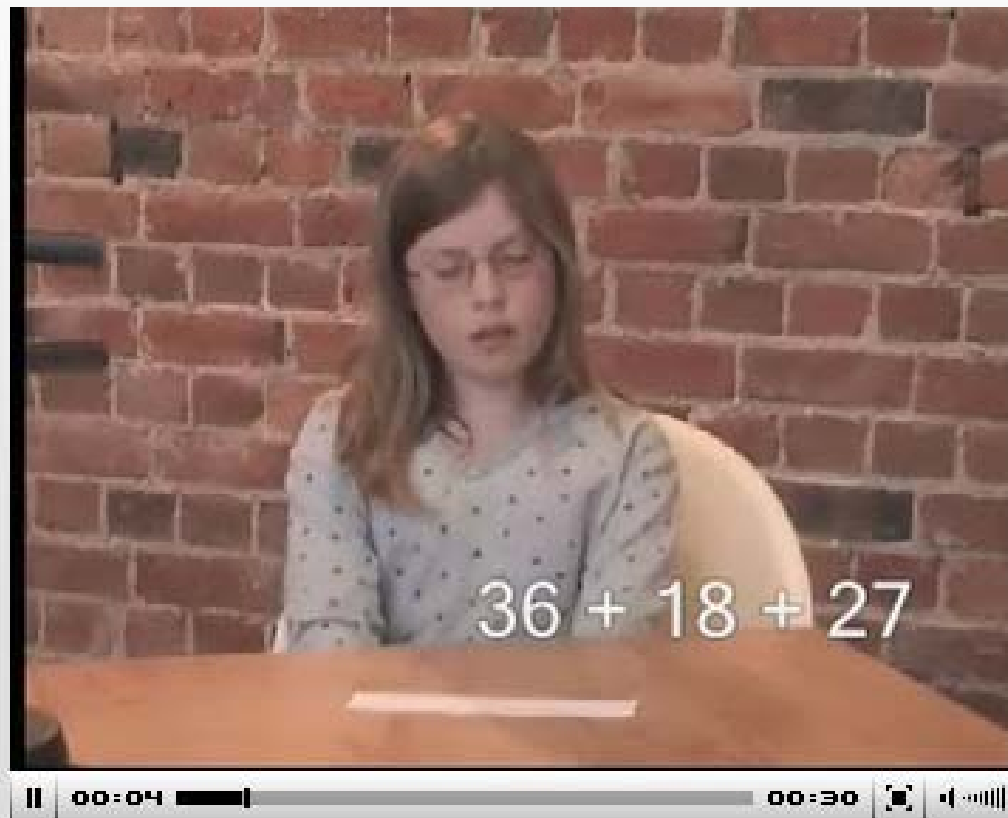
[Tertiary Fees Funding Support: Mathematics](#)

[Numeracy References](#)



## 6: Advanced Additive - Addition and Subtraction

John is picking apples. He picks 36 from the first tree, 18 from the second tree, and 27 from the third tree. How many apples does he pick from the three trees altogether?



## 6: Advanced Additive - Addition and Subtraction



**“18 + 27 ...  
20 + 27 = 47  
So that must be 45  
45 + 36 ...  
40 + 30 = 70  
5 + 6 = 11  
11 + 70 = 81”**

## 7: Advanced Multiplicative - Addition and Subtraction



Additive

Multiplicative

Proportional

John is picking apples. He picks 36 from the first tree, 18 from the second tree, and 27 from the third tree. How many apples does he pick from the three trees altogether?

$$\begin{aligned} 36 + 18 + 27 &= (4 \times 9) + (2 \times 9) + (3 \times 9) \\ &= 9 \times 9 \\ &= 81 \\ &81 \text{ apples.} \end{aligned}$$

Student: They are all multiples of nine. Four times nine plus two times nine plus three times nine equals nine times nine which is eighty-one.

[Click here for video](#)

## 6: Advanced Additive - Addition and Subtraction

There are 121 students at Sarah's school. Sixty-six of them are girls. How many are boys?



$$121 - 60 = 61$$
$$61 - 6 = 55$$

55 boys

## 7: Advanced Multiplicative - Addition and Subtraction

There are 121 students at Sarah's school. Sixty-six of them are girls. How many are boys?

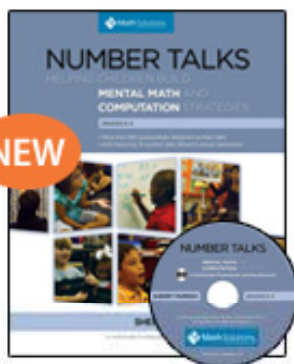


$$\begin{aligned}121 - 66 &= (11 \times 11) - (6 \times 11) \\ &= 5 \times 11 \\ &= 55 \\ 55 \text{ Boys}\end{aligned}$$







# Computation Strategies, Grades K-5

## 5

### Overview



Order Now

-  [Endorsements](#)
-  [Table of Contents](#)
-  [How to Use this Resource](#)
-  [Video Clips by Grade](#)
-  [Chapter 1](#)
-  [NCTM Standards Alignment](#)

### Number Talks \ˈnəm-bər\ ˈtɒks\

1. A five- to fifteen-minute classroom conversation around purposefully crafted computation problems that are solved mentally.
2. The best part of a teacher's day.

Whether you want to implement number talks but are unsure of how to begin or have experience but want more guidance in crafting purposeful problems, this dynamic multimedia resource will support you in building mental math and computational strategies. The author explains

- what a classroom number talk is;
- how to follow students' thinking and pose the right

problems, Grades 3–5

- [Show and Tell: Representing and Communicating Mathematical Ideas in –2 Classrooms](#)
- [Minilessons for Math Practice, Complete Series](#)
- [Classroom Discussions: Using Math Talk to Help Students Learn, Grade K–6, Second Edition](#)
- [Classroom Discussions: Seeing Math Discourse in Action, Grades K–6](#)
- [Big Talk Value Bundle](#)
- [Small Talk Value Bund](#)

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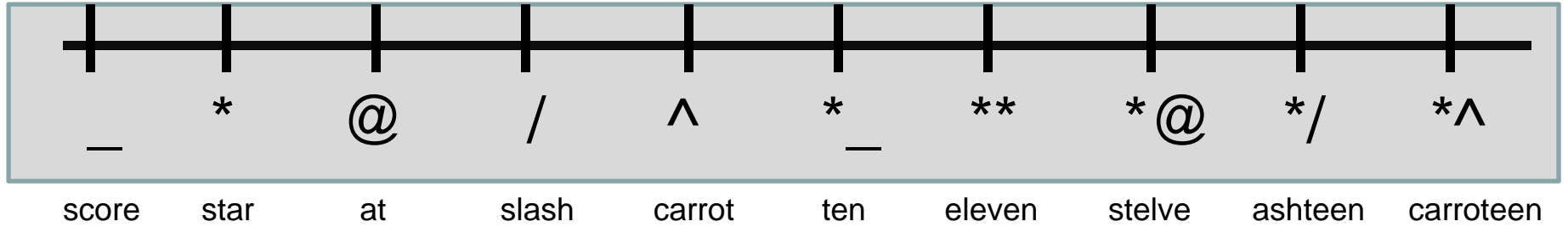
Number Talks Preview

View sample video clips



## **Kentucky Common Core Academic Standards for Mathematical Practice**

- 1 Make sense of problems and persevere in solving them.**
- 2 Reason abstractly and quantitatively.**
- 3 Construct viable arguments and critique the reasoning of others.**
- 4 Model with mathematics.**
- 5 Use appropriate tools strategically.**
- 6 Attend to precision.**
- 7 Look for and make use of structure.**
- 8 Look for and express regularity in repeated reasoning.**



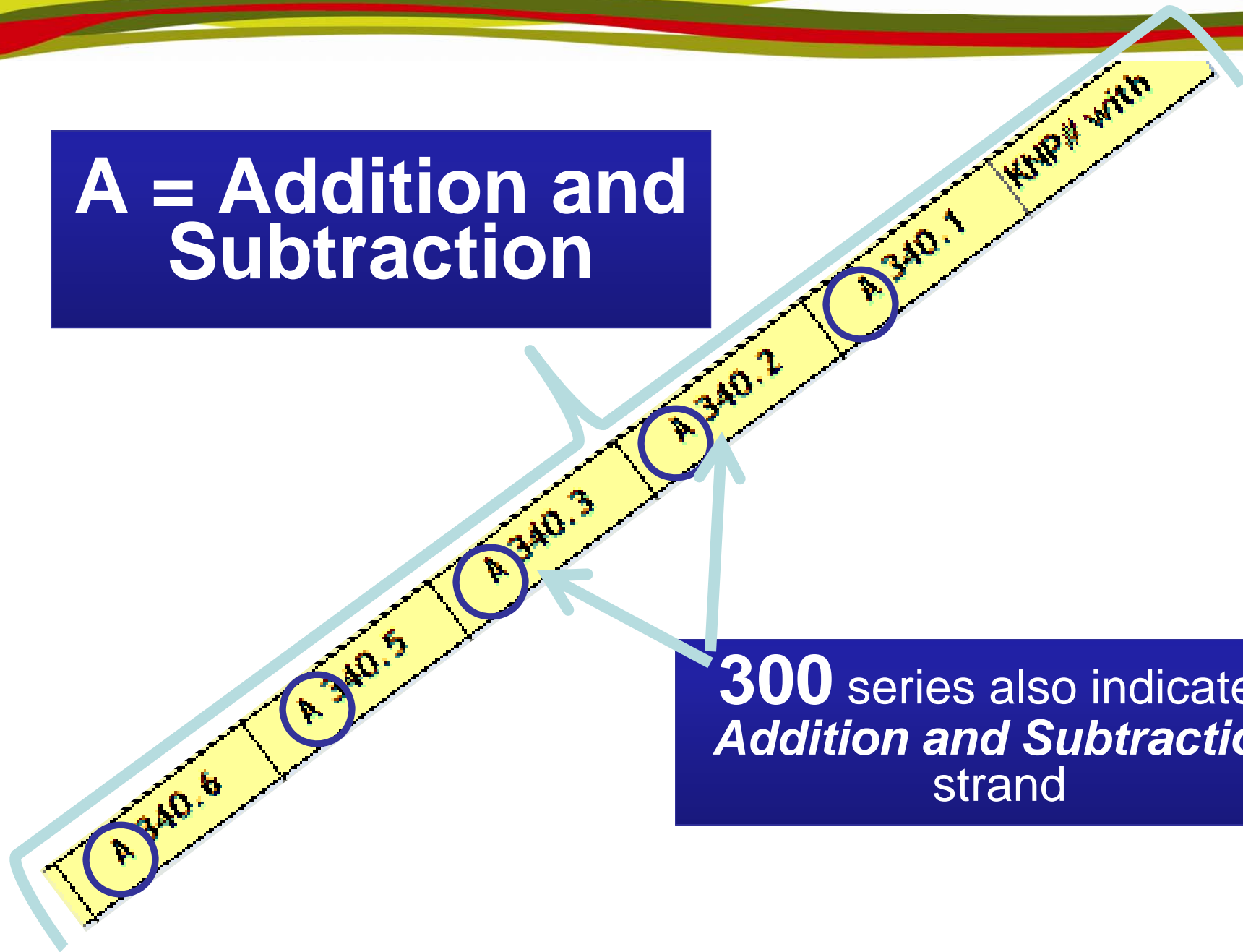
|     |   |    |    |    |     |
|-----|---|----|----|----|-----|
| (+) | — | *  | @  | /  | ^   |
| —   | — | *  | @  | /  | ^   |
| *   | * | @  | /  | ^  | *—  |
| @   | @ | /  | ^  | *— | **  |
| /   | / | ^  | *— | ** | *@  |
| ^   | ^ | *— | ** | *@ | * / |

$$\wedge + * = ?$$





**A = Addition and Subtraction**



**300** series also indicates *Addition and Subtraction* strand

# Task group A 340

| KNP # no prefix | KNP# with | Kentucky Common Core Academic Standard (KCAS) (*see glossary)  | KCAS Domain                       | KCAS Cluster  | Setting (situation & materials)  | Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand          |
|-----------------|-----------|--|-----------------------------------|---|--|--|--------------------------|
| 340.5           | A 340.5   | 1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., $8 + 6 = 8 + 2 + 4 = 10 + 4 = 14$ ); decomposing a number leading to a ten (e.g., $13 - 4 = 13 - 3 - 1 = 10 - 1 = 9$ ); using the relationship between addition and subtraction (e.g., knowing that 8 + 5 = 13, one can find 13 - 8 = 5). | Operations and Algebraic Thinking | Add and subtract within 20                                    | Problem strings in the range of 20 (see link), double bead rack (optional), writing material | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition & Subtraction   |
| 340.6           | A 340.6   | 2.NBT.5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.   | Number & Operations in Base Ten   | Use place value understanding and properties of operations to | Problem strings in the range of 100 (see link), 100 bead rack (optional), writing material   | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition and Subtraction |

| KNP Entry | Kentucky Common Core Academic Standard (KCAS) (*see glossary)  | KCAS Domain                       | KCAS Cluster   |
|-----------|--|-----------------------------------|--|
| A 340.3   | <p>1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., <math>8 + 6 = 8 + 2 + 4 = 10 + 4 = 14</math>); decomposing a number leading to a ten (e.g., <math>13 - 4 = 13 - 3 - 1 = 10 - 1 = 9</math>); using the relationship between addition and subtraction (e.g., knowing that <math>8 + 4 = 12</math>, one knows <math>12 - 8 = 4</math>); and creating equivalent but easier or known sums (e.g., adding <math>6 + 7</math> by creating the known equivalent <math>6 + 6 + 1 = 12 + 1 = 13</math>).</p> | Operations and Algebraic Thinking | Add and subtract within 20   |
| A 340.5   | <p>1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., <math>8 + 6 = 8 + 2 + 4 = 10 + 4 = 14</math>); decomposing a number leading to a ten (e.g., <math>13 - 4 = 13 - 3 - 1 = 10 - 1 = 9</math>); using the relationship between addition and subtraction (e.g., knowing that <math>8 + 4 = 12</math>, one knows <math>12 - 8 = 4</math>); and creating equivalent but easier or known sums (e.g., adding <math>6 + 7</math> by creating the known equivalent <math>6 + 6 + 1 = 12 + 1 = 13</math>).</p> | Operations and Algebraic Thinking | Add and subtract within 20   |
| A 340.6   | <p>2.NBT.5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.</p>  | Number & Operations in Base Ten   | Use place value understanding and properties of operations to add and subtract |

# Task group A 340

| KNP # no prefix | KNP# with | Kentucky Common Core Academic Standard (KCAS) (*see glossary)  | KCAS Domain                       | KCAS Cluster  | Setting (situation & materials)  | Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand          |
|-----------------|-----------|--|-----------------------------------|---|--|--|--------------------------|
| 340.5           | A 340.5   | 1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., $8 + 6 = 8 + 2 + 4 = 10 + 4 = 14$ ); decomposing a number leading to a ten (e.g., $13 - 4 = 13 - 3 - 1 = 10 - 1 = 9$ ); using the relationship between addition and subtraction (e.g., knowing that 8 + 5 = 13, one can subtract 13 - 5 = 8). | Operations and Algebraic Thinking | Add and subtract within 20                                    | Problem strings in the range of 20 (see link), double bead rack (optional), writing material | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition & Subtraction   |
| 340.6           | A 340.6   | 2.NBT.5. Fluently add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction.   | Number & Operations in Base Ten   | Use place value understanding and properties of operations to | Problem strings in the range of 100 (see link), 100 bead rack (optional), writing material   | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition and Subtraction |



## What is a *Mental Math Problem String*?

A problem string is a *sequence of related arithmetic tasks*

- Designed to call attention to a particular mathematical feature
- May be posed with materials or as bare number problems
- Tasks are presented one at a time
- Usually each solution remains visible as each successive task is presented

Example \*

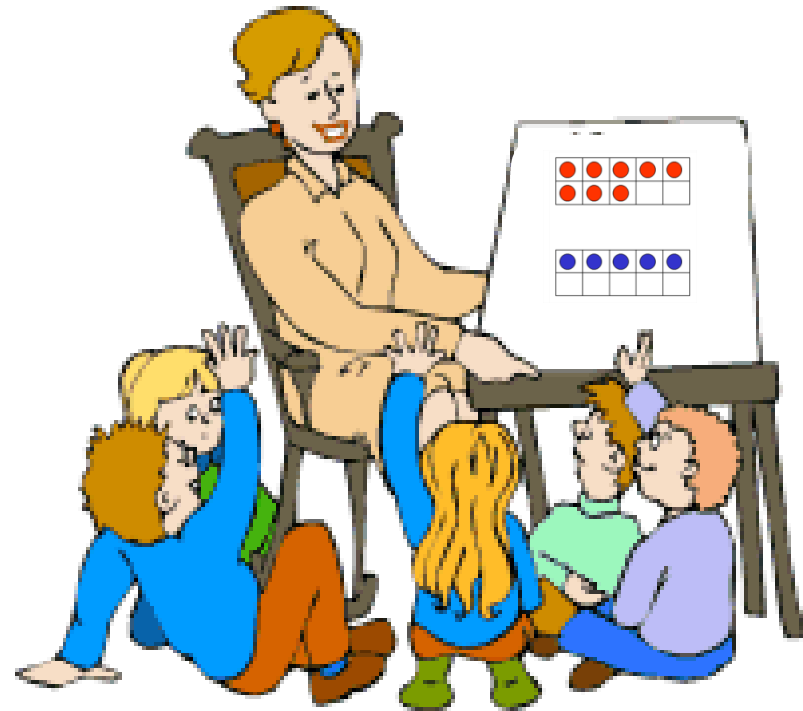
|            |
|------------|
| $7 + 7 =$  |
| $14 - 7 =$ |
| $8 + 6 =$  |
| $14 - 8 =$ |
| $14 - 6 =$ |
| $14 - 9 =$ |
| $13 - 6 =$ |

\* Fosnot, C. T. & Uittenbogaard, W. (2007). *Minilessons for Early Addition and Subtraction*. Portsmouth, NH: Heinemann.



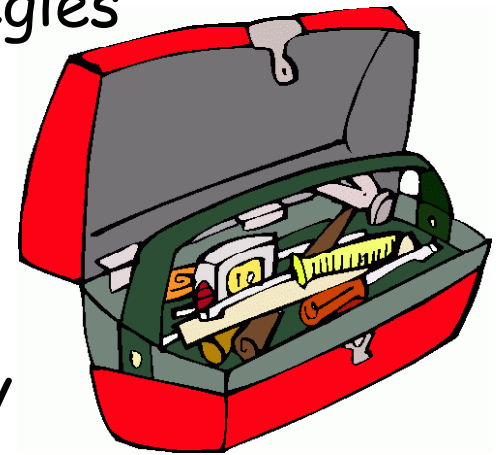
# Format

- Small or whole group
- 10 to 15 minutes per lesson
- 2 to 5 lessons per week throughout the year
- Student driven discussion



## Purpose (Students will...)

- Compute accurately and efficiently
- Develop a toolbox of computation strategies
- Match an appropriate strategy to the problem
- Express mathematical reasoning verbally and in writing





# Fostering student thinking

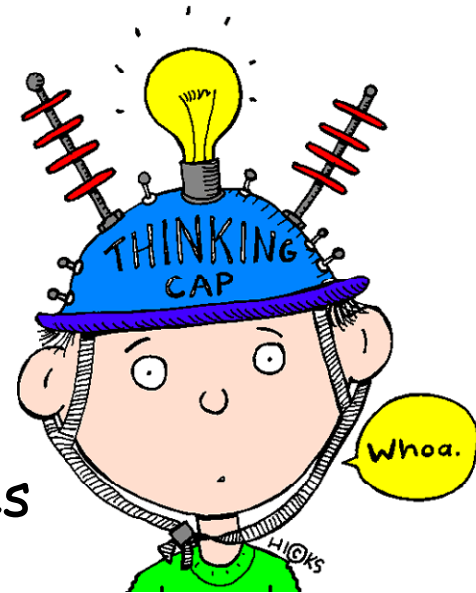
Establish think time

Honor children's strategies

Invite students to share different approaches

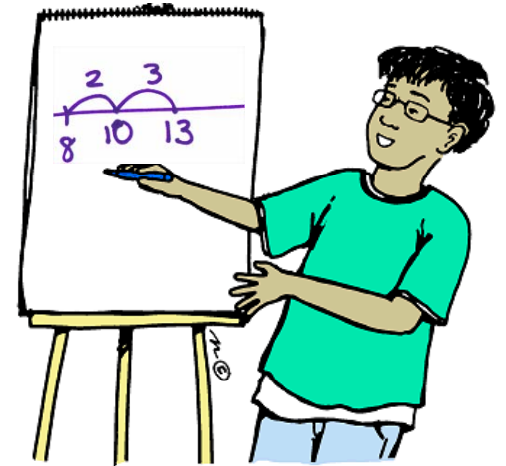
Use open-ended questions to prompt student thinking, such as

- How did you work that out?
- Why does that work?
- What did you know that helped you work that out?
- Does anyone have another way to work that out?
- Do you see a pattern? What is it?
- What is a new problem that is similar to these?
- Can you use the previous problem(s) to help with this problem?



## Teacher's role

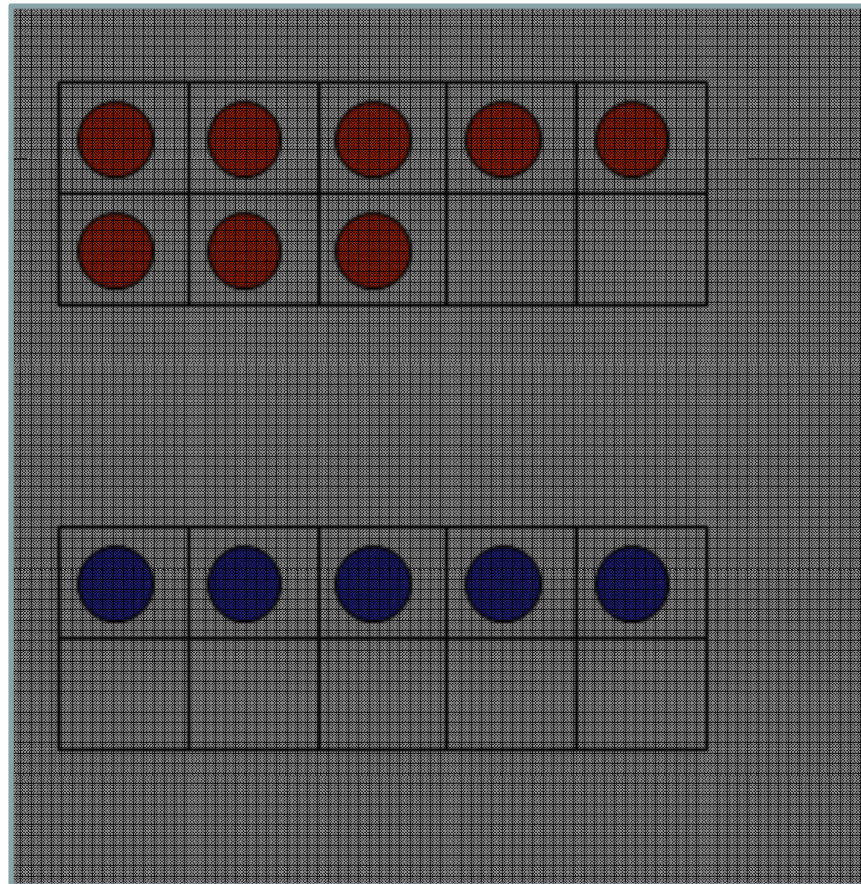
- Keep discussion mathematically focused
- Support students in communicating with each other
- Avoid praising ideas; acknowledge effort and hard thinking
- Help students express themselves verbally
  - act out strategy with materials
  - offer the correct mathematical language
  - ask one student to explain another student's strategy
- Help students to make a written record of their thinking
  - match the written model to the strategy

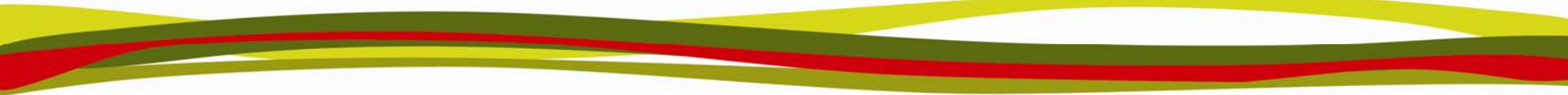


## Modeling Student Strategies

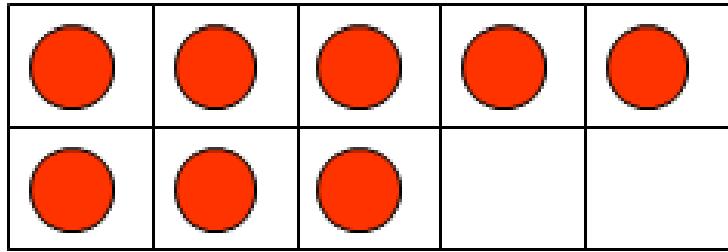
“Act out” student explanations with an appropriate model

Example:  $8 + 5$

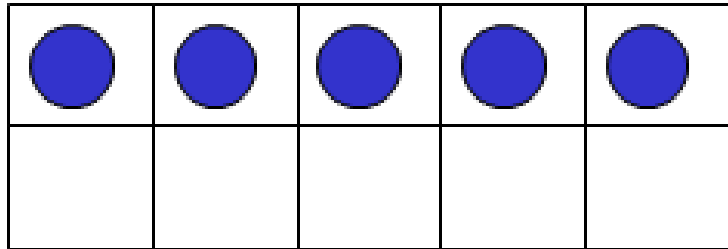




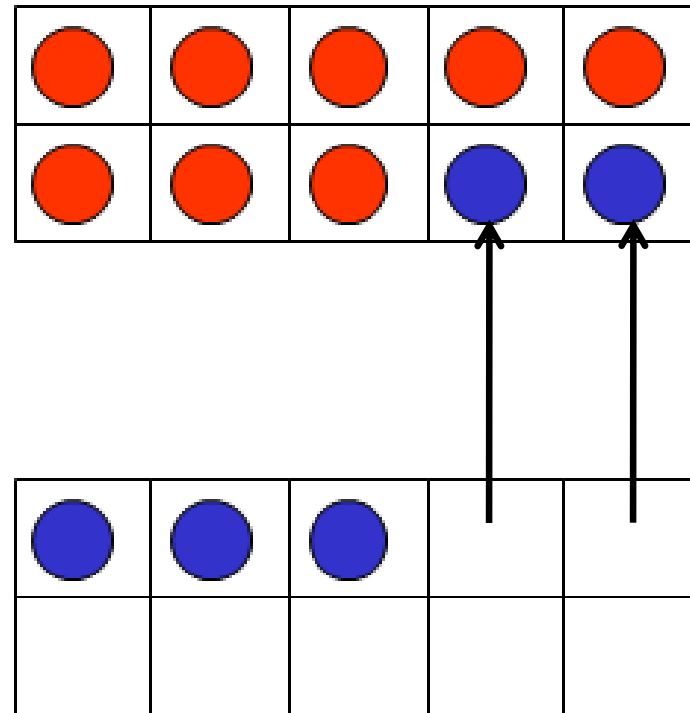
It's 13...  
I counted... 9,  
10, 11, 12, 13



9      10      11      12      13



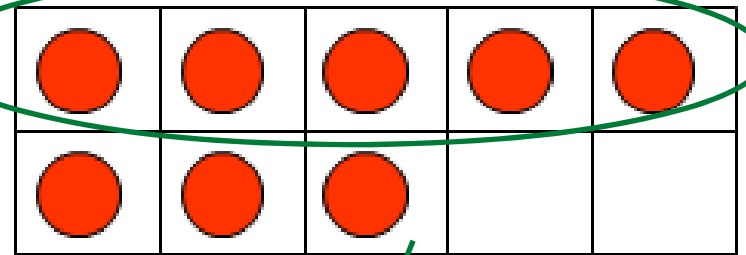
I took 2 from the 5 to make  
10. Then 10 and 3 is 13.



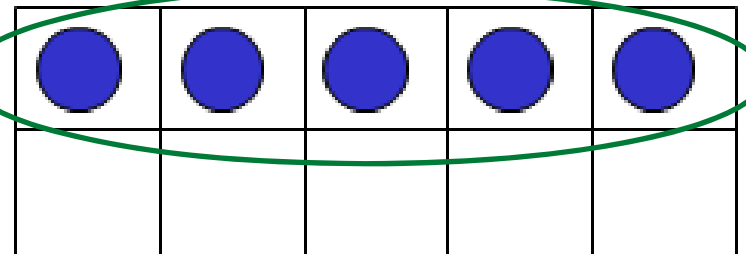
There were 2 fives and  
3 more, that's 13



10



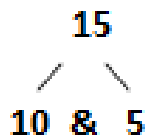
$$10 + 3 = 13$$



## Record student thinking with a written model

**SPLIT MODEL**

$$15 + 3 =$$

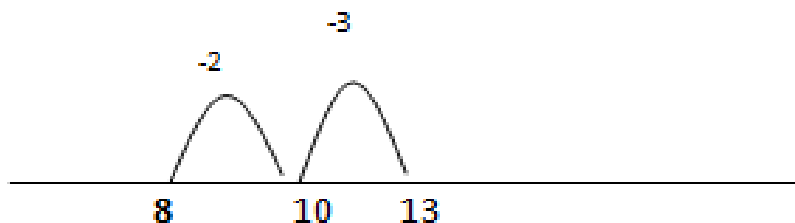


$$5 + 3 = 8$$
$$10 + 8 = 18$$

**JUMP MODEL**

$$13 - 5 =$$

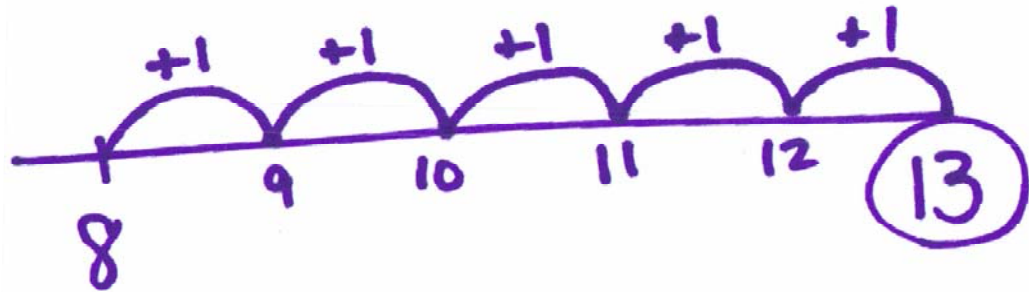
(Empty Number Line)



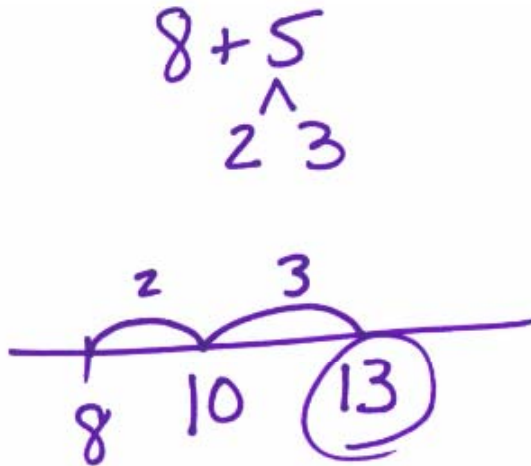
From Teaching Number in the Classroom with 4-8 year. For more information about the Split Model, see Chapter 9. For more information about the Jump model, see Chapter 8.

## Examples of written models

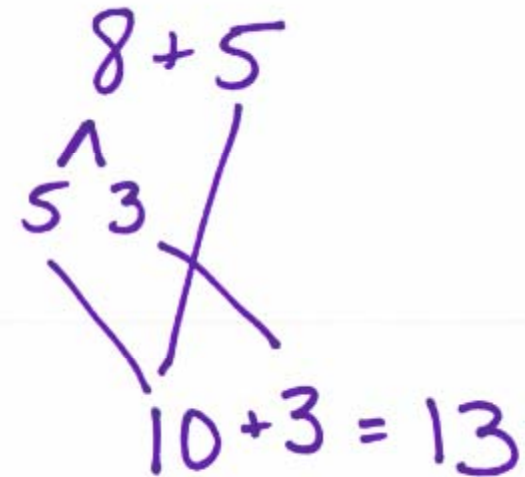
"I counted... 9, 10, 11, 12, 13"



"I took 2 from the 5 to make 10.  
Then 10 and 3 is 13"



"There were 2 fives and 3 more, that's 13"





# Task group A 340

| Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand          | Construct/Level (from AVMR) | Numeracy Target               | "I CAN ....." (*see glossary)                              | Assessment for Learning (*see glossary)  | Student Grouping                          | Video Link | Print Link  | Interactive Website   | Reference |
|--|--------------------------|-----------------------------|-------------------------------|--|--|---|------------|---|---|-----------|
| The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition & Subtraction   | 3 to 5 PINK                 | Facile number sequence        | ... use composite strategies to add and subtract within 20 | Present any of the problem strings. Prompt student to explain thinking for each solution. Prompt student to look for patterns or ways to use previous problems to solve subsequent problems. | teacher partner, small group, whole class |            | <a href="http://www.kentuckymath.com">http://www.kentuckymath.com</a> | <a href="http://www.ronblond.com/MathGlossary/Division">http://www.ronblond.com/MathGlossary/Division</a> |           |
| The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition and Subtraction | 5+ ORANGE                   | Beyond facile number sequence | ...use composite strategies to add and subtract within 100 | Present any of the problem strings. Prompt student to explain thinking for each solution. Prompt student to look for patterns or ways to use previous problems to solve subsequent problems. | teacher partner, small group, whole class |            | <a href="http://www.kentuckymath.com">http://www.kentuckymath.com</a> | <a href="http://www.ronblond.com/MathGlossary/Division">http://www.ronblond.com/MathGlossary/Division</a> |           |

# MENTAL MATH PROBLEM STRINGS

## What is a Mental Math Problem String?

A problem string is a sequence of related arithmetic tasks (typically 5-10 problems presented horizontally) that are designed to call attention to a particular mathematical feature. They can be posed with materials, such as showing an addition problem on a double bead rack, or posed with just numerals. The tasks are presented one at a time. Often, the previous tasks and their solutions remain visible as each successive task is presented.

Problem strings create opportunities for students to discover and strengthen composite arithmetical strategies and foster number sense. The types of tasks and the way successive tasks build on preceding tasks will influence which strategies students will discover and use. Teacher questioning, student think time and student discussions are critical to the process.

Some examples are listed below of problem strings are listed here:

| Using a related known fact | Using 5 and 10 structures | Part – Whole Relationships |
|----------------------------|---------------------------|----------------------------|
| 12+3 =                     | 15+3 =                    | 18-2 =                     |
| 12+4 =                     | 19-4 =                    | 18-16 =                    |
| 12+5 =                     | 16-6 =                    | 14-2 =                     |
| 12+7 =                     | 5+12 =                    | 14-12 =                    |
| 13+7 =                     | 13-5 =                    | 17-15 =                    |

## Fostering student thinking

Use open-ended questions to prompt student thinking, such as

- How did you work that out?
- Does anyone have another way to work that out?
- What did you know that helped you work that out?
- Do you see a pattern? What is it?
- What is a new problem that is similar to these?
- Can you use the previous problem(s) to help with this problem?

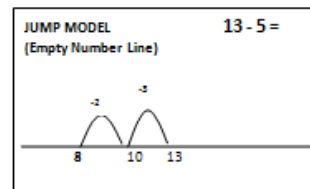
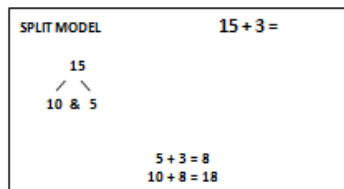
Allow think time before students respond. A "thumbs up" or other hand signal can be used by students to indicate their readiness to answer. Foster an expectation that students listen to each other and may ask questions about each other's strategies. At times, ask one student to paraphrase another student's explanation. Invite multiple solutions.

## Modeling Student Strategies

When leading activities involving mental problem strings, the teacher can support student thinking and student discussion by acting out and/or recording the students' explanations. For example, a setting such as a bead rack, a double 10 frame or snap cubes can be used to act out a student's strategy.

Written methods like those shown below can be used to record student thinking. Match the recording model to the strategy used. As students become more familiar with investigating and discussing strings, transition from teacher modeling to the students recording their own thinking and sharing those recordings with the class. (A class document camera is very helpful for these kinds of discussions!)

The teacher's role is to keep the mathematical discussion focused, help student express and record their own thinking and support the students in listening to and understanding each other. Be careful not to show a "teacher" way of solving or thinking - this will discourage students from pursuing their own ideas and listening to peers. Be open - students may come up with ideas you did not anticipate but contain wonderful mathematics!



## Teacher Resources

The above models are discussed in more detail in [Teaching Now](#) (see reference). For more information about Split Strategies, Split Jump strategies, see Chapter 8.

The following two teacher resources use a series of problems to add and subtraction ideas. Copy the URL below the title for

- [Minilessons for Early Addition and Subtraction; A Year](http://www.heinemann.com/products/E01013.aspx)
- [Minilessons for Extending Addition and Subtraction; A Year](http://www.heinemann.com/products/E01102.aspx)

## References

- Fosnot, C., & Dolk, M. (2001). *Young mathematicians at work: Constructing* Portsmouth: Heinemann.
- Fosnot, C. T. & Uittenboogard, W. (2007). *Minilessons for Early Addition and Subtraction*
- Fosnot, C. T. & Uittenboogard, W. (2007). *Minilessons for Extending Addition and Subtraction*
- Wright, R.J., Martindale, J., Stafford, A.K., & Stanger, G.S. (2002). *Teaching Now*

## Examples of Mental Math Problem Strings within 20

| Doubles and near doubles | Bridging through 10 | Transformation |
|--------------------------|---------------------|----------------|
| 6 + 6 =                  | 10 + 6 =            | 7 + 7 =        |
| 6 + 7 =                  | 9 + 6 =             | 8 + 6 =        |
| 7 + 8 =                  | 9 + 4 =             | 6 + 6 =        |
| 14 - 7 =                 | 8 + 5 =             | 7 + 5 =        |
| 16 - 8 =                 | 5 + 7 =             | 8 + 4 =        |
| 17 - 8 =                 |                     |                |

| Bridging through 10 | Commutative Property | Adding 5 |
|---------------------|----------------------|----------|
| 9 + 4 = 10 + ____   | 8 + 3 =              | 5 + 3 =  |
| 9 + 7 = 10 + ____   | 3 + 8 =              | 5 + 8 =  |
| 8 + 5 = 10 + ____   | 17 + 2 =             | 5 + 4 =  |
| 11 + 4 = 10 + ____  | 2 + 17 =             | 5 + 9 =  |
| 11 + 6 = 10 + ____  | 3 + 14 =             | 5 + 6 =  |

## Examples of Mental Math Problem Strings within 100

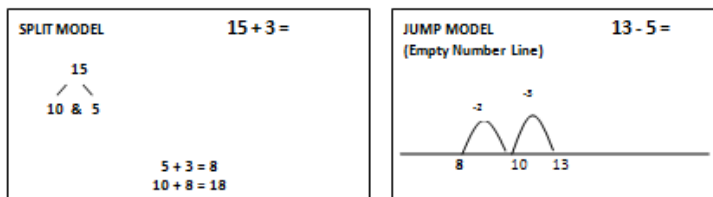
| addition within a decade | subtracting within a decade | Across the decade |
|--------------------------|-----------------------------|-------------------|
| 3 + 5 =                  | 9 - 6 =                     | 8 + 3 =           |
| 43 + 5 =                 | 29 - 6 =                    | 28 + 3 =          |
| 73 + 5 =                 | 59 - 6 =                    | 58 + 3 =          |
| 24 + 4 =                 | 47 - 5 =                    | 58 + 6 =          |
| 64 + 4 =                 | 67 - 5 =                    | 38 + 6 =          |

### Modeling Student Strategies

When leading activities involving mental problem strings, the teacher can support student thinking and student discussion by acting out and/or recording the students' explanations. For example, a setting such as a bead rack, a double 10 frame or snap cubes can be used to act out a student's strategy.

Written methods like those shown below can be used to record student thinking. Match the recording model to the strategy used. As students become more familiar with investigating and discussing strings, transition from teacher modeling to the students recording their own thinking and sharing those recordings with the class. (A class document camera is very helpful for these kinds of discussions!)

The teacher's role is to keep the mathematical discussion focused, help student express and record their own thinking and support the students in listening to and understanding each other. Be careful not to show a "teacher" way of solving or thinking - this will discourage students from pursuing their own ideas and listening to peers. Be open - students may come up with ideas you did not anticipate but contain wonderful mathematics!



#### Teacher Resources

The above models are discussed in more detail in [Teaching Number in the Classroom with 4-8 year olds](#) (see reference). For more information about Split Strategies, see Chapter 9. For more information about Jump strategies, see Chapter 8.

The following two teacher resources use a series of problem strings over the course of a year to develop addition and subtraction ideas. Copy the URL below the title for ordering information.

- *Minilessons for Early Addition and Subtraction; A Yearlong Resource*  
<http://www.heinemann.com/products/E01013.aspx>
- *Minilessons for Extending Addition and Subtraction; A Yearlong Resource*  
<http://www.heinemann.com/products/E01102.aspx>

#### References

Fosnot, C., & Dolk, M. (2001). *Young mathematicians at work: Constructing number sense, addition and subtraction*. Portsmouth: Heinemann.

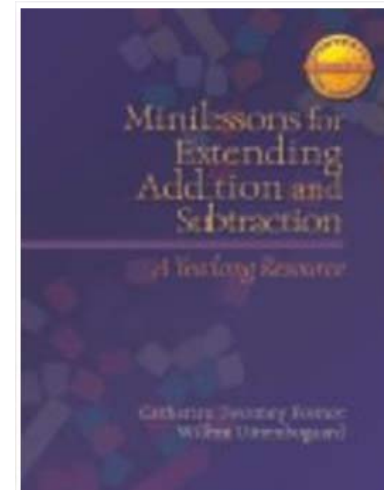
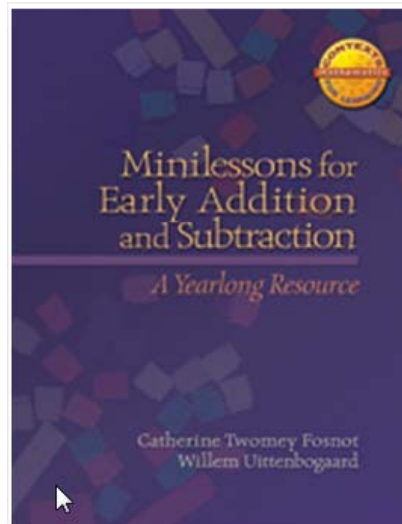
Fosnot, C.

Fosnot, C.

Wright, R.J.

The following two teacher resources use a series of problem strings over the course of a year to develop addition and subtraction ideas. Copy the URL below the title for ordering information.

- *Minilessons for Early Addition and Subtraction; A Yearlong Resource*  
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- *Minilessons for Extending Addition and Subtraction; A Yearlong Resource*  
<http://www.heinemann.com/products/E01102.aspx>





## *Why use Mental Math Problem Strings?*

“Calculating with number sense as a mathematician means having many strategies at your disposal and looking to the numbers first *before* choosing a strategy. How do we, as teachers, develop children’s ability to do this?”

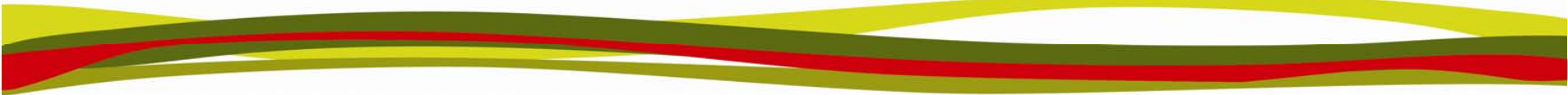
“...encourage children to examine the numbers in the problem and think about clever, efficient ways to reach a solution. The relationships among the problems in the minilesson will support children in doing this. By developing a repertoire of strategies, an understanding of the big ideas underlying why they work, and a variety of ways to model the relations, children are developing powerful toolboxes for flexible and efficient computation.”\*

\* Fosnot, C. T. & Uittenbogaard, W. (2007). *Minilessons for Extending Addition and Subtraction*. Portsmouth, NH: Heinemann.



# A 340.6

| KCAS Cluster                                  | Setting (situation & materials)  | Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand          | Construct/Level (from AVMR) | Numeracy Target               | "I CAN ....." (*see glossary)                              | Assessment for Learning (*see glossary)  | Student Grouping                          | Video Link |
|---|--|--|--------------------------|-----------------------------|-------------------------------|--|--|---|------------|
| Add and subtract within 20                    | Problem strings in the range of 20 (see link), double bead rack (optional), writing material | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition & Subtraction   | 3 to 5 PINK                 | Facile number sequence        | ... use composite strategies to add and subtract within 20 | Present any of the problem strings. Prompt student to explain thinking for each solution. Prompt student to look for patterns or ways to use previous problems to solve subsequent problems. | teacher partner, small group, whole class |            |
| understanding and properties of operations to | Problem strings in the range of 100 (see link), 100 bead rack (optional), writing material   | The teacher will choose or create a problem string and present the string, one problem at a time, to the student or group of students. (See the print link for more information about problem strings and several examples.) | Addition and Subtraction | 5+ ORANGE                   | Beyond facile number sequence | ...use composite strategies to add and subtract within 100 | Present any of the problem strings. Prompt student to explain thinking for each solution. Prompt student to look for patterns or ways to use previous problems to solve subsequent problems. | teacher partner, small group, whole class |            |



**Subtracting  
within a  
decade**

$$9 - 6 =$$

$$29 - 6 =$$

$$59 - 6 =$$


$$47 - 5 =$$

$$67 - 5 =$$

## **Behind the Numbers**

Create an opportunity for students to see that subtraction in the range 1 to 10 connects to subtraction with higher quantities.

### **Ask Questions**

- How did you work that out?
  - Does anyone have another way to work that out?
  - Can you use the previous problem(s) to help with this problem?
  - What did you know that helped you work that out?
  - Do you see a pattern? What is it?
  - What is a new problem that is similar to these?
- 



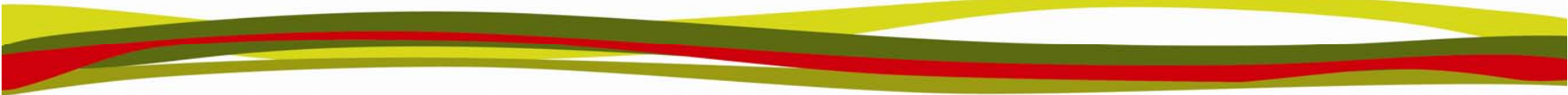
# Task group A304.4

| KNP# with prefix | Kentucky Common Core Academic Standard (KCAS)<br>(*see glossary)   | KCAS Domain                       | KCAS Cluster               | Setting<br>(situation & materials)  | Activities: Exemplary Learning Experiences<br>(*see glossary)   | Numeracy Strand<br>(from AVMR) | Construct/Level<br>(from AVMR) | Numeracy Target<br>(from AVMR) | "I CAN ....."<br>(*see glossary)                        |
|------------------|--|-----------------------------------|----------------------------|---|---|--------------------------------|--------------------------------|--------------------------------|---|
| A 304.4          | 1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. Use strategies such as counting on; making ten (e.g., $8 + 6 = 8 + 2 + 4 = 10 + 4 = 14$ ); decomposing a number leading to a ten (e.g., $13 - 4 = 13 - 3 - 1 = 10 - 1 = 9$ ); using the relationship between addition and subtraction (e.g., knowing that $8 + 4 = 12$ , one knows $12 - 8 = 4$ ); and creating equivalent but easier or known sums (e.g., adding $6 + 7$ by creating the known equivalent $6 + 6 + 1 = 12 + 1 = 13$ ). | Operations and Algebraic Thinking | Add and subtract within 20 | Fill 20 Game Board (see link), 20 counters per player, 1 cube labeled "10, 10, 11, 12, 13, 14" and another labeled "10, 11, 12, 13, 14, 14" | Each student uses one "Fill 20" game board. During a turn, the student rolls both cubes and finds the difference. This is the number of counters added to the game board. Ex., if 11 and 14 is rolled, the difference is 3 and 3 counters are added to the game board. Game ends when game board(s) are filled. Students might be asked to record the subtraction sentence for each turn. | Addition & Subtraction         | 3 to 4 PURPLE                  | Intermediate number sequence   | ...subtract using the more efficient counting strategy* |



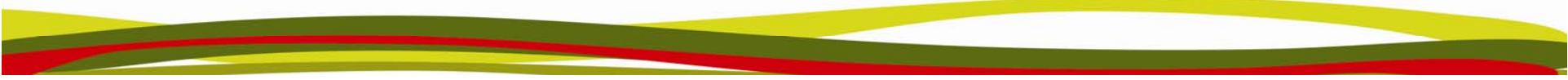
# Task group A304.4

| KNP# with prefix | Kentucky Common Core Academic Standard (KCAS)<br>(*see glossary)  | KCAS Domain                       | KCAS Cluster               | Setting<br>(situation & materials)   | Activities: Exemplary Learning Experiences<br>(*see glossary)  | Numeracy Strand<br>(from AVMR) | Construct/Level<br>(from AVMR) | Numeracy Target<br>(from AVMR) | "I CAN ....."<br>(*see glossary)                                      |
|------------------|---|-----------------------------------|----------------------------|--|--|--------------------------------|--------------------------------|--------------------------------|---|
| A 304.4          | <p>1.OA.6 Add and subtract within 20, demonstrating fluency for addition and subtraction within 10. <u>Use strategies such as counting on; making ten</u> (e.g., <math>8 + 6 = 8 + 2 + 4 = 10 + 4 = 14</math>); <u>decomposing a number leading to a ten</u> (e.g., <math>13 - 4 = 13 - 3 - 1 = 10 - 1 = 9</math>); <u>using the relationship between addition and subtraction</u> (e.g., knowing that <math>8 - 4 = 4</math>, one knows <math>12 - 8 = 4</math>); <u>and creating equivalent but easier or known sums</u> (e.g., adding <math>6 + 7</math> by creating the known equivalent <math>6 + 6 + 1 = 12 + 1 = 13</math>).</p> | Operations and Algebraic Thinking | Add and subtract within 20 | <p>Fill 20 Game Board (see link), 20 counters per player, 1 cube labeled "10, 10, 11, 12, 13, 14" and another labeled "10, 11, 12, 13, 14, 14"</p> | <p>Each student uses one "Fill 20" game board. During a turn, the student rolls both cubes and finds the difference. This is the number of counters added to the game board. Ex., if 11 and 14 is rolled, the difference is 3 and 3 counters are added to the game board. Game ends when game board(s) are filled. Students might be asked to record the subtraction sentence for each turn.</p> | Addition & Subtraction         | 3 to 4 PURPLE                  | Intermediate number sequence   | <p>...subtract using the <u>more efficient</u> counting strategy*</p> |


$$\begin{array}{r} 14 \\ - 9 \\ \hline \end{array}$$

$$\begin{array}{r} 0 \quad 14 \\ \cancel{+ 14} \\ - 9 \\ \hline 5 \end{array}$$

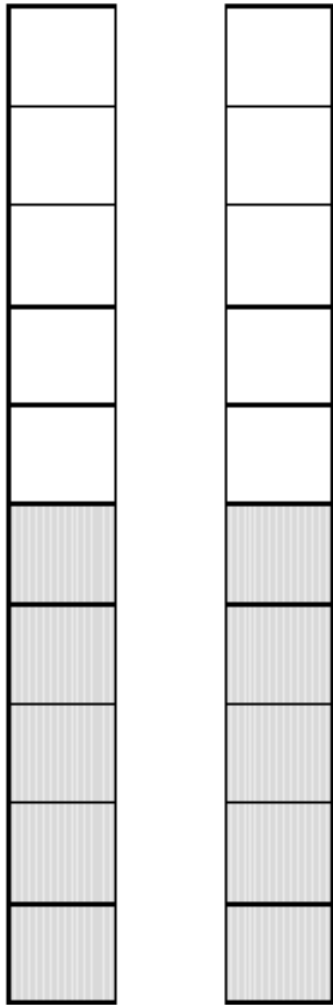
Yikes!



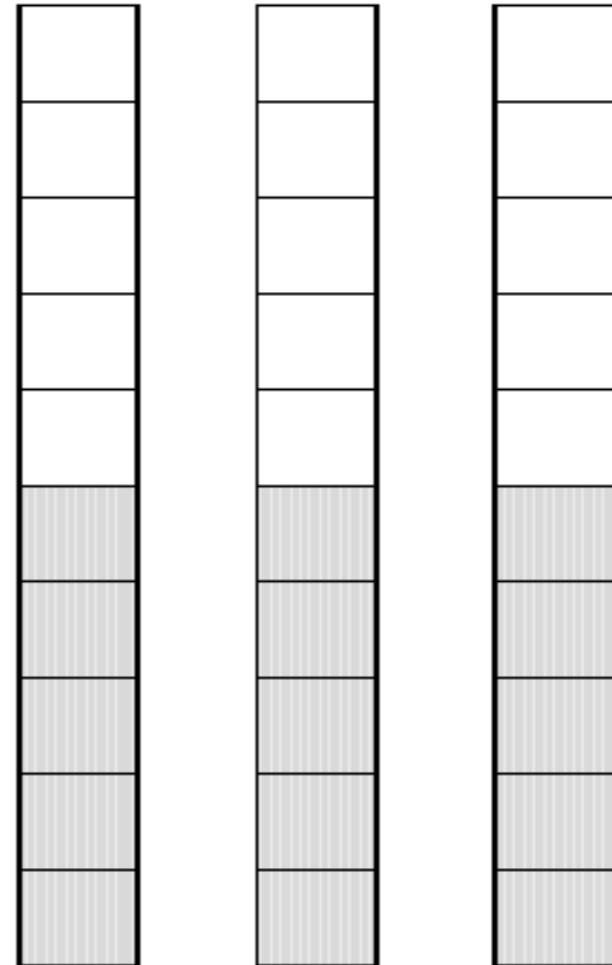
# Task group A304.4

| Exemplary Learning Experiences (glossary)   | Numeracy Strand (from AVMR) | Construct/Level (from AVMR) | Numeracy Target (from AVMR)  | "I CAN ....." (*see glossary)                           | Assessment for Learning (*see glossary)   | Student Grouping               | Video Link | Print Link  | Interactive Website | Reference | Teacher Notes   |
|---|-----------------------------|-----------------------------|------------------------------|---|---|--------------------------------|------------|---|---------------------|-----------|---|
| <p>Each turn, the student rolls two dice and finds the sum. This is the number of counters to be placed on the game board. If a 1 and 14 is rolled, 3 and 3 counters are placed on the game board(s). Students might be asked to perform the subtraction for each turn.</p> | Addition & Subtraction      | 3 to 4 PURPLE               | Intermediate number sequence | ...subtract using the more efficient counting strategy* | <p>Pose the following tasks one at a time by writing the task on a card or white board. Observe if the student is using an efficient strategy. 15-3, 14-12 and 13-10.</p> | teacher partner<br>small group |            | <a href="http://kymath.org/intervention/doc/NumeracyProject/Fill20GameBoard.pdf">http://kymath.org/intervention/doc/NumeracyProject/Fill20GameBoard.pdf</a> |                     |           | <p>The reason both cubes are in the task is to generate problems where the student can use no more than 4. It is hoped that students will realize that it is easier to count on than to use related known facts rather than to subtract the amount being removed. For example, if a student rolls a 11 and 13, it is hoped that the student will not start at 13 and count down. Rather, the student could reach 12 and removing 2 is 11, so it's 2 more. Then 13-11 is 2". If a student is using these strategies, the student may be asked to work the problem on a 20-sided die.</p> |

# Game boards for task group A304



Prepared by Cindy Acassey for KCM

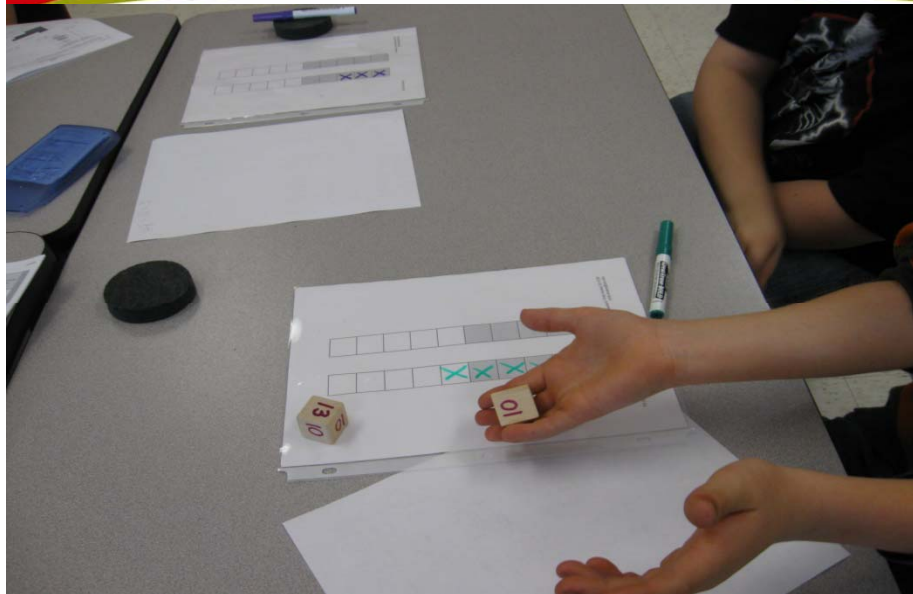


Fill 50 Game Board

Prepared by Cindy Acassey for KCM  
cindy.acassey@uky.edu

Materials for task group A304.4  
(can use counters or put game boards in plastic sleeves and use dry-erase markers to fill game boards)



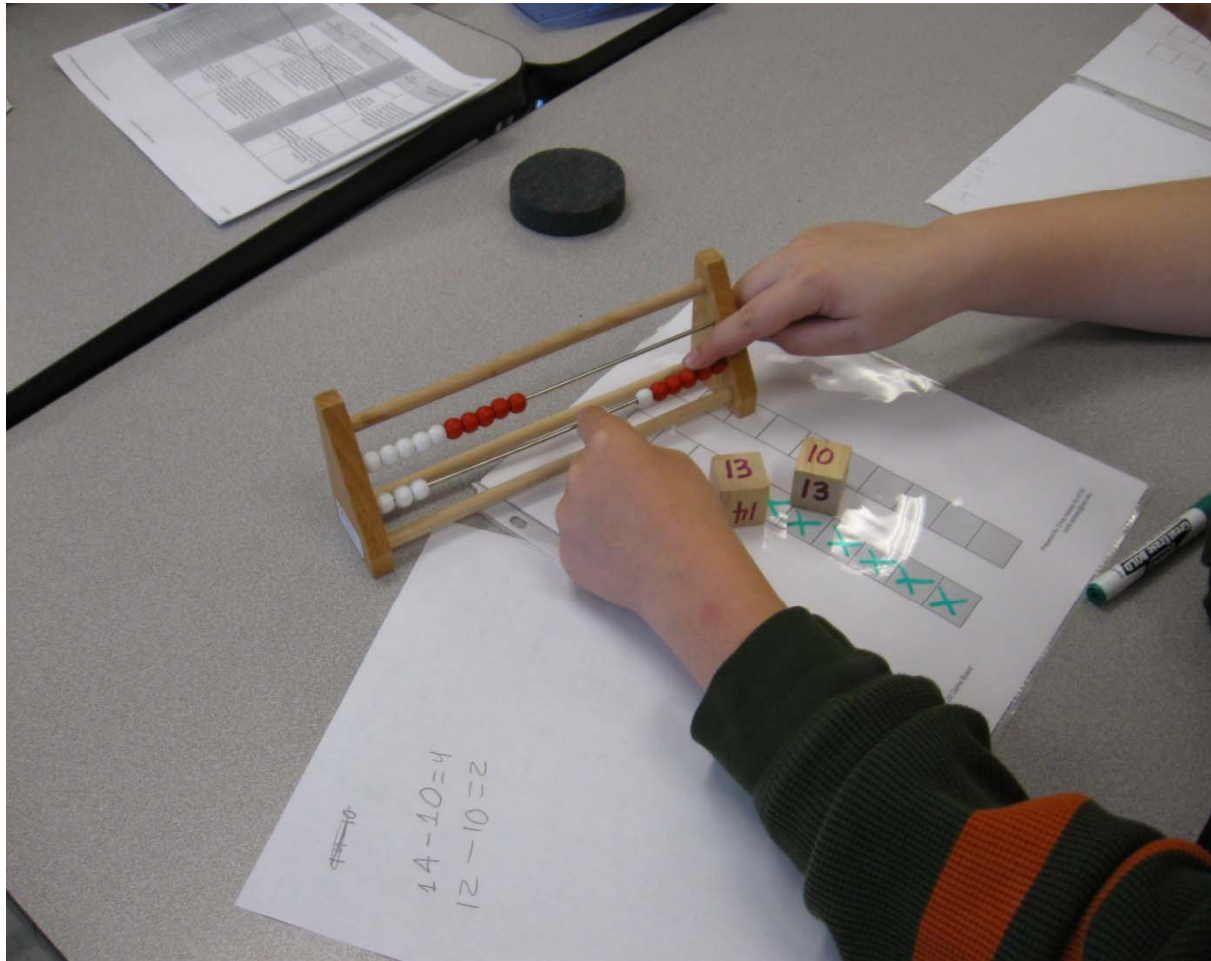


Student rolls both number cubes, finds the difference, then covers (or fills) that many squares on the game board.



Students can record equations for later discussion!

Use bead  
rack to help  
support  
student  
thinking



# Task group A304.5

| KNP#    | Kentucky Common Core Academic Standard (KCAS)<br>(*see glossary)   | KCAS Domain                       | KCAS Cluster               | Setting<br>(situation & materials)  | Activities: Exemplary Learning Experiences<br>(*see glossary)  | Numeracy Strand<br>(from AV/MR) | Construct/Level<br>(from AV/MR) |
|---------|--|-----------------------------------|----------------------------|---|--|---------------------------------|---------------------------------|
| A 304.5 | 2.OA.2. Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers. | Operations and Algebraic Thinking | Add and subtract within 20 | Fill 30 Game Board (see link), 30 counters per player, 1 cube labeled "10, 11, 12, 13, 14, 15" and another labeled "15, 16, 17, 18, 19, 20" | Give each student one "Fill 30" game board. On his or her turn, a student will roll both cubes and find the difference. This is the number of counters the student will add to the game board. Ex., if 11 and 19 is rolled, the student will determine the difference (i.e. $19-11 = 8$ ) and add 8 counters to the game board. Game ends when game board(s) are filled. Students could record the subtraction sentence for each turn. | Addition & Subtraction          | 4 to 5 PINK                     |



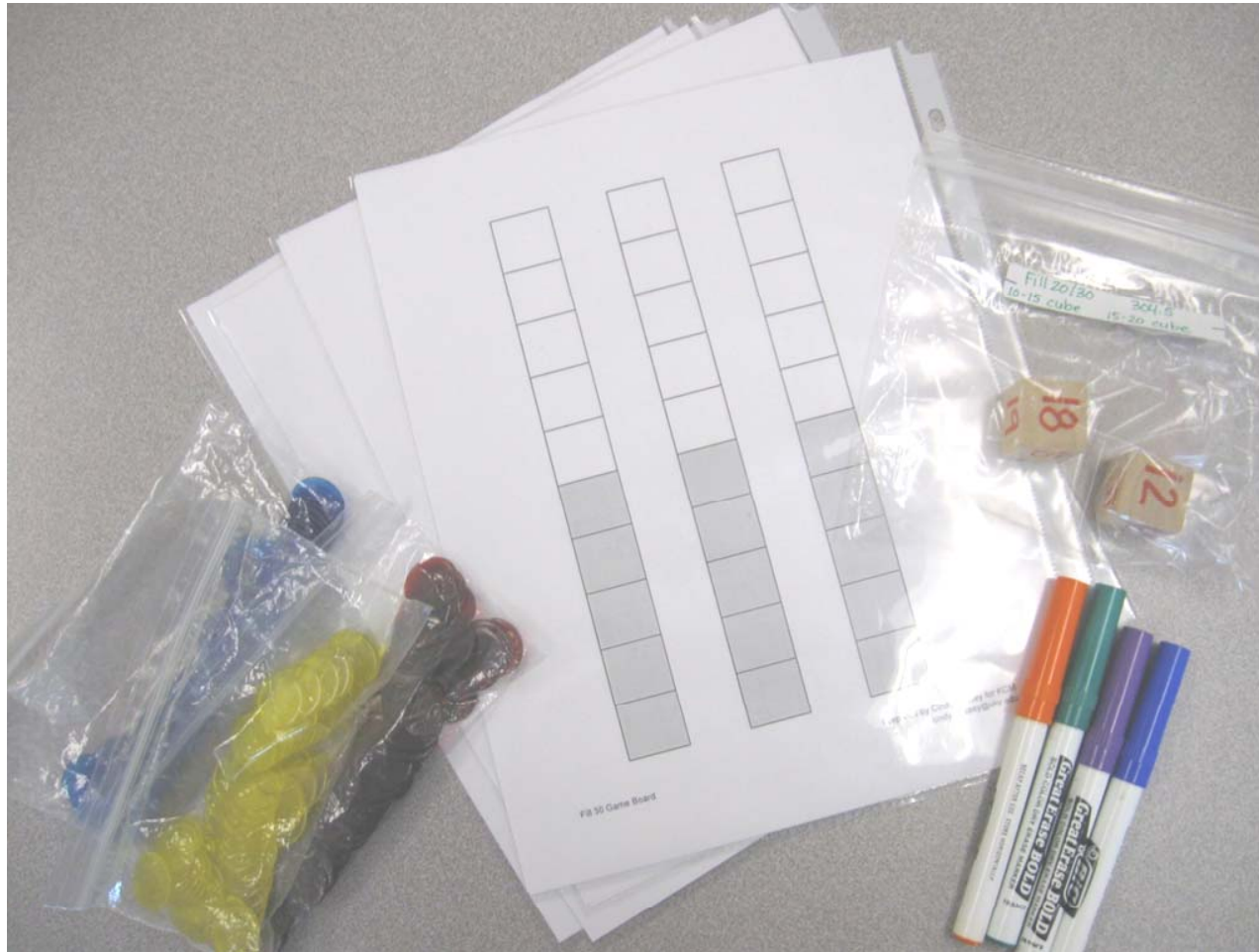
# Task group A304.5

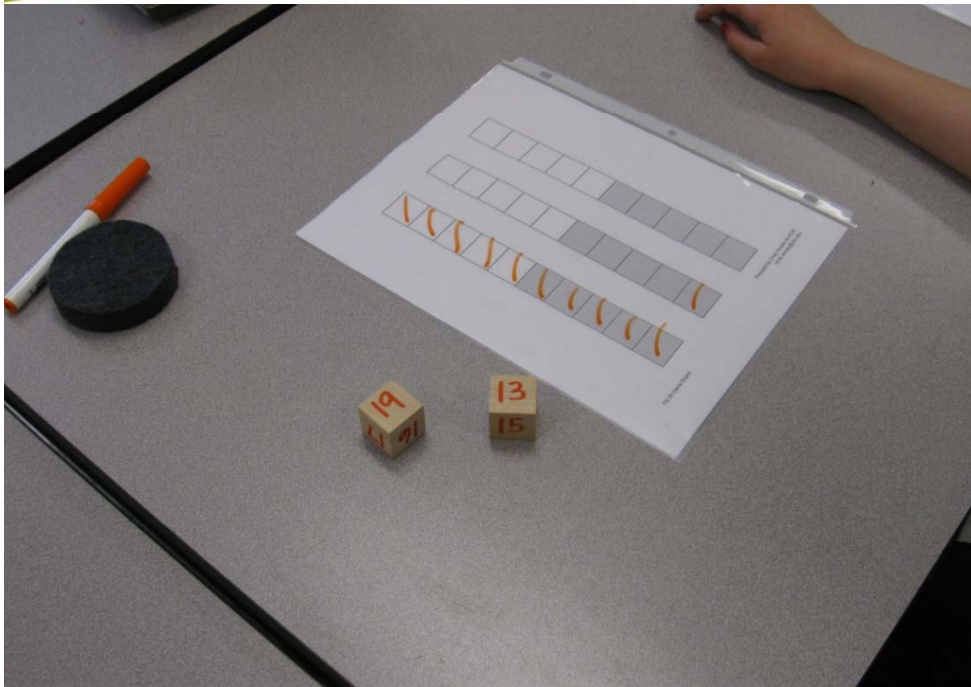
| KNP#    | Kentucky Common Core Academic Standard (KCAS)<br>(*see glossary)   | KCAS Domain                       | KCAS Cluster               | Setting<br>(situation & materials)  | Activities: Exemplary Learning Experiences<br>(*see glossary)  | Numeracy Strand<br>(from AV/MR) | Construct/Level<br>(from AV/MR) |
|---------|--|-----------------------------------|----------------------------|---|--|---------------------------------|---------------------------------|
| A 304.5 | 2.OA.2. <u>Fluently add and subtract within 20 using mental strategies.</u> By end of Grade 2, know from memory all sums of two one-digit numbers. | Operations and Algebraic Thinking | Add and subtract within 20 | Fill 30 Game Board (see link), 30 counters per player, 1 cube labeled "10, 11, 12, 13, 14, 15" and another labeled "15, 16, 17, 18, 19, 20" | Give each student one "Fill 30" game board. On his or her turn, a student will roll both cubes and find the difference. This is the number of counters the student will add to the game board. Ex., if 11 and 19 is rolled, the student will determine the difference (i.e. $19-11 = 8$ ) and add 8 counters to the game board. Game ends when game board(s) are filled. Students could record the subtraction sentence for each turn. | Addition & Subtraction          | 4 to 5 PINK                     |

# Task group A304.5

| Numeracy Target<br>(from AVMR) | "I CAN ....."<br>(*see glossary)                        | Assessment for Learning<br>(*see glossary)  | Student Grouping                       | Video Link | Print Link   | Interactive Website | Reference | Teacher Notes   |
|--------------------------------|---|---|--|------------|--|---------------------|-----------|---|
| Facile number sequence         | <p>...subtract using mental computation strategies*</p> | <p>Pose the following tasks one at a time by writing the task on a card or white board. Observe if the student is using an efficient strategy: 19-11, 15-13, 20-12.</p> | <p>teacher partner<br/>small group</p> |            | <p><a href="http://www.kymath.org/intervention/doc/NumeracyProject/A_304-5.pdf">http://www.kymath.org/intervention/doc/NumeracyProject/A_304-5.pdf</a></p> |                     |           | <p>Students should be asked to explain their reasoning. The students will use mental strategies other than counting problems. For example, if a student rolls 18-11, he could 10 is 8 so 18-11 is 7. Or he might reason that 8-1 is 7 so also 7. If a student is struggling to see these strategies, may find it helpful to work the problem on a 20 be</p> |

## Materials for task group A304.5

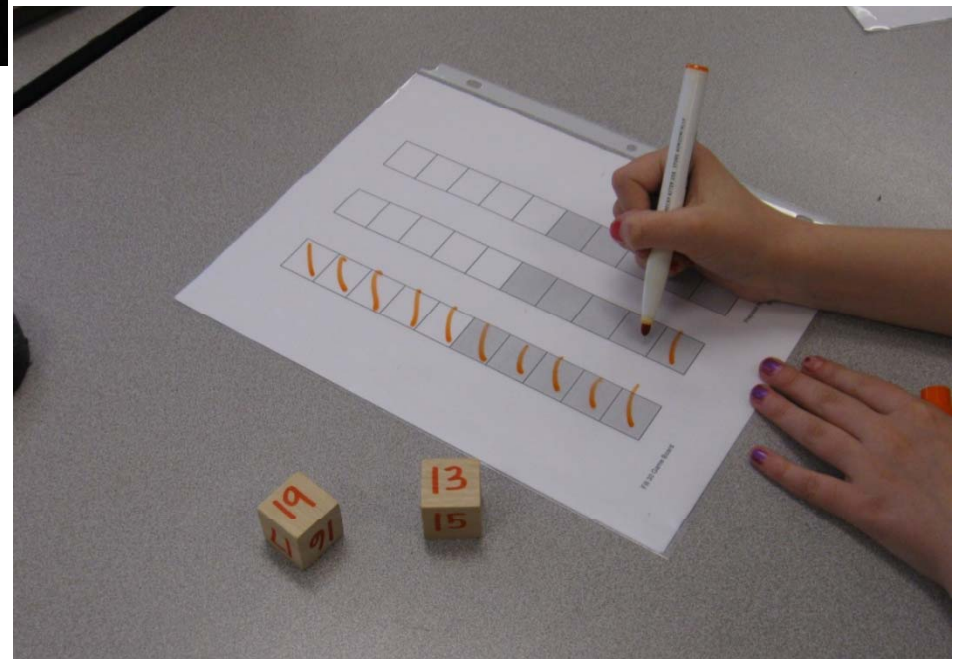




Student rolls both number cubes, finds the difference, then covers that many squares on game board.

How is the student finding the difference?

- Counting backwards from 19 to 13?
- Counting forward from 13 to 19?
- Using related addition? ( $13+6=19$ )
- Using early place value? ( $9-3$  is 6, so  $19-13$  is also 6)



# Task group A304.6

| KNP# with prefix | Kentucky Common Core Academic Standard (KCAS) (*see glossary)                          | KCAS Domain                       | KCAS Cluster   | Setting (situation & materials)   | Activities: Exemplary Learning Experiences (*see glossary)  | Numeracy Strand (from AVMR) | Construct/Level (from AVMR) |
|------------------|--|-----------------------------------|--|---|---|-----------------------------|-----------------------------|
| A 304.6          | 3.NBT.1 Use place value understanding to round whole numbers to the nearest 10 or 100. | Number and Operations in Base Ten | Use place value understanding and properties of operations to perform multi-digit arithmetic | Fill 20 or Fill 30 Game Board (see link), 30 counters per player, cards or tiles with numbers in range 1 to 100 | <p>Give each student one "Fill 20" or "Fill 30" game board. On his or her turn, a student will draw a card or tile with a number in the range 1 to 100. The student will determine how far the number is from the nearest multiple of 10. This is the number of counters the student will add to the game board. Ex., if 27 is drawn, the student will determine that 27 is 3 from 30 and will place 3 counters on the game board. Game ends when game board(s) are filled.</p> | Addition and Subtraction    | 5+ ORANGE                   |

# Task group A304.6

| KNP# with prefix | Kentucky Common Core Academic Standard (KCAS) (*see glossary)                          | KCAS Domain                       | KCAS Cluster   | Setting (situation & materials)   | Activities: Exemplary Learning Experiences (*see glossary)  | Numeracy Strand (from AVMR) | Construct/Level (from AVMR) |
|------------------|--|-----------------------------------|--|---|---|-----------------------------|-----------------------------|
| A.304.6          | 3.NBT.1 Use place value understanding to round whole numbers to the nearest 10 or 100. | Number and Operations in Base Ten | Use place value understanding and properties of operations to perform multi-digit arithmetic | Fill 20 or Fill 30 Game Board (see link), 30 counters per player, cards or tiles with numbers in range 1 to 100 | <p>Give each student one "Fill 20" or "Fill 30" game board. On his or her turn, a student will draw a card or tile with a number in the range 1 to 100. <u>The student will determine how far the number is from the nearest multiple of 10.</u></p> <p>This is the number of counters the student will add to the game board. Ex., if 27 is drawn, the student will determine that 27 is 3 from 30 and will place 3 counters on the game board. Game ends when game board(s) are filled.</p> | Addition and Subtraction    | 5+ ORANGE                   |

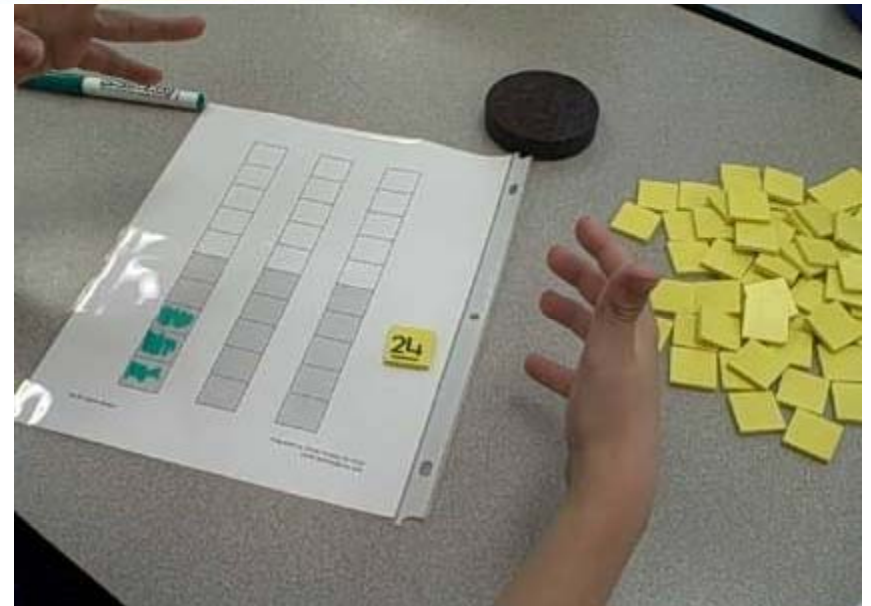
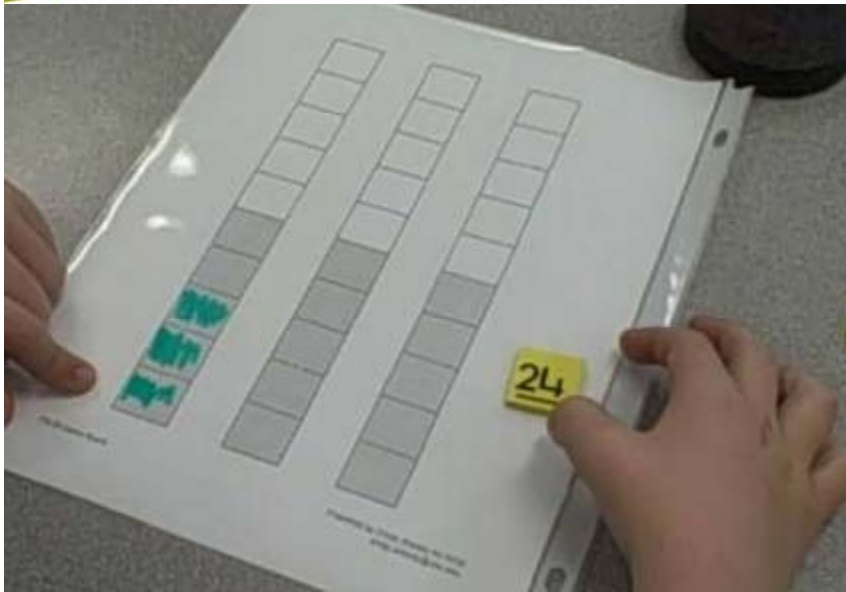
# Task group A304.6

| (from AVMR)                   | Numeracy Target | "I CAN ....." (*see glossary)   | Assessment for Learning (*see glossary)   | Student Grouping               | Video Link | Print Link  | Interactive Website | Reference | Teacher Notes  |
|-------------------------------|-----------------|---|---|--------------------------------|------------|---|---------------------|-----------|--|
| Beyond facile number sequence |                 | <p>...determine how far any number is from the nearest multiple of 10</p> | <p>Show the student the number 64. Ask "What is the closest multiple of 10? How far away is it?" Repeat with other numbers in the range 1 to 100.</p> | teacher partner<br>small group |            | <a href="http://www.kymath.org/intervention/doc/NumeracyProject/A_304-5.pdf">http://www.kymath.org/intervention/doc/NumeracyProject/A_304-5.pdf</a> |                     |           | <p>A "decuple" is a multiple of 10. Decuples are important re numbers for rounding as well as addition and subtraction. I helpful to refer to them as "nice" or "friendly" numbers to e their usefulness. It might be helpful to start with the numbe only 1 or 2 away from a decuple. If students need additional setting such as a numeral roll, 100 bead rack (with 10 rows r 100 beadstring can be used. Use as little support as is neede be sufficient to encourage students to use visualization. For e a student has the number 27, prompt a student by saying "In numeral roll. Where is 27? What friendly number is closest? away is it?" If that is not enough support, a numeral roll with multiples of 10 may be sufficient. Rounding can be discusse activity. For more information about numeral rolls, see the archives page for a video and a pdf file.</p> |

## Materials for task group A304.6

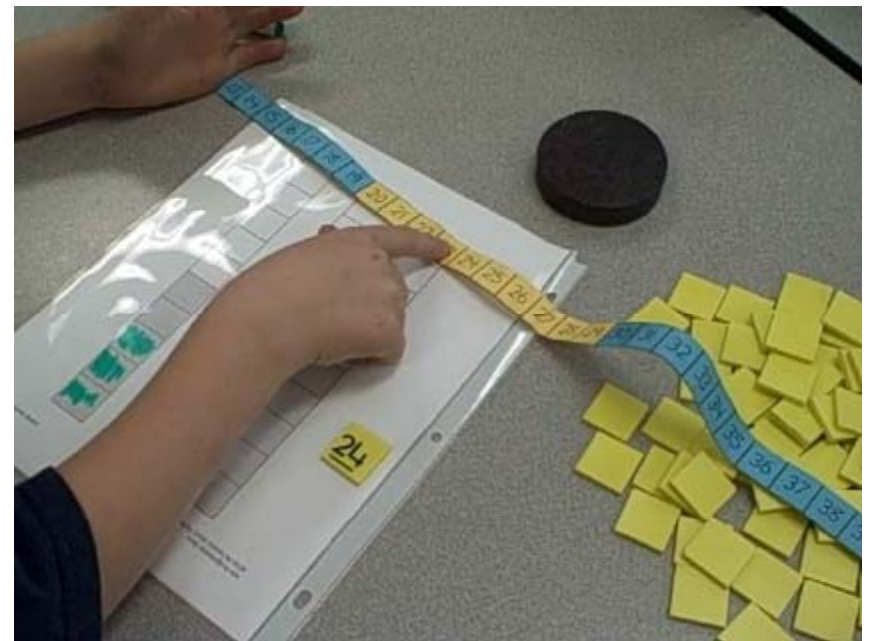






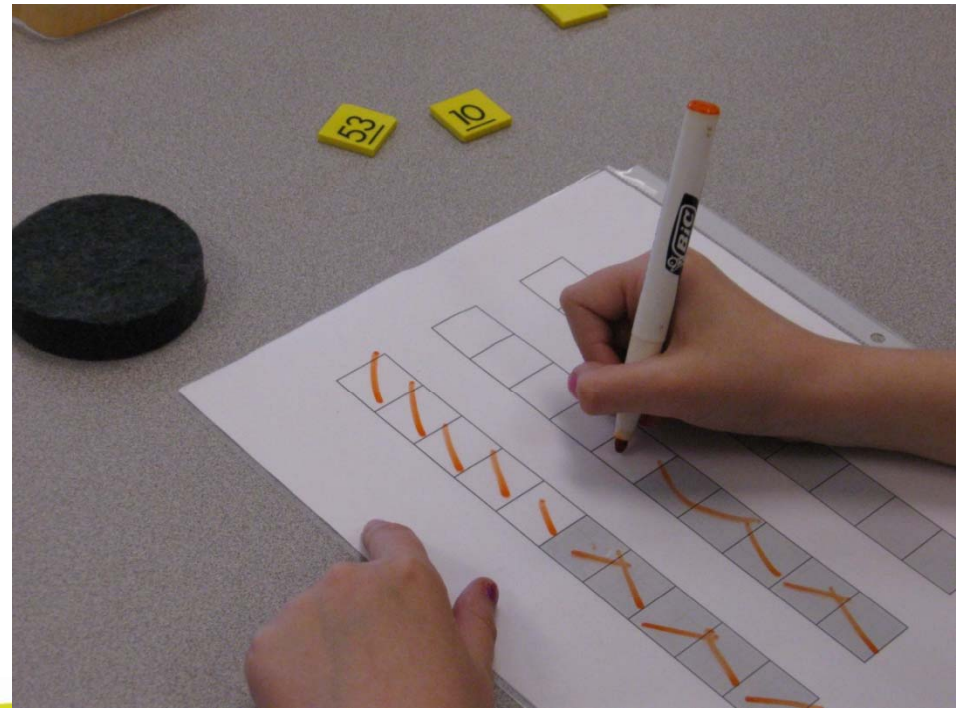
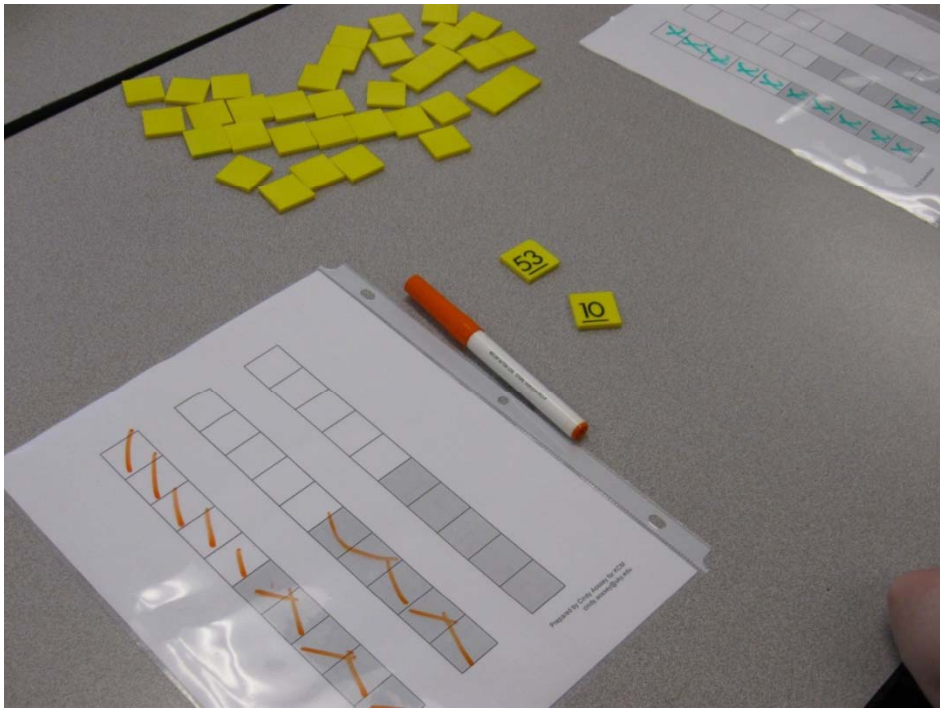
Students turn over a tile or number card, determine how far the number is from the nearest multiple of 10, and cover that many squares on game board.

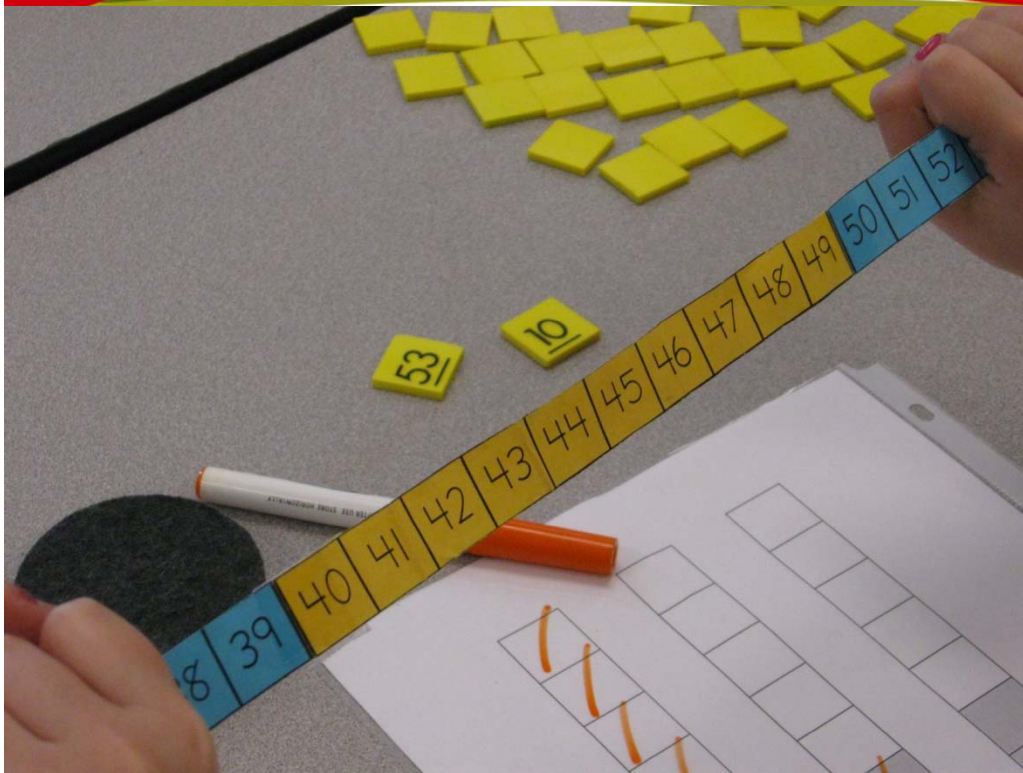
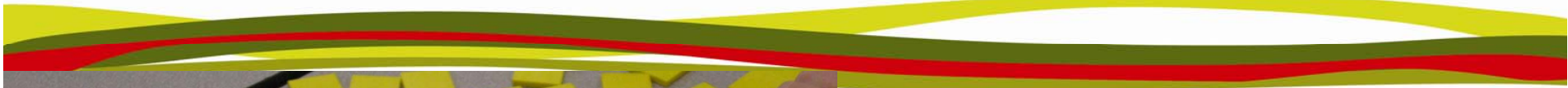
Students can use numeral roll to show their thinking or for support, if needed.



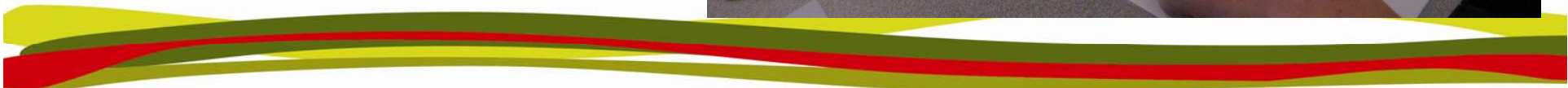
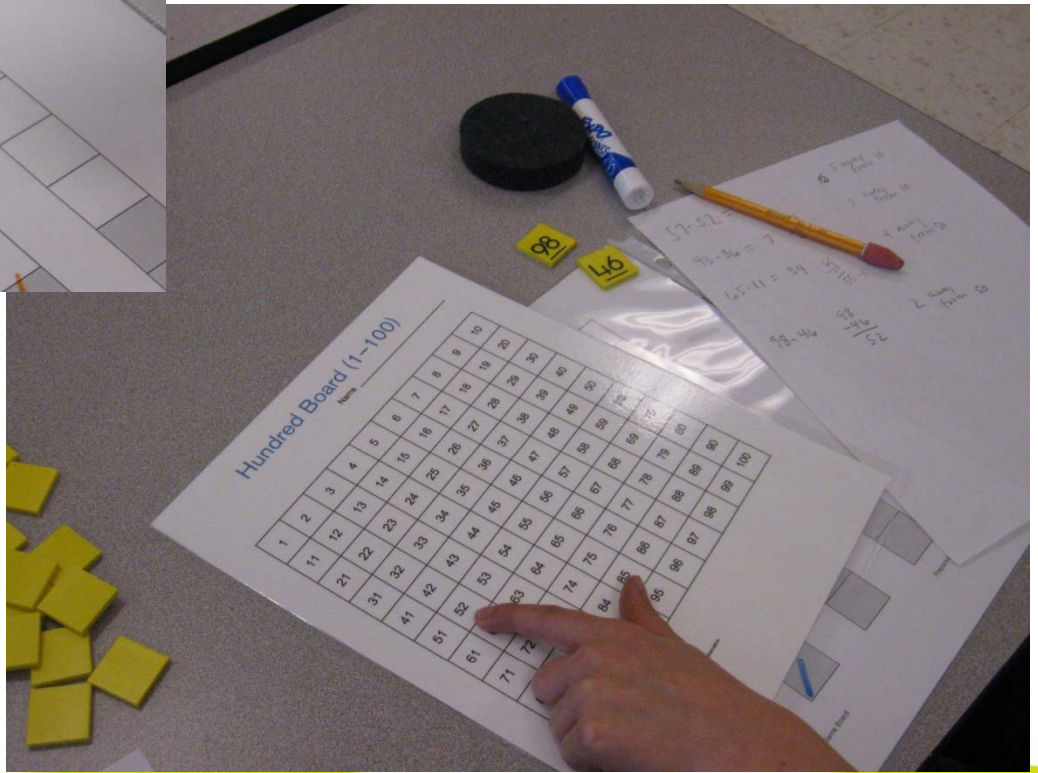
Another option for intermediate or more advanced students:

Student turns over 2 tiles (or cards), finds the difference, then determines how far the difference is from the nearest multiple of 10 and covers that many squares on game board.





Use a numeral roll or 100's chart to support student thinking



$$\begin{array}{r} 23 \\ -12 \\ \hline 11 \end{array}$$

1 away  
from 10

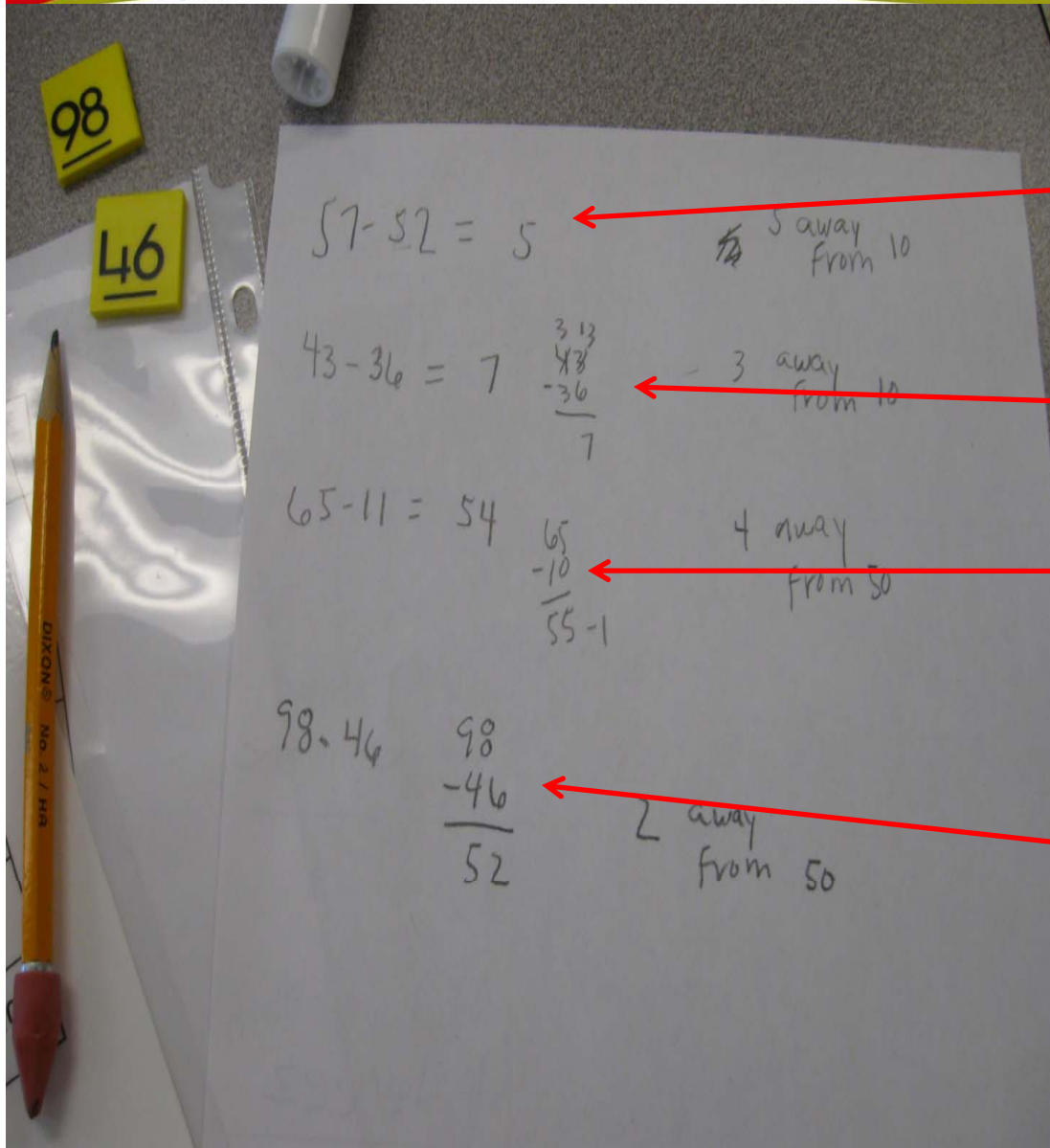
$$\begin{array}{r} 512 \\ -62 \\ \hline 48 \\ \hline 14 \end{array}$$

4 away  
from 10

$$\begin{array}{r} 237 \\ -9 \\ \hline 8 \end{array}$$

2 away  
from 10

Solved with traditional  
algorithm



Solved mentally by using a known fact

Solved with traditional algorithm

Solved by anchoring to 10

Solved with traditional algorithm

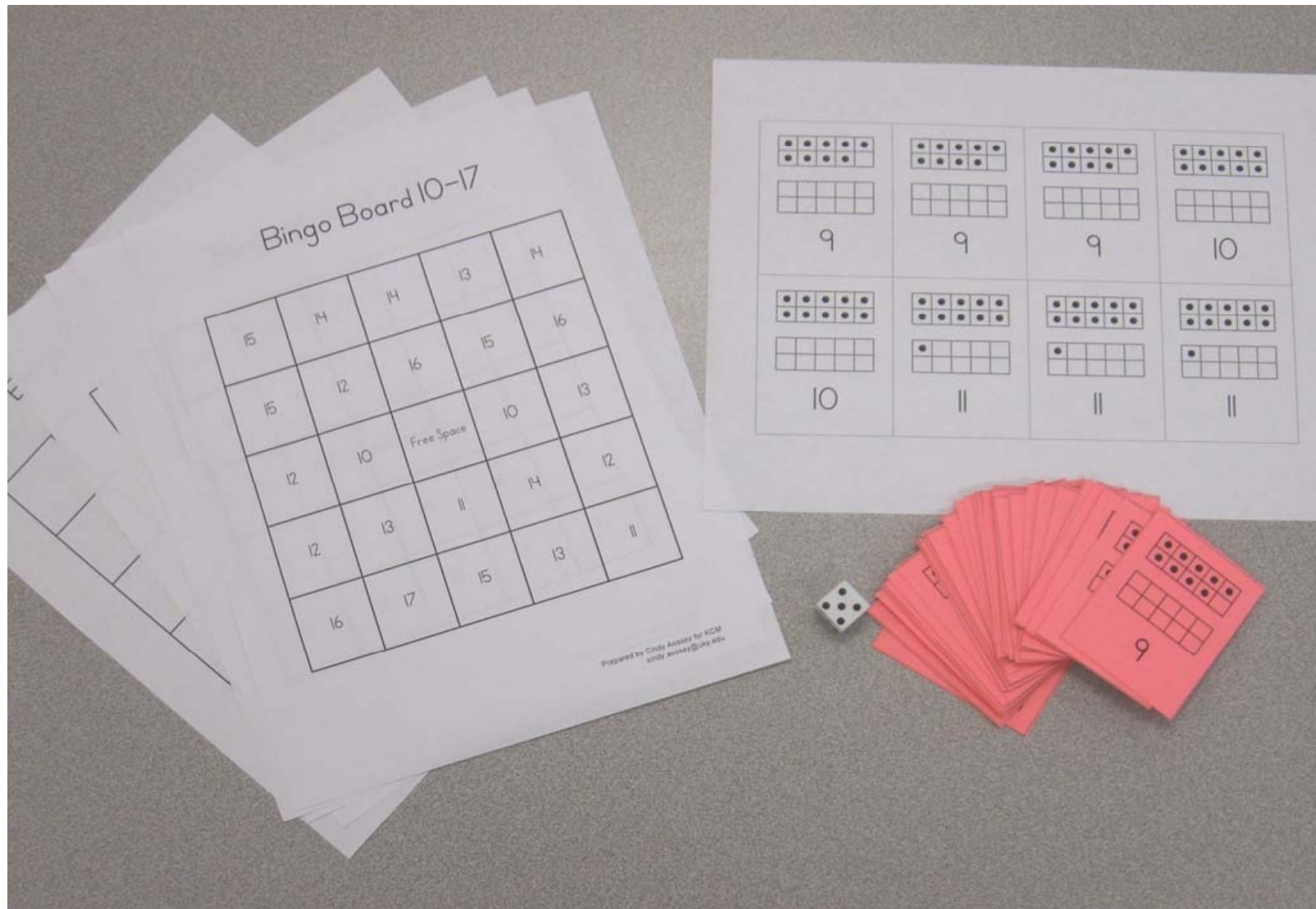
# Task group A321.5

| KNP entry number | Kentucky Common Core Academic Standard (KCAS) (*see glossary)  | KCAS Domain                       | KCAS Cluster               | Setting (situation & materials)   | Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand (from AVMR) | Construct/Level |
|------------------|--|-----------------------------------|----------------------------|---|--|-----------------------------|-----------------|
| A 321.5          | 1.OA 6 Add/subtract w/in 20, demonstrate fluency for addition/subtraction w/in 10. Use strategies such as counting on; making 10 ( $8+6=8+2+4=10+4=14$ ); decomposing a number leading to 10 ( $13-4=13-3-1=10-1=9$ ); use relationship of add/sub (knowing $8+4=12$ , know $12-8=4$ ); creating equivalent, easier, known sums ( $6+7$ as know equivalent $6+6+1=12+1+13$ ) | Operations and Algebraic Thinking | Add and subtract within 20 | Bingo Boards filled with numerals 10 -17 (see link), Bingo covers, double 10 frame cards 9 to 11 (several of each), numeral cube 1 to 6 | Bingo Addition: Each student will have a Bingo board (10-17) and covers. Players take turns finding the number that all players cover on their own board. The player should draw a card, roll the cube and find the sum. The first student to have a "Bingo" wins. | Addition & Subtraction      | 1.OA.6          |

# Task group A321.5

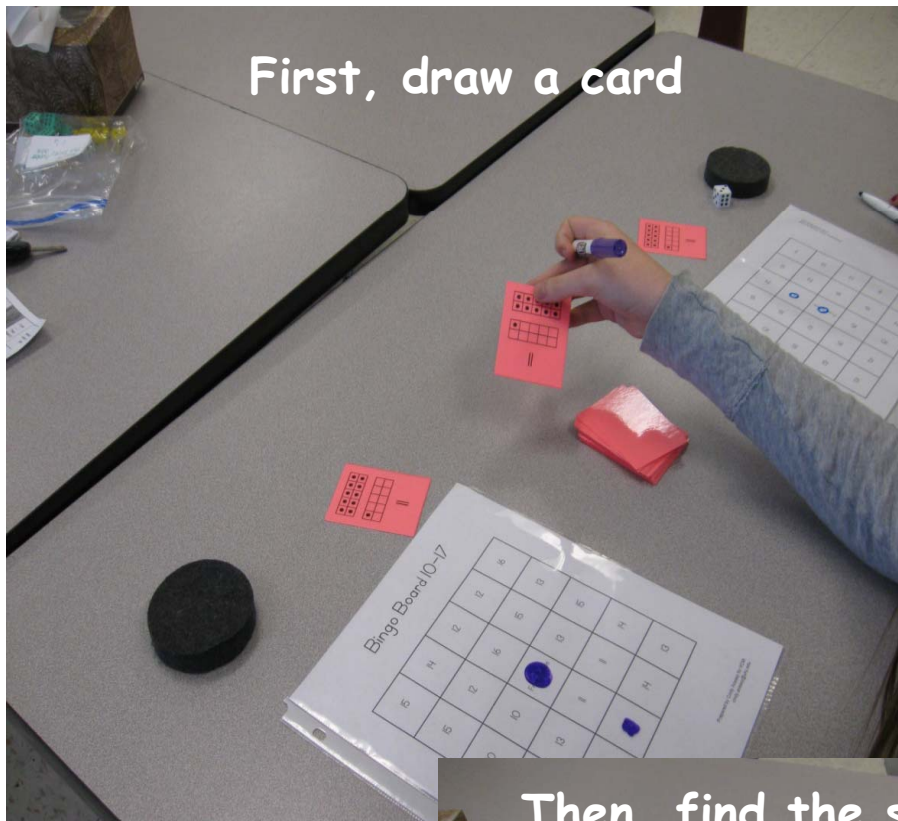
| "I CAN ....."<br>(*see glossary)                     | Assessment for Learning<br>(*see glossary)  | Student Grouping          | Video Link | Print Link  | Interactive Website | Reference | Teacher Notes  |
|--|---|---------------------------|------------|---|---------------------|-----------|--|
| ...use a known fact to mentally solve addition tasks | Show the 10 card and ask student "How much is 10 plus 4?" Show student the 9 card and ask "How much is 9 + 5". Observe how student solves the task (i.e. counting on or anchoring to the 10+ structure of the teens). | partner pair, small group |            | <a href="http://www.kynmath.org/intervention/doc/NumeracyProject/A_321-5.pdf">http://www.kynmath.org/intervention/doc/NumeracyProject/A_321-5.pdf</a> |                     |           | By using a first addend that is no more than 1 away from 10, students are encouraged to use the known 10+ structure of the teens rather than counting to solve addition tasks. |

## Materials for task group A321.5

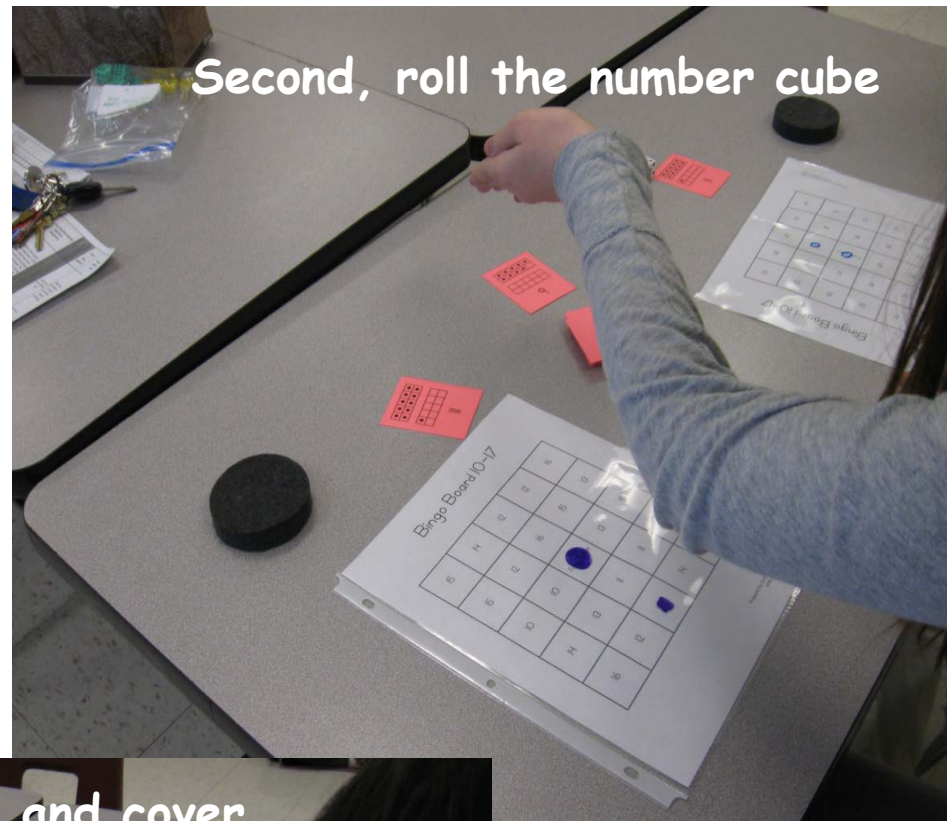




First, draw a card

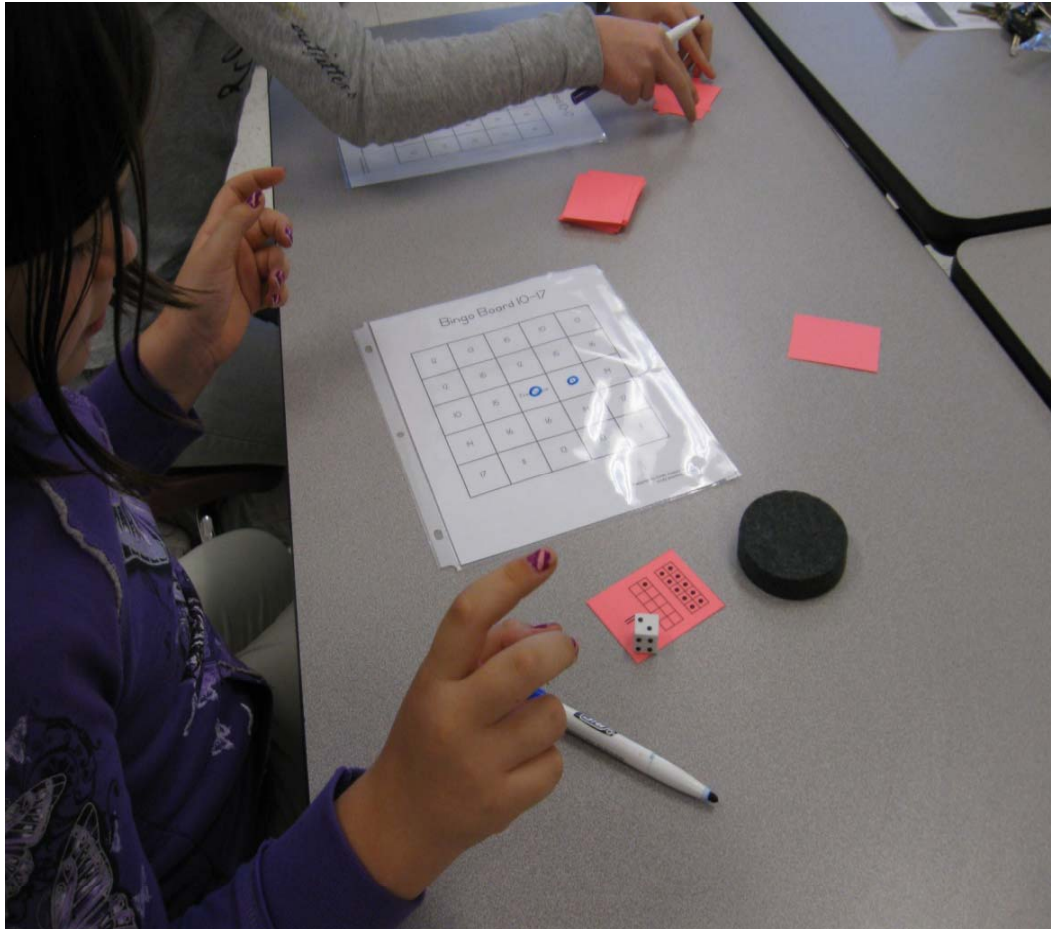


Second, roll the number cube



Then, find the sum and cover





Observe students as they think about the sum:

Are they counting the dots?

Are they using their fingers efficiently?

Are they counting on from the number of dots on the card?

Are they using 10 as an anchor?

Are they using a known sum to help?

*How did you get your answer???*

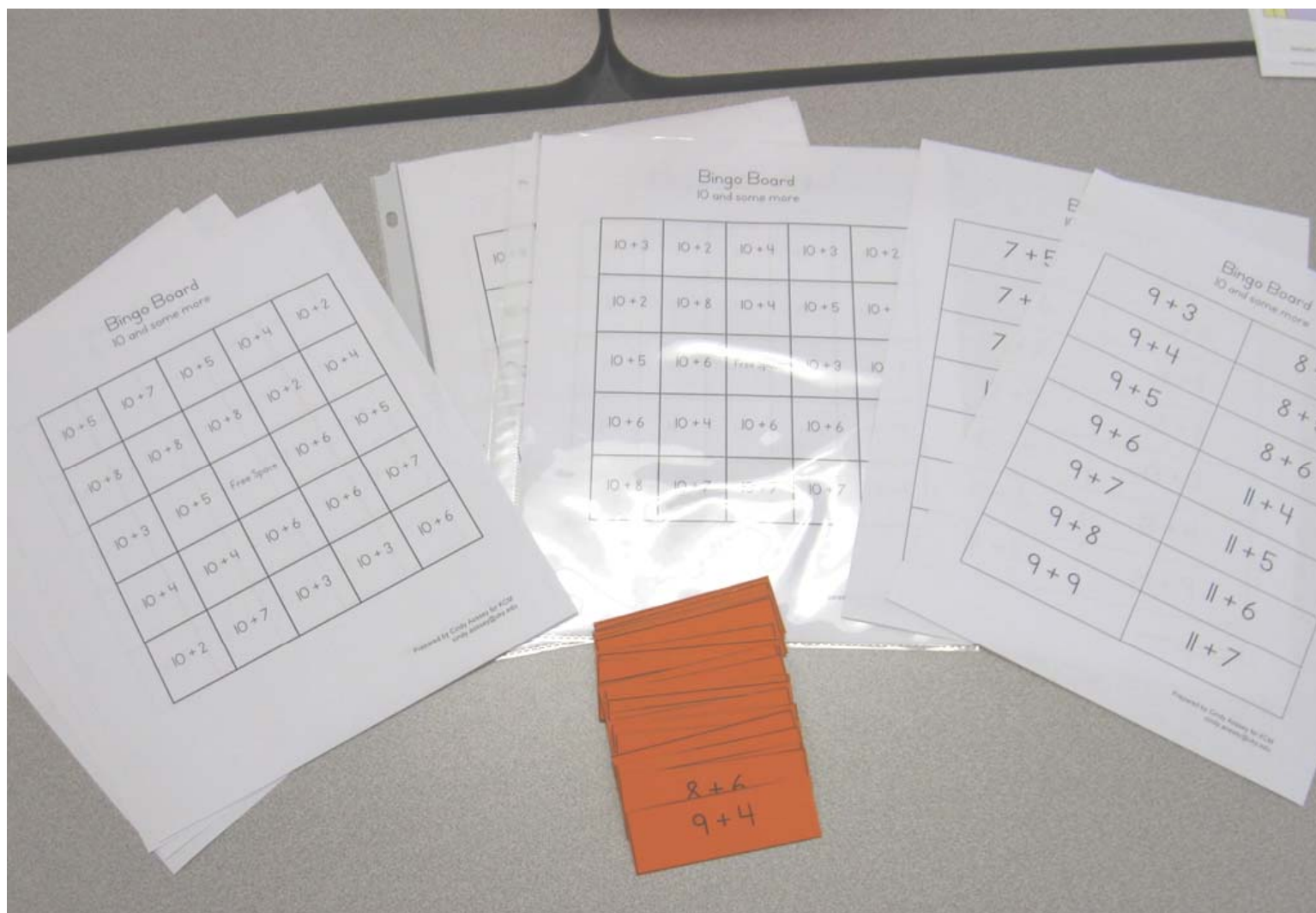
# Task group A321.6

| KNP entry number | Kentucky Common Core Academic Standard (KCAS) (*see glossary)  | KCAS Domain                       | KCAS Cluster               | Setting (situation & materials)   | Activities: Exemplary Learning Experiences (*see glossary)   | Numeracy Strand (from AVM3) | Construct/Level |
|------------------|--|-----------------------------------|----------------------------|---|--|-----------------------------|-----------------|
| A 321.6          | 2.OA.2. Fluently add and subtract within 20 using mental strategies.2 By end of Grade 2, know from memory all sums of two one-digit numbers. | Operations and Algebraic Thinking | Add and subtract within 20 | Bingo Boards filled with expressions "10 + 1" to "10 + 8", expression cards with sums in the range 11 to 18 (see link for both), bingo covers | Bingo: Each student will have a "10 and some more" Bingo board and covers. Place the expression cards face down in a pile. On a player's turn, the player will turn over one expression card and read the expression to the group. Each player will cover an expression on his or her board that matches the card. For example, if the $8 + 4$ card is turned over, players will cover a "10 + 2" square. After all cards are used, the card can be shuffled and reused. The first student to have a "Bingo" wins. | Addition and Subtraction    | Construct/Level |

# Task group A321.6

| "I CAN ....."<br>(*see glossary)          | Assessment for Learning<br>(*see glossary)  | Student Grouping          | Video Link | Print Link  | Interactive Website | Reference | Teacher Notes  |
|---|---|---------------------------|------------|---|---------------------|-----------|--|
| ... match equivalent addition expressions | Place an empty "10 and some more" bingo board in front of student. Show the expression "7 + 5". Say "Read this please. What square on the Bingo board matches this expression?" Repeat with other expression with a sum in the range of 11 to 18, such as "13+3" and "11+7". Note if student is counting by ones or using composite strategies. | partner pair, small group |            | <a href="http://www.kymath.org/intervention/doc/NumeracyProject/A-321-6.pdf">http://www.kymath.org/intervention/doc/NumeracyProject/A-321-6.pdf</a> |                     |           | To make game easier, use the expression cards that are 8+, 9+ and 11+ (first page). If additional support is needed, a student can use counter: (in two colors) on an empty double 10 frame or a double bead rack. As students play, ask questions such as "How did you work that out?", "Is there another way you could figure that out?" and "Is there a faster way you could figure that out?". Note if students are using composite strategies. For example, a student using a composite strategy might look at 7+ 5 and reason "I can take 3 from the 5 and put it with the 7 to get 10 + 2". |

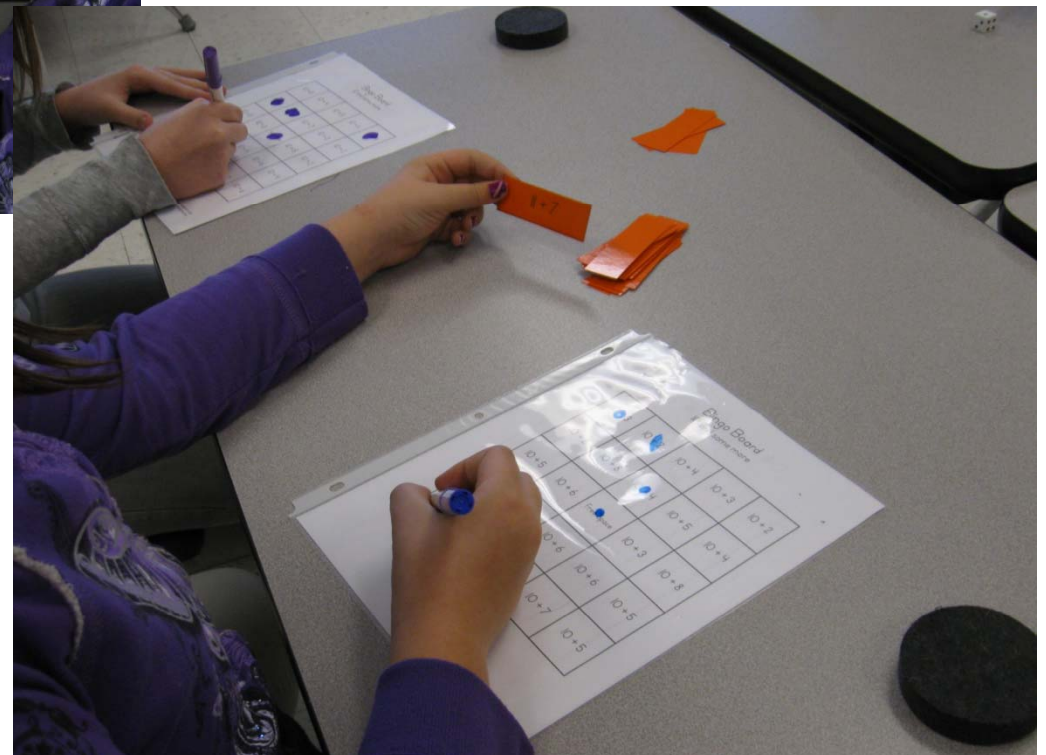
## Materials for task group A321.6

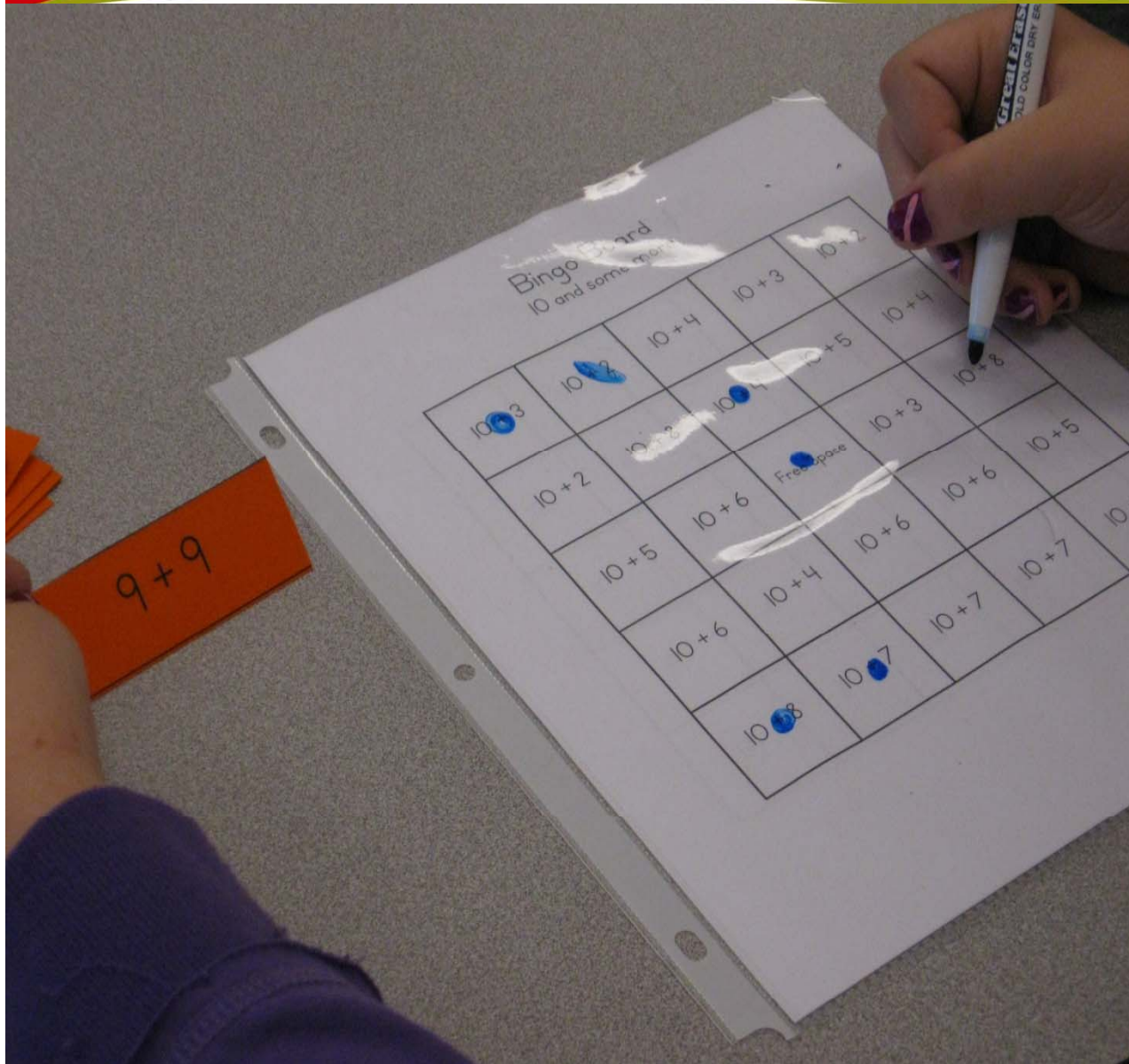




Students or teacher draw a card and announce the number expression

Students cover the matching 10+ expression on their board





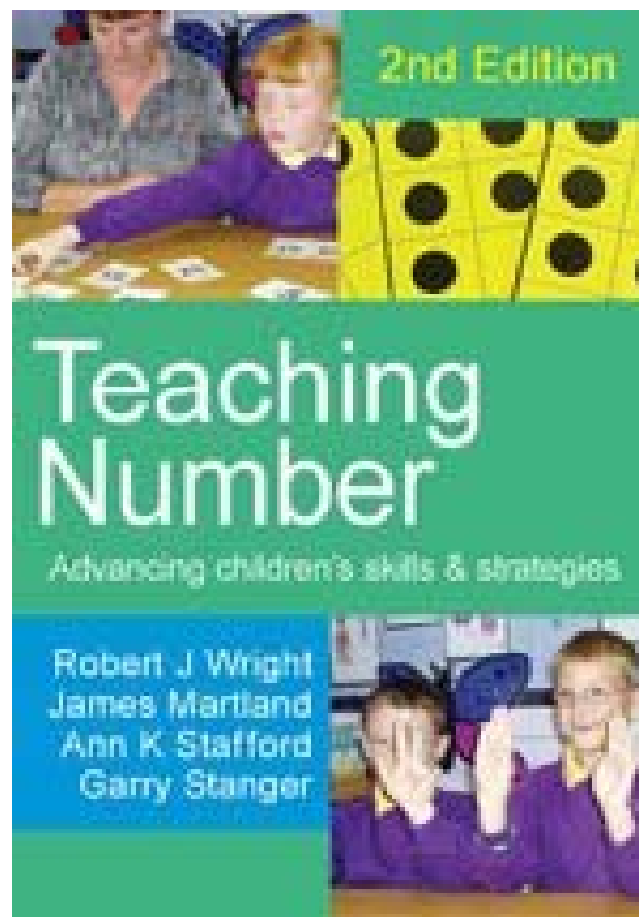
How are students matching the expressions?

Which expressions do they solve automatically?

Are students able to identify the matching 10+ expression fairly quickly?







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## Upcoming KNP Sessions, 3:30 to 4:30 p.m. ET

- **May 12 – Multiplication and Division**
- **June 2 – Tens and Ones**

<http://kymath.org/intervention/iKNP.asp>

## Reflection Questions

- 1) What does it mean for a student to “know” the basic facts for addition and subtraction?
- 2) How might you provide frequent opportunities for your students to derive and share mental arithmetic strategies?
- 3) What are different types of mental math strategies?
- 4) Which mental math strategies are enactments of the commutative property and/or the associative property?
- 5) How might daily “Number Talks” support students in enacting the Mathematical Practices and in mastering Mathematical Content Standards?
- 6) Why is it important for a teacher to know *how* students are thinking about number and operation besides just checking for accuracy of the answer?