Operations and Algebraic Thinking: Decomposing Numbers Kindergarten

Designed and revised by the Kentucky Department of Education
Field-tested by Kentucky Mathematics Leadership Network Teachers

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Decomposing Numbers (Operations and Algebraic Thinking) Kindergarten

This Formative Assessment Lesson is designed to be part of an instructional unit. This task should be implemented approximately two-thirds of the way through the instructional unit. The results of this task should be used to inform the instruction that will take place for the remainder of your unit.

Mathematical goals

This lesson is intended to help you assess how well students are able to decompose numbers less than or equal to 10 into pairs in more than one way. It will help you to identify students who have the following difficulties:

- Anchoring to 5 and 10
- Identify different representations of a number sentence
- One to one correspondence
- Structuring numbers
- Addition

Kentucky Academic Standards

This lesson involves *mathematical content* in the standards from across the grade, with emphasis on:

Operations and Algebraic Thinking K.OA

- **Understanding addition as putting together and adding to, and understanding subtraction as taking apart and taking from.**

This lesson involves a range of S*tandards for Mathematical Practice,* with emphasis on:

2. Reason abstractly and quantitatively.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Introduction

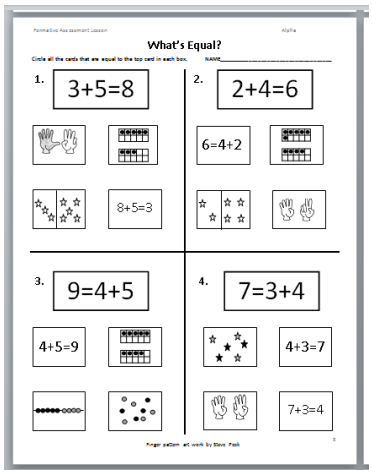
This lesson is structured in the following way:

- A day or two before the lesson, students work individually on an assessment task that is designed to reveal their current understandings and difficulties. You then review their work and create questions for students to answer in order to improve their solutions.
- A whole class introduction provides students with guidance on how to engage with the content of the task.
- Students work with a partner on a collaborative discussion task to match multiple representations of quantities and equations. As they do this, they interpret the cards' meanings and begin to link them together. Throughout their work, students justify and explain their decisions to their peers and teacher(s).
- In a final whole class discussion, students synthesize and reflect on the learning to make connections within the content of the lesson.
- Finally, students revisit their original work or a similar task, and try to improve their individual responses.

Materials required

Each individual student will need:

- Two copies of the assessment task *What's Equal?*
- A copy of the Ten Frame Template



Each pairs of students will need the following resources:

- *Card sets: A, B, C, D, E, and F. All* cards should be cut out before the lesson and it would be helpful if each set were a different color.

Time needed

Approximately 15 minutes before the lesson (for the individual assessment task), one 40 minute lesson, and 15 minutes for a follow-up lesson (for students to revisit individual assessment task). Timings given are only approximate. All students need not complete all sets of card activities. Exact timings will depend on the needs of the class.

Before the Lesson

Assessment task: What's Equal? (15 minutes)

Have students do this task individually in class a day or more before the formative assessment lesson. This will give you an opportunity to assess the work, and to find out the kinds of difficulties students have with it. You will be able to target your help more effectively in the follow-up lesson. Depending on your class you can have them do it all at once or in small groups (they should still work individually). You may consider cutting the assessment into four individual questions sheets so students may focus on one section at a time.

Frame the Pre Assessment:

Give each student a copy of the assessment task "*What's Equal?*"

Today you are going to work on a math task finding equal number sentences. You will look at the number sentences in the box and circle all the cards equal to that problem. (Students can work in small teacher led groups.)

It is important that the students are allowed to answer the questions without your assistance, or use of manipulatives as far as possible.

Students should not worry too much if they do not understand or cannot do everything, because in the next lesson they will engage in a similar task, which should help them. Explain to students that by the end of the next lesson, they should expect to answer questions such as these confidently. This is their goal.

Assessing students' responses

Collect students' responses to the task. Make some notes about what their work reveals about their current levels of understanding, and their different problem solving approaches. Strategically partner students based on results of the pre assessment.

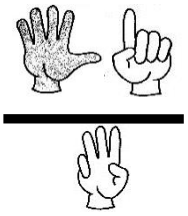
We suggest that you do not score student's work. The research shows that this will be counterproductive, as it will encourage students to compare their scores, and will distract their attention from what they can do to improve their mathematics.

Instead, help students to make further progress by summarizing their difficulties as a series of questions. Some questions on the following page may serve as examples. These questions have been drawn from commonly identified student misconceptions.

We suggest that you write a list of your own questions, based on your students' work, using the ideas that follow. You may choose to write questions on each student's work. If you do not have time to do this, select a few questions that will be of help to the majority of students. These can be written on the board at the end of the lesson before students revisit initial task.

The solution to all these difficulties is not to teach one particular way of counting or adding, but to help students find a variety of ways that work in different situations and make sense to them.

Below is a list of common issues and questions/prompts that may be written on individual initial tasks or during the collaborative activity to help students clarify and extend their thinking.

Common Issues:	**Suggested questions and prompts:**
Students may not choose cards as equal because they are in a different order.	• What does it mean to be equal? • Is this (three fingers and two fingers) the same as this (two fingers and three fingers)? Why or why not?
Students may choose card as equal that has same numbers.	• What do the numbers mean when we put them together? • Can you show how many altogether?
Students may have incorrect answers due to miscount.	• How did you decide how many there were? • Show me how you counted. • Do you get the same number every time you count?
Students may think some cards do not have matches because of the structure of the problem with the sum listed first. E.g. 9 = 5 + 4	• What does an equal sign mean? Often times student view the equal sign as an indication of an "answer." It needs to be viewed as both sides representing the same amount. • Use a balance scale and have student build problem with linking cubes, crayons, etc.
Students think that three hands in the finger pattern cards mean there are three addends.	• *What is another way to say "5 and 1"?* • *How many are above the line? How many are below the line?* 

Suggested lesson outline

Whole class introduction (10 minutes)

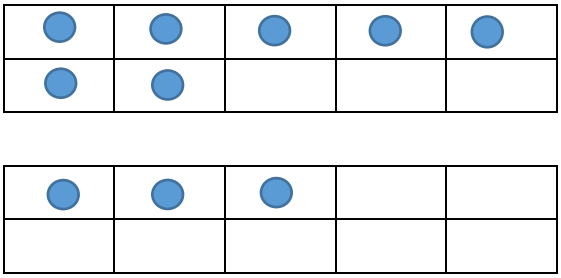
In kindergarten, a teacher directed center may be appropriate for this lesson.

Begin by writing this number sentence/expression

3 + 4

Ask students to represent this expression on the two ten frames template using counters.
Have students share their frames with their partners, discussing their similarities and differences.

Then show this model.



Ask - *What problem is represented, how do you know? Share your thinking with your partner?*

Collaborative Activity: matching *Card Sets A, B, C, and D* (30 min.)

Taking two class periods to complete all activities
If you have to divide the lesson into two class periods, you may want to have a way for students to save the work they have done with matching the card sets. You may give each pair a chart paper or poster board and have them tape the cards down with their matches. You may choose to have them do this even if you are not dividing up the class period just to use as a visual during the class discussion.

Strategically partner students based on pre-assessment data. Partner students with others who display similar errors/misconceptions on the pre-assessment task. While this may seem counterintuitive, this will allow each student to more confidently share their thinking. This may result in partnering students who were very successful together, those who did fairly well together, and those who did not do very well together.

Introduce the collaborative activity carefully:

> *Today we are going to do some more work on finding equal number sentences. I want you to work in pairs. Take turns placing a number sentence card with an equal ten frame card. Each time you do this; explain your thinking clearly to your partner. If your partner disagrees with your match then challenge him or her to explain why. It is important that you both understand why each card is matched with another one. There is a lot of work to do today and you may not all finish. The important thing is to learn something new, so take your time. When you*

finish with the first card set, raise your hand and I'll come and ask you to explain your thinking before moving on to a new card set.

Your task during the partner work is to make notes of student approaches to the task, and to support student problem solving through questioning.

Give each pair *Card Set A (Equations)* and *(Ten-Frames).*

Make a note of student approaches to the task
You can then use this information to focus a whole-class discussion towards the end of the lesson. In particular, notice any common mistakes. For example, students may have trouble tracking unorganized structures or have difficulty with inverse order of problems, or they may consistently forget to anchor to five or miscount figures.

Support student problem solving
Try not to make suggestions that move students toward a particular approach to the task. Instead, ask questions to help students clarify their thinking. Encourage students to use each other as a resource for learning.

If one student has placed a particular card to make a match, challenge their partner to provide an explanation.

If you find students have difficulty articulating their decisions, then you may want to use the questions from the *Common Issues* table to support your questioning.

If the whole class is struggling on the same issue, then you may want to write a couple of questions on the board and organize a whole class discussion.

This task is designed for students to apply mental strategies they have been developing during the unit of instruction. Manipulatives should only be considered for students who have exhausted all other strategies.

Placing *Card Set B (Stars)*
As students finish with matching card set A, have students explain their thinking before handing out card set B. These provide students with a different way of interpreting the equations.

Do not collect card set A. An important part of this task is for students to make connections between different representations of equations.

As you monitor the work, listen to the discussion and help students to look for patterns and generalizations.

Placing *Card Set C (Finger Cards)*
As students finish matching card set B, have students explain their thinking before handing out card set C. Continue to monitor work and listen to discussion.

Do not collect any of the card sets, allow students to continue to add on to previously completed work.

Question and prompt students to look for differences and similarities as they work.

Placing *Card Set D (Irregular Patterns)*
As students finish matching card set C, have students explain their thinking before handing out card set D. Continue to monitor work and listen to discussion. Card Set D contains three additional cards to expose student misconceptions that just matching numbers always yields equality.

Do not collect any of the card sets, allow students to continue to add on to previously completed work.

Question and prompt students to look for differences and similarities as they work.

Extension activities
Two additional card sets are included to extend student work. Card Set E and Card Set F. Continue work in same manner as previous card sets.

Whole-class discussion (10 minutes)
Conduct a whole-class discussion about what has been learned and highlight misconceptions and strategies you want to be revealed. Select students or pairs who demonstrated strategies and misconceptions you want to share with the class. Be intentional about the order of student sharing from least complex to most complex thinking. As each pair shares, highlight the connections between strategies.

Possible questions to ask: How does student A's strategy connect to student B's strategy?

You might have students discuss other representations that would be equal for each equation and how they know they are equal. Perhaps give each student a mini-whiteboard, pen, and eraser and have them draw a picture or write an expression or equation that is equal.

Conclude the lesson by discussing and generalizing what has been learned. The generalization involves first extending what has been learned to new examples, and then examining some of the conclusions the students come up with.

Ask: *Which cards were easiest/hardest to match? Why?*
What might be a different way to explain?
Did anyone do the same or something different?
How would you explain in words your model?

Improving individual solutions to the assessment task (10 minutes)
Return to the students their original assessment, *What's Equal?,* as well as a second blank copy of the task.

Look at your original responses and think about what you have learned during this lesson.
Using what you have learned, try to improve your work.

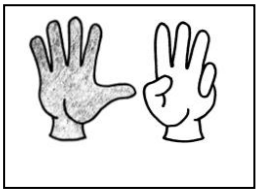
If you have not added questions to individual pieces of work then write your list of questions on the board. Students should select from this list only the questions appropriate to their own work. (With kindergarten, you may only focus on the questions students really seemed to need and state these out loud and ask them again as you move around the room or work with a small group at a time.) This lesson format was designed from the Classroom Challenge Lessons intended for students in grades 6 through 12 from the Math Assessment Project.

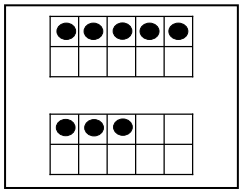
What's Equal?

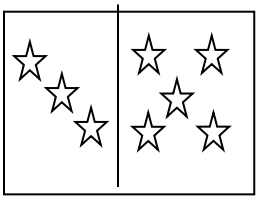
Circle all the cards that are equal to the top card in each box. **NAME**_____

1.

3+5=8





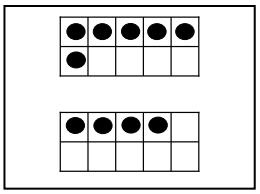


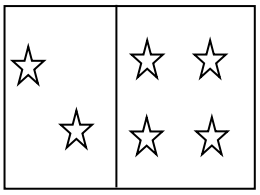
8+5=3

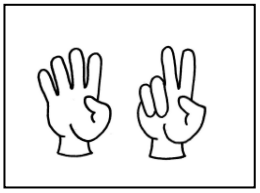
2.

2+4=6

6=4+2



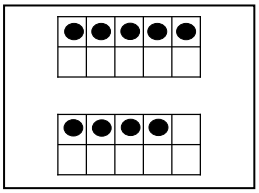


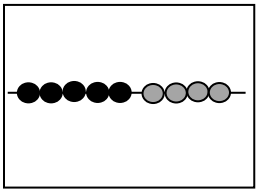


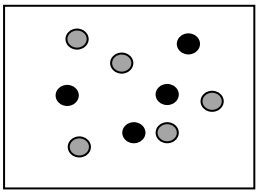
3.

9=4+5

4+5=9

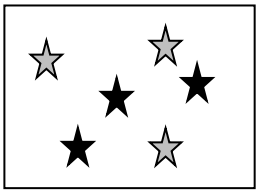




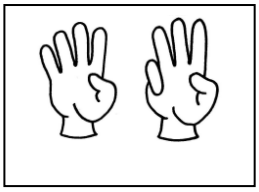


4.

7=3+4



4+3=7



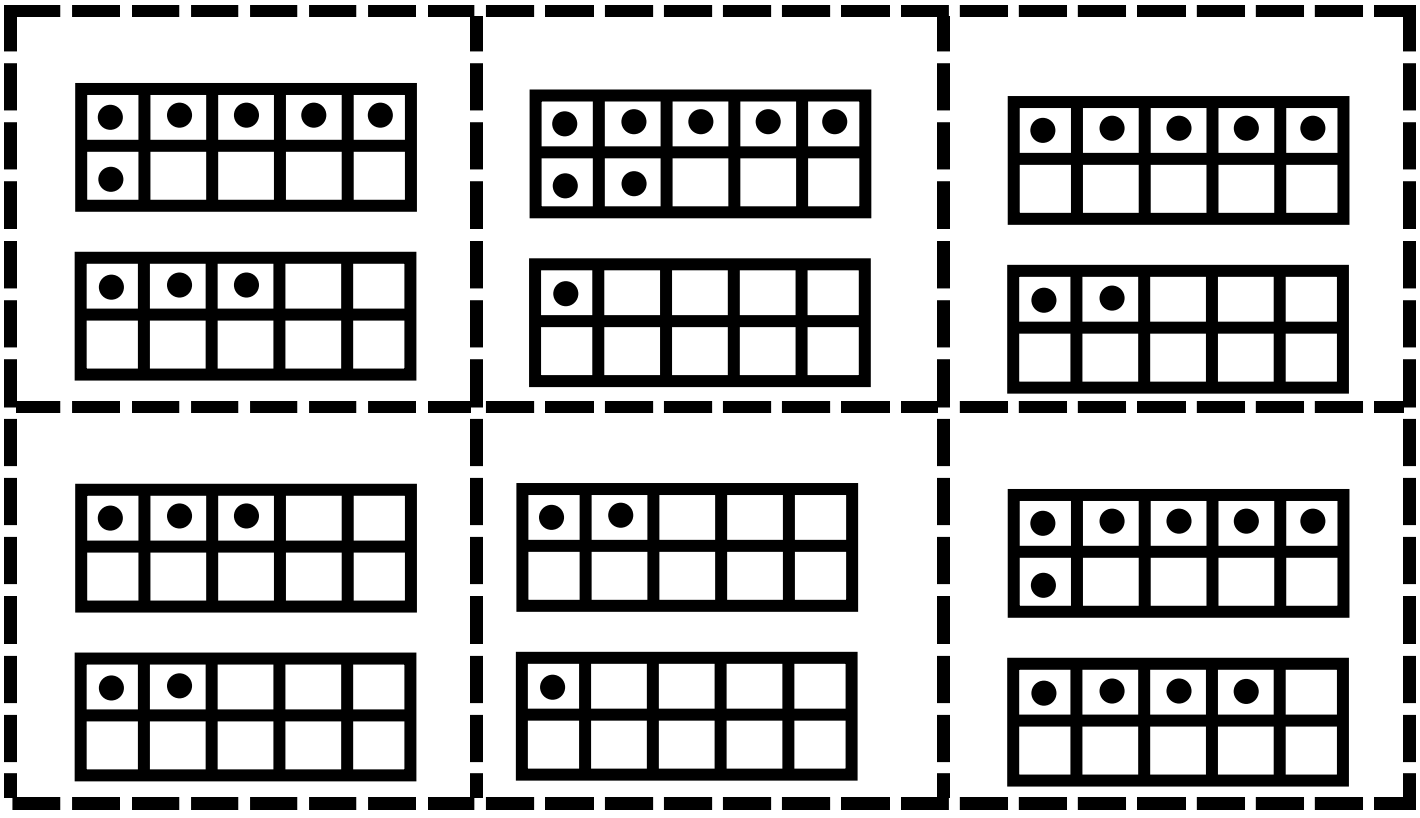
7+3=4

Finger pattern art work by Steve Peck

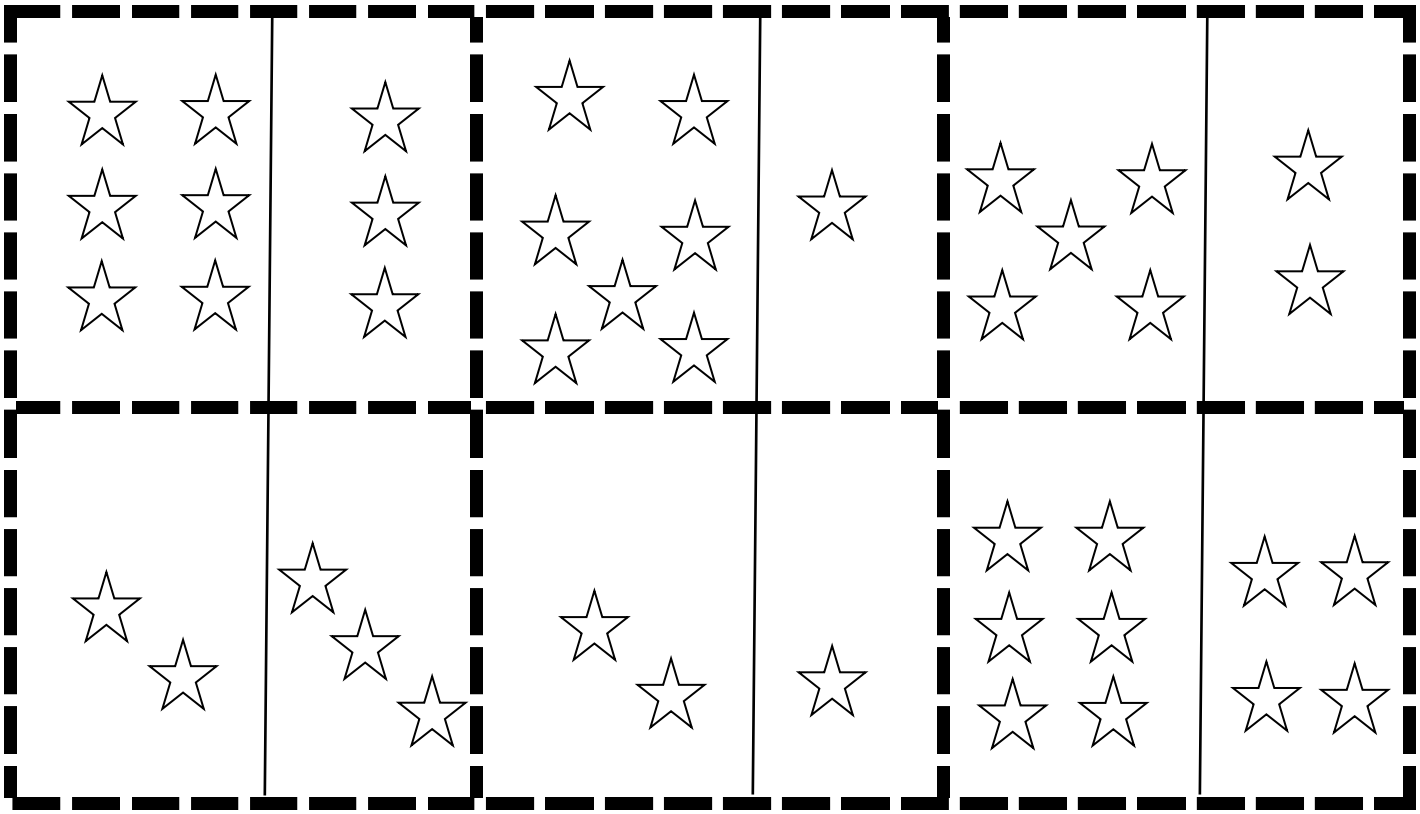
Student Materials

Card Set A

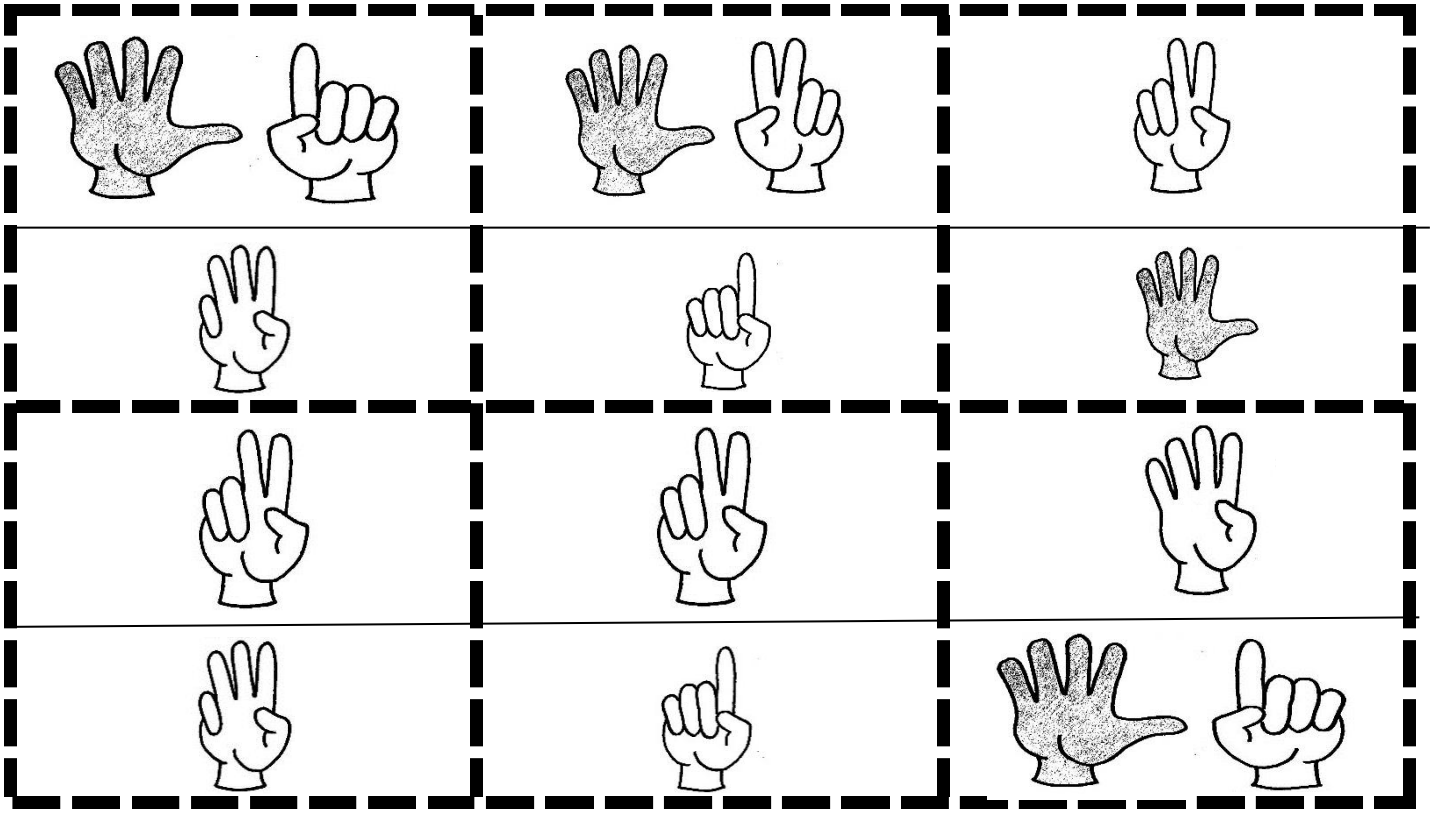
6+3=9	7+1=8	5+2=7
5=3+2	3=2+1	10=6+4



Card Set B

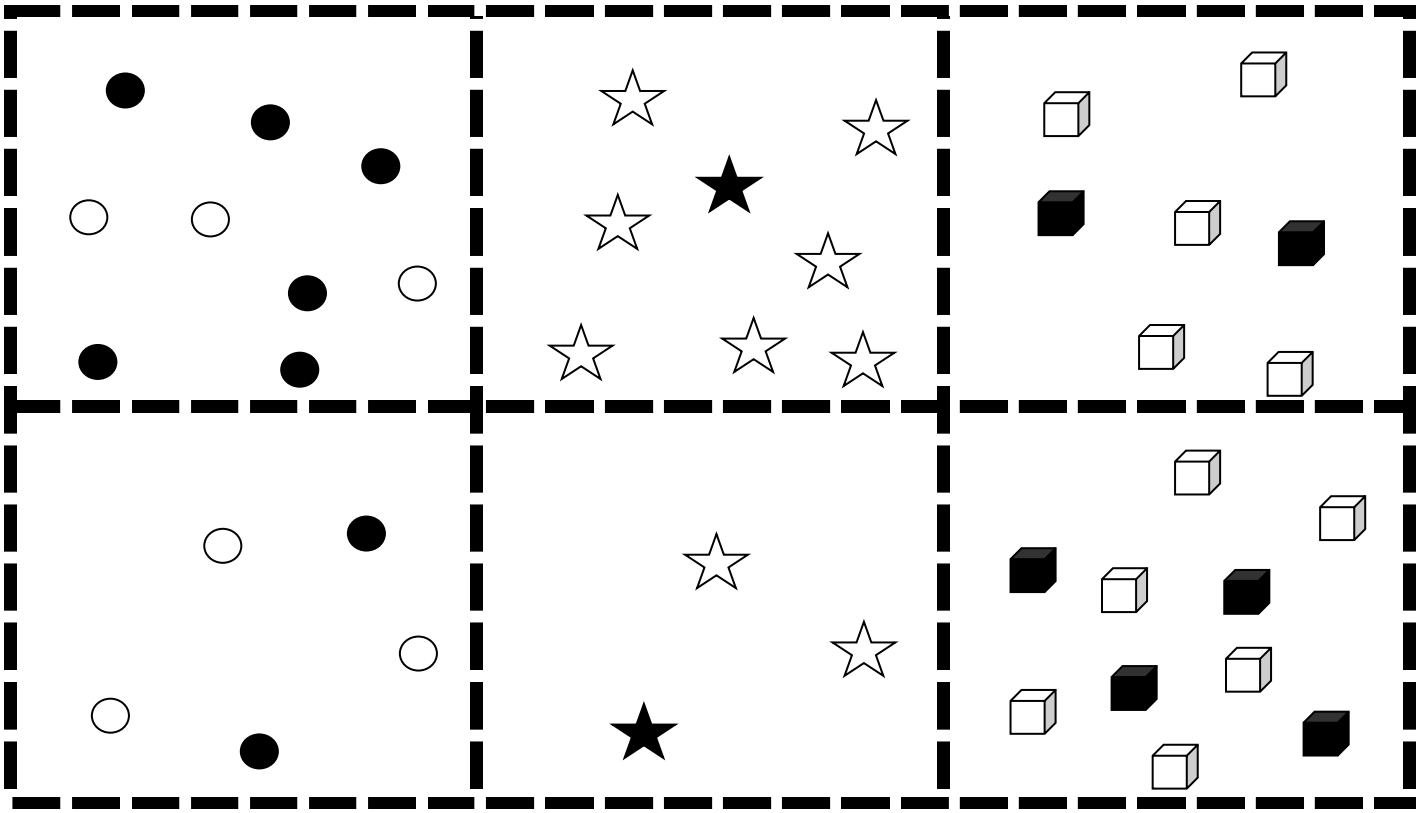


Card Set C

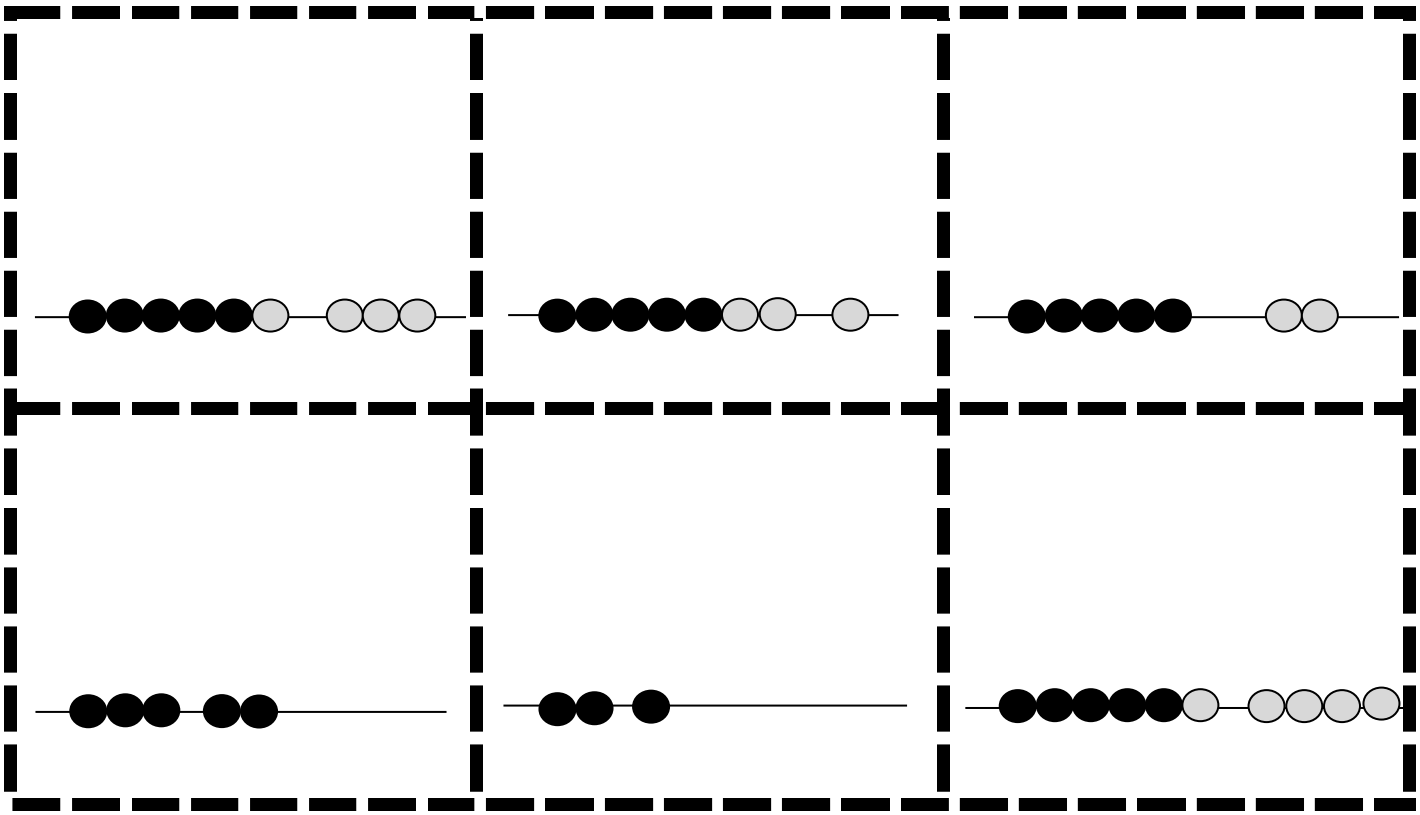


Finger pattern art work by Steve Peck

Card Set D



Card Set E



Card Set F

2+3=5 Card Set F	2+1=3 Card Set F	6+4=10 Card Set F
9=3+6 Card Set F	8=7+1 Card Set F	7=2+5 Card Set F
2=3+5 Card Set F	7=1+8 Card Set F	5=2+7 Card Set F

Template of Ten Frames for Whole Class Introduction

