



Canadian Disability Policy Alliance

Alliance Canadienne concernant  
les politiques reliées au handicap

# Schema Based Instruction: Teaching Children with Different Learning Needs to Successfully Solve Word Problems

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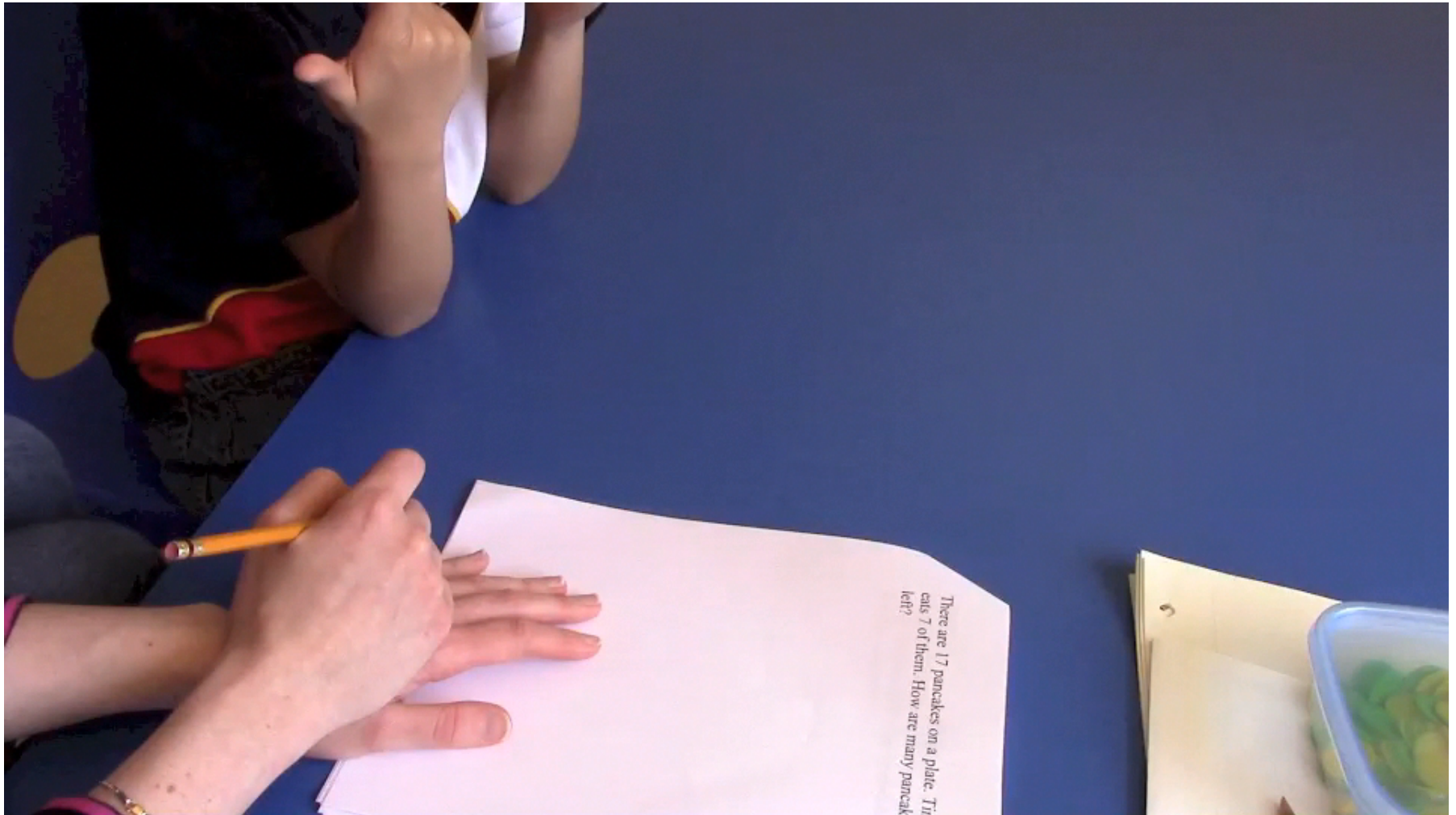
How I see math word problems: If you have 4 pencils and I have 7 apples, how many pancakes will fit on the roof? Purple, because aliens don't wear hats.



your  cards  
someecards.com

# Meet Lionel – Before Instruction

*There are 17 pancakes on a plate. Timmy eats 7 of them. How many pancakes are left?*





# Meet Lionel – After Instruction

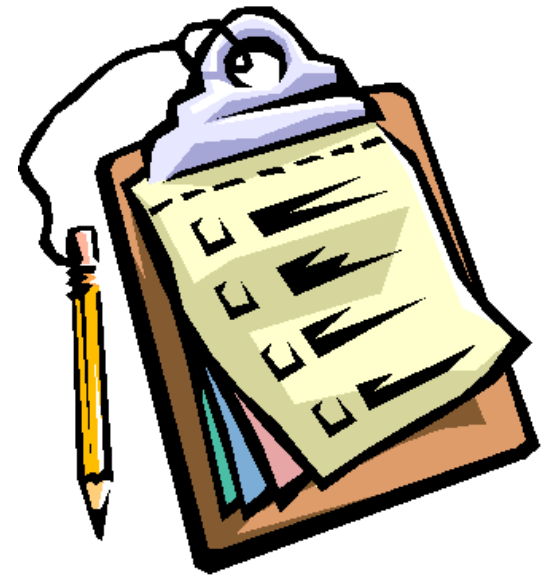
*There are 19 balloons at a party. 8 of the balloons pop. How many balloons are left?*





# Outline of Presentation

- Introduction
- Word Problems
- Schema Based Instruction (SBI)
  - Problem Types
  - Instructional Phases
  - Teaching Tips
  - Why SBI Works
- Questions



# Schema Based Instruction (SBI)

- Used for word problem solving
- Uses visual representations as teaching tools
- Demonstrates relationships between the numbers in the problem

# Shoe Tying

## Prerequisites

- Fine motor coordination
- Range of motion
- Hand strength
- Right/left discrimination





# Situational Problems

- Drawn from real-life experiences
- Multiple steps
- Multiple solution strategies
- Cross-curricular

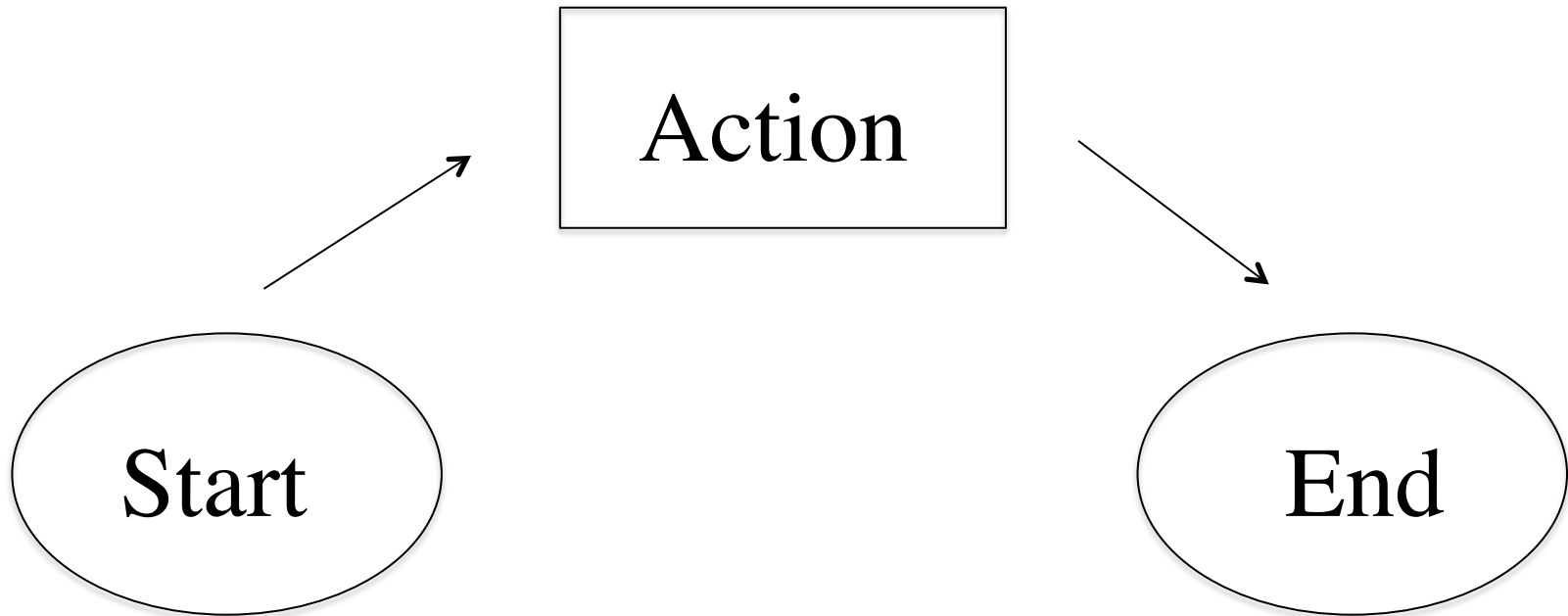
*Mr. Owl goes shopping. Meat costs 34 dollars and dessert costs 18 dollars. He has 90 dollars in his wallet. How much money does he have left?*

# Schema Based Instruction Problem Types

2 problem types

- Action
  - Characterized by an action
- Part-Whole
  - Sets or collections, no action

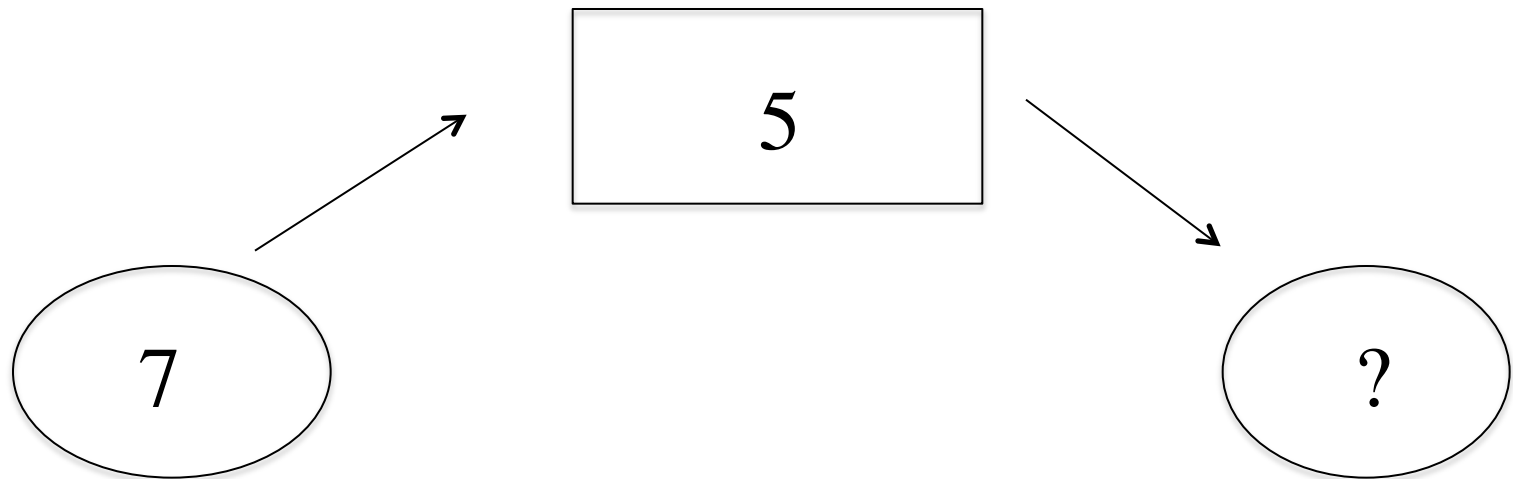
# Problem Types - Action





# Problem Types - Action

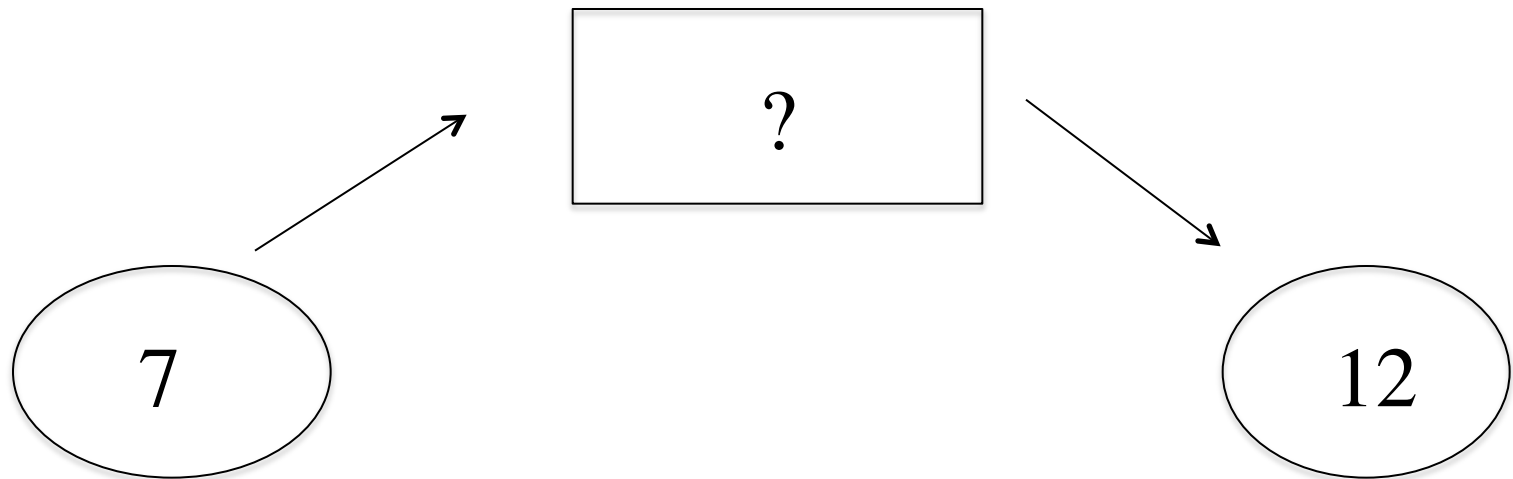
Kelly has 7 dolls. For her birthday, she gets 5 more dolls. How many dolls does Kelly have?



**End Unknown**

# Problem Types - Action

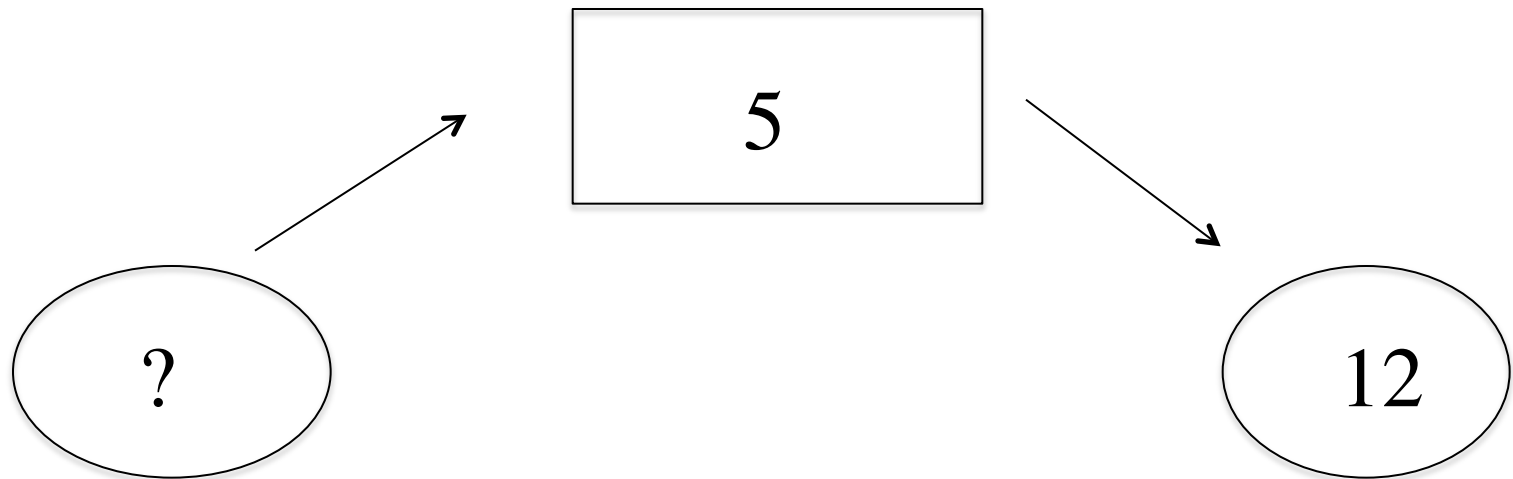
Kelly has 7 dolls. For her birthday, she gets some more dolls. Now she has 12 dolls. How many dolls did Kelly get for her birthday?



**Action Unknown**

# Problem Types - Action

Kelly has some dolls. For her birthday, she gets 5 more dolls. Now she has 12 dolls. How many dolls did Kelly have before her birthday?

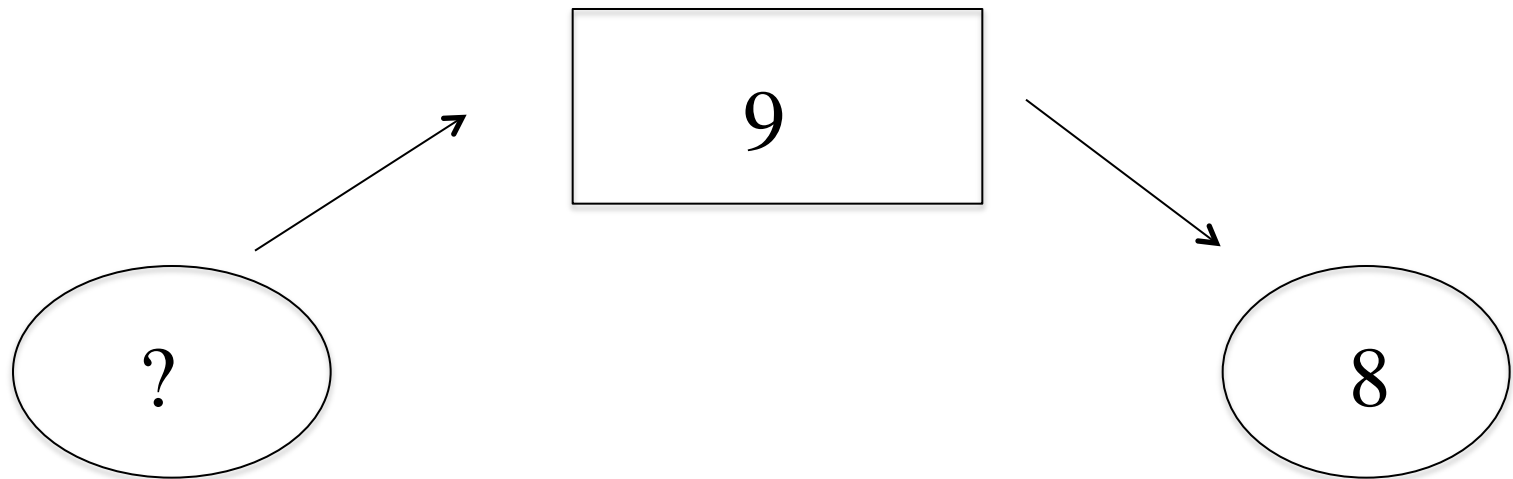


**Start Unknown**



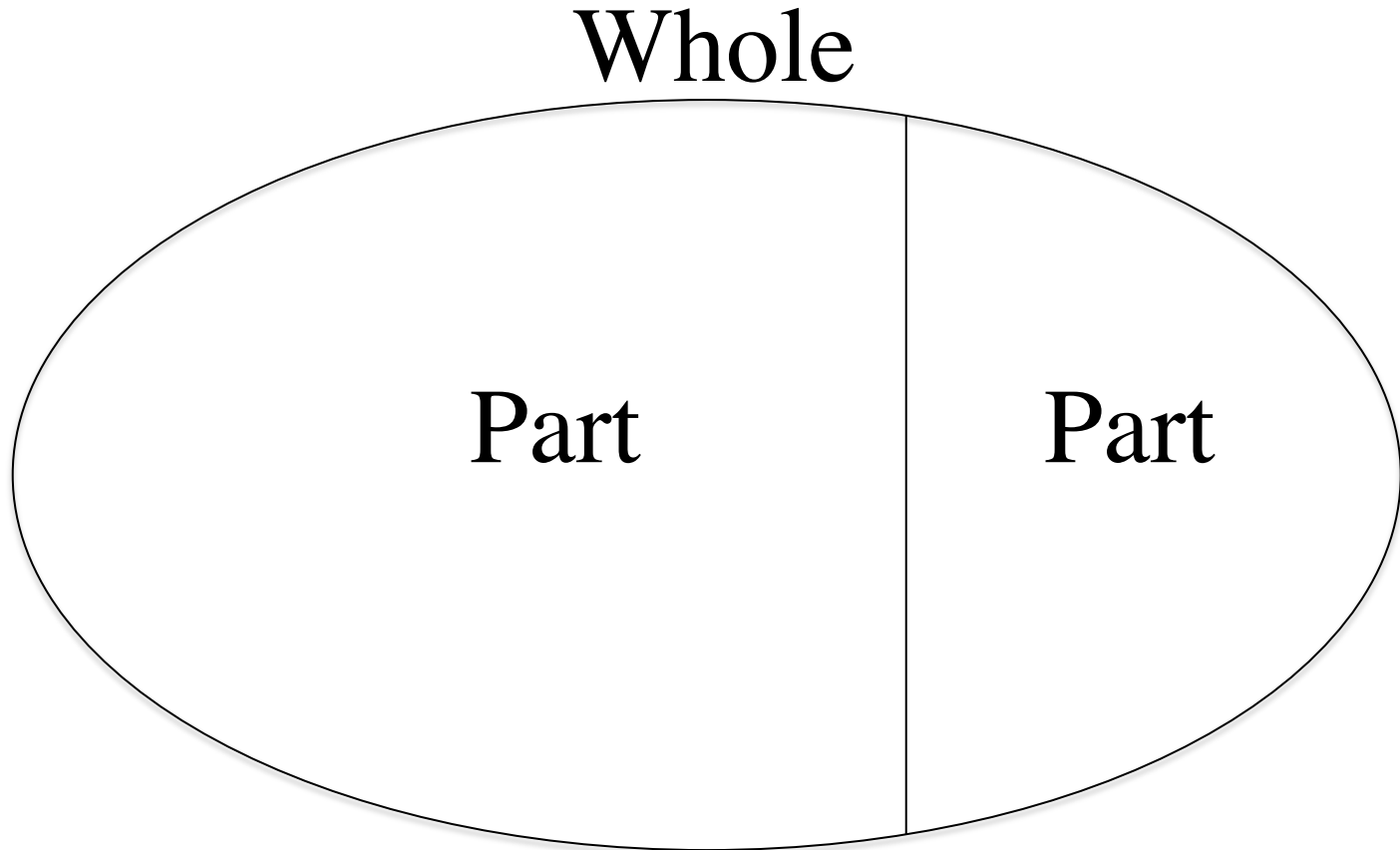
# Problem Types - Action

There are some geese in a field. There is a loud noise and 9 of them fly away. Now there are 8 geese left. How many geese were in the field at the beginning?



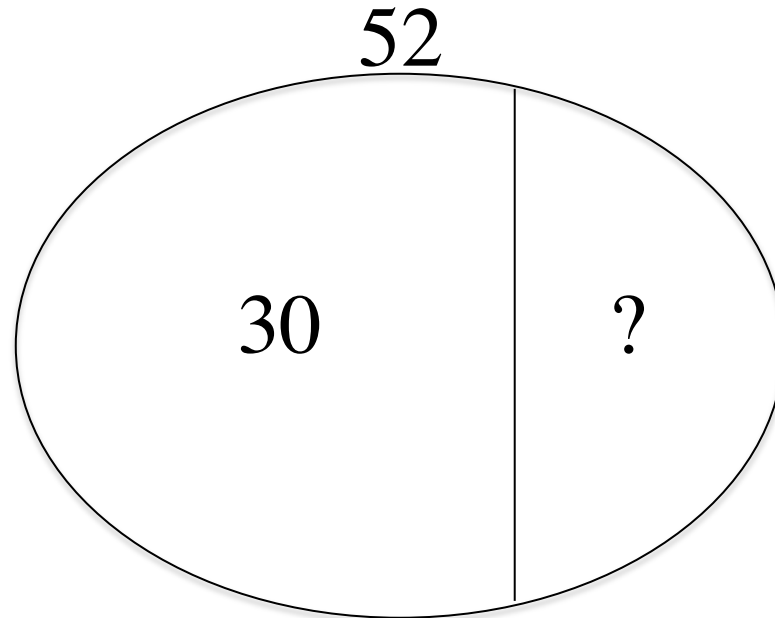
**Start Unknown**

# Problem Types – Part/Whole



# Problem Types – Part/Whole

Jamie has 52 stickers in her collection. 30 of them are butterfly stickers and the rest are hearts. How many heart stickers does Jamie have?

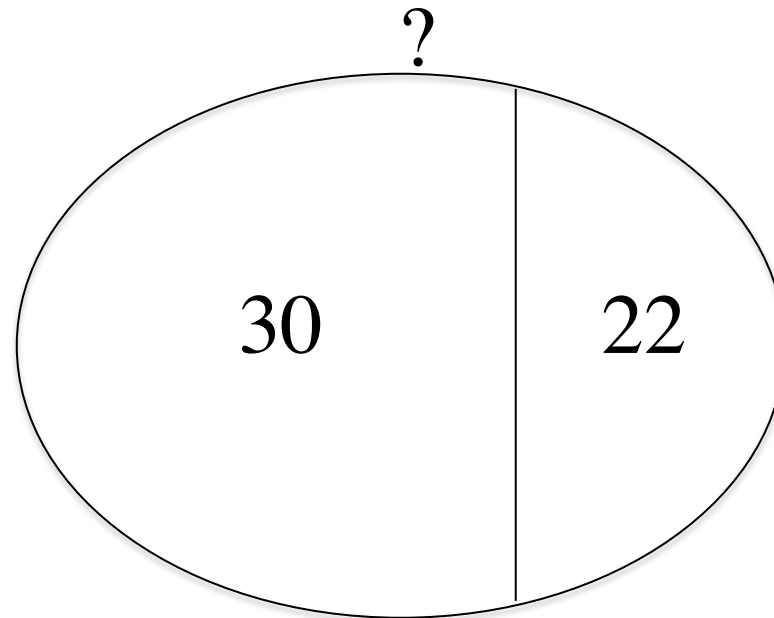


**Part Unknown**



# Problem Types – Part/Whole

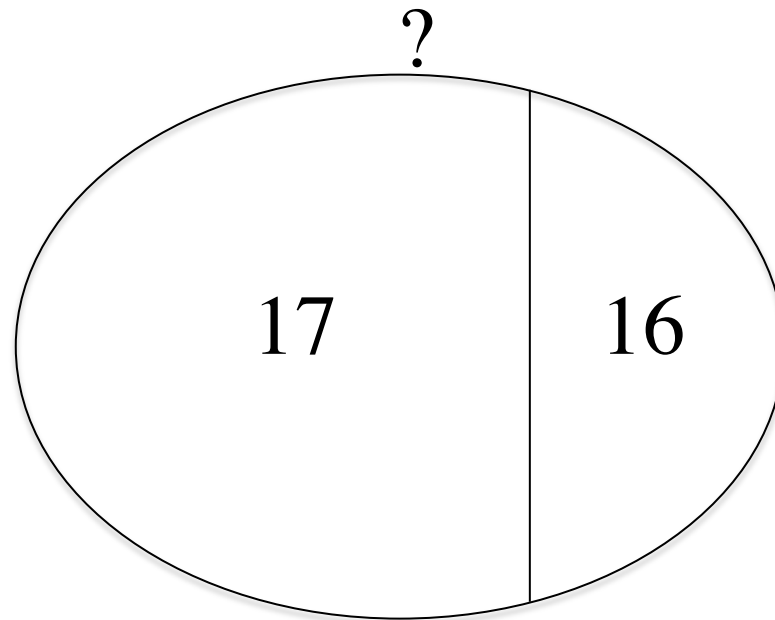
Jamie has many stickers in her collection. 30 of them are butterfly stickers and 22 are hearts. How many stickers does Jamie have in her collection?



**Whole Unknown**

# Problem Types

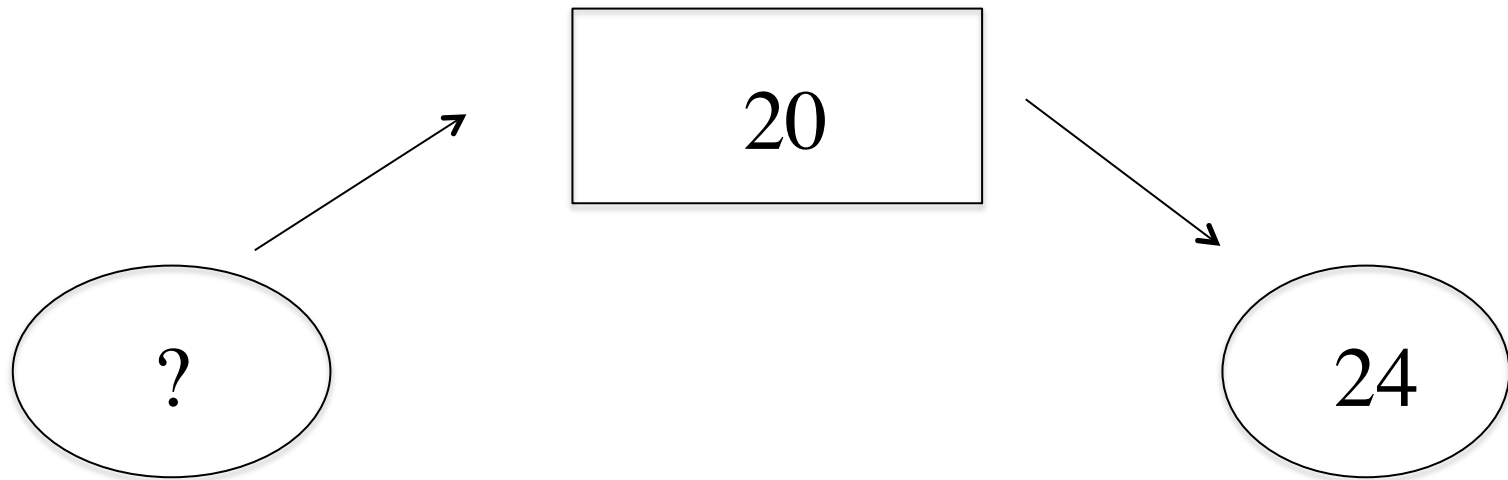
*There are many children swimming in the lake. 16 are girls and 17 are boys. How many children are swimming in the lake?*



**Part/Whole - Whole Unknown**

# Problem Types

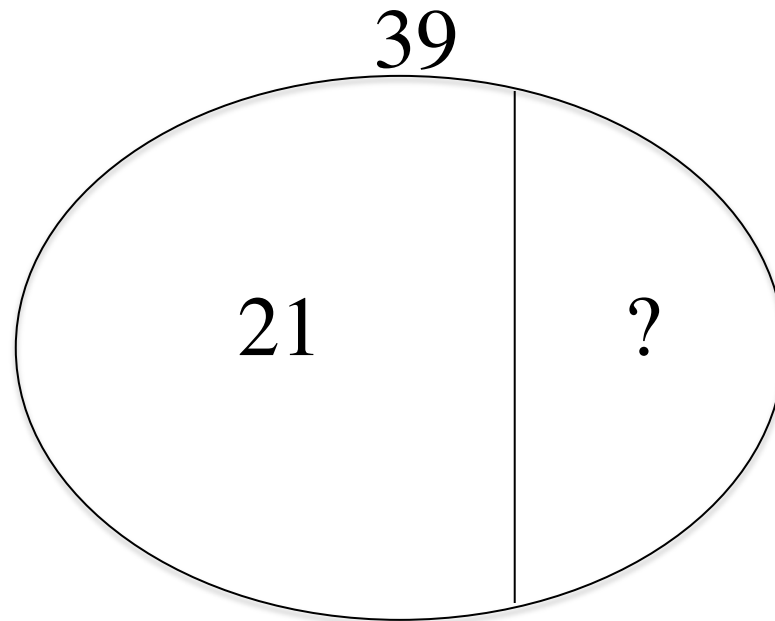
*Dena has a large collection of bottle caps. While walking to school one day, she dropped 20 of them. Now she has 24 bottle caps. How many bottle caps did Dena have before she lost some?*



**Action - Start Unknown**

# Problem Types

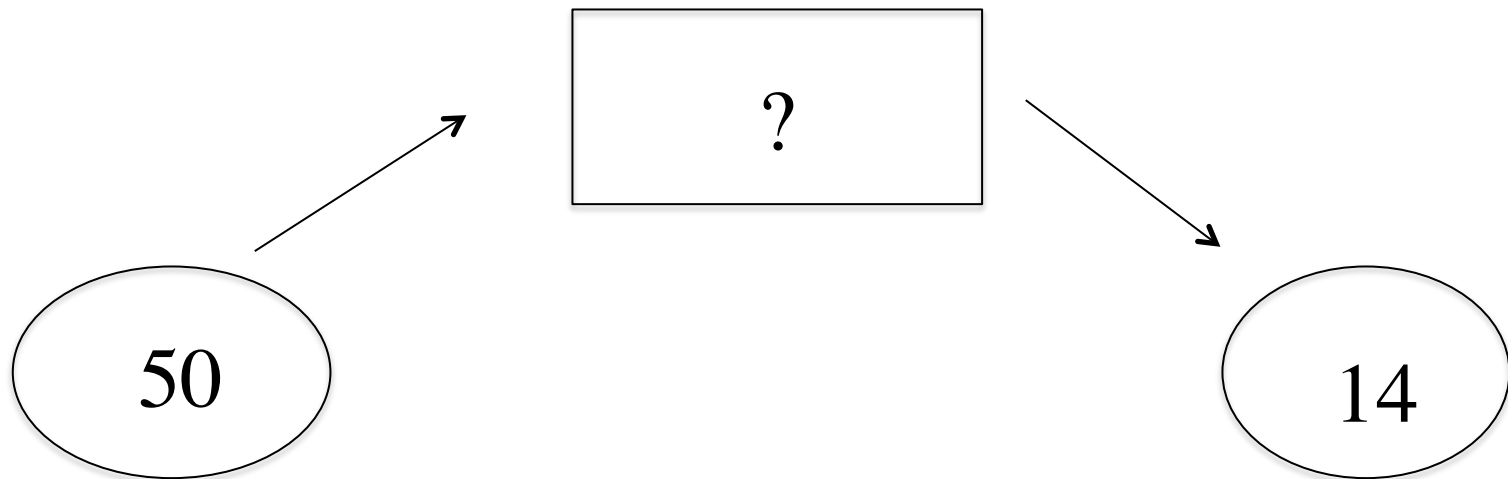
*Jesse has 21 Superman comic books and some Batman comic books. He has 39 comic books in all. How many Batman comic books does Jesse have?*



**Part/Whole - Part Unknown**

# Problem Types

*The bakery bakes cookies every day. At the end of the day, there are only 14 left. They started with 50 cookies. How many cookies were sold during the day?*



**Action - Action Unknown**



# Schema Based Instruction

## I. Problem Learning Phase

- Teaches the underlying word problem structure
- Uses “story scenarios”

## II. Solution Sharing Phase

- Pictures guide solution strategies
- Uses word problems

# Schema Based Instruction

The difference between story scenarios and word problems is the unknown.

In a story scenario, there is NO unknown.

*Richie has 9 Hot Wheels. He gives 3 of them to his brother. Richie has 6 Hot Wheels left.*

# Schema Based Instruction

In contrast, word problems talk about an unknown amount. There is a number that is missing and that children have to find.

*Richie has 9 Hot Wheels. He gives 3 of them to his brother. How many Hot Wheels does Richie have left?*

**End Unknown**

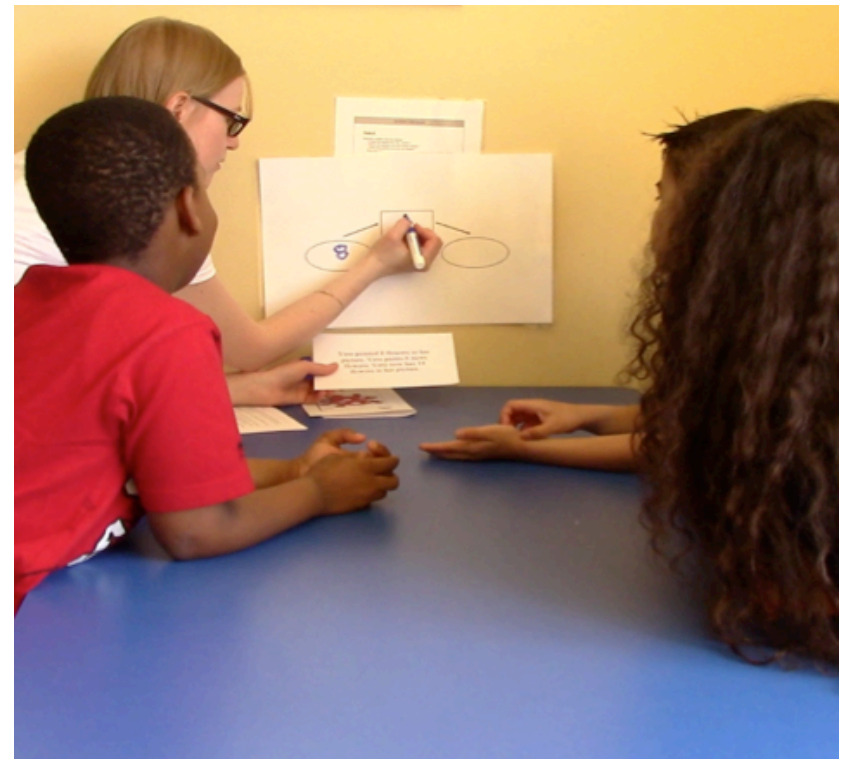
# Schema Based Instruction

## I. Problem Learning Phase

Teach the components of the word problem structure

Teach where numbers are placed in the diagram

Uses story scenarios

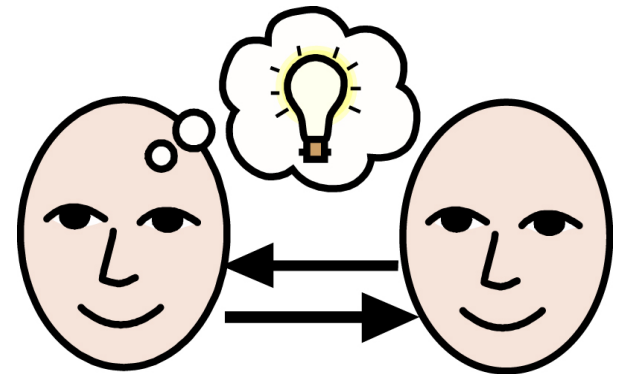


# Teaching: Problem Learning Phase

- Introduce parts of diagram
- Direct instruction → Guided instruction
- Clear and explicit teaching
- Review and repeat
- Provide explicit corrective feedback

# Teaching: Problem Learning Phase

- **Mix it up!**
  - Change order of components in problems
- Use story scenarios
  - **NO** unknowns
- Use checklist



# Reordering Story Scenarios and Word Problems

Megan's mom made 18 bags of candy for Halloween. She gave out 10 bags of candy. Now, Megan's mom has 8 bags of candy left.

Start → Action → End



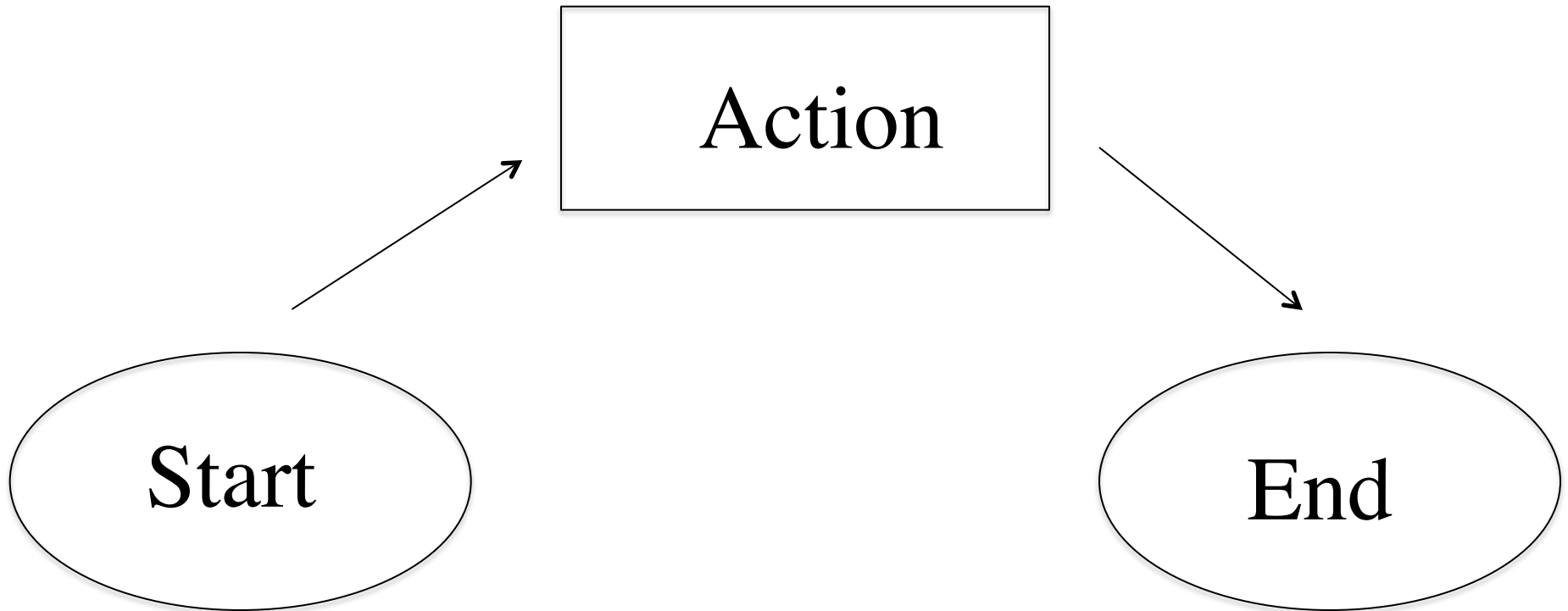
# Reordering Story Scenarios and Word Problems

Megan's mom gave out 10 bags of candy for Halloween. Megan's mom had made 18 bags of candy. Megan's mom now has 8 bags of candy left.

Action → Start → End

# Action Schemer

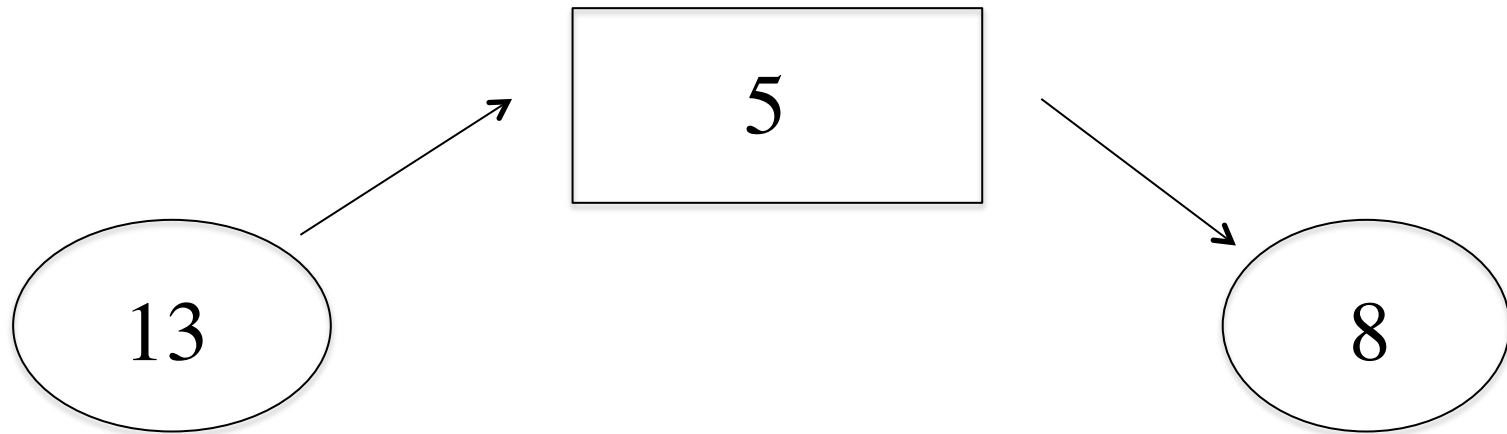
Problem  
Learning  
Phase



# Action Schemer

Problem  
Learning  
Phase

There are 13 apples in the bin.  
5 apples fall out of the bin.  
There are 8 apples left in the bin.



Write the numbers into the schemer.

- Does the problem have a start number?
- Does the problem have an action number?
- Does the problem have an end number?

Find your “?”

# ACTION CHECKLIST

## Problem Learning Phase

### **Write it!**

Write the numbers into the schemer.

- Does the problem have a start number?
  - Does the problem have an action number?
  - Does the problem have an end number?
- Find your “?”

### **Find it!**

Plan your strategy to answer the question.

- How are you going to answer it?
- What strategy will you use?

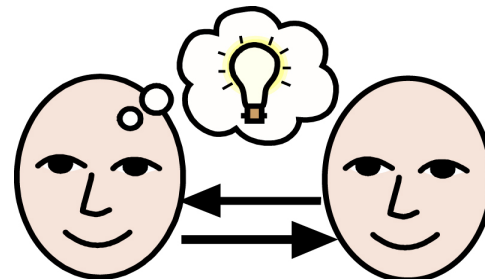
### **Do it!**

Solve the problem.

- Use your strategy to solve the problem.
- Check your work.

### **Share it!**

Share your strategy with your friends.



# Problem Learning Phase

*There are 13 apples in the bin. 5 apples fall out of the bin. There are 8 apples left in the bin.*<sub>x</sub>

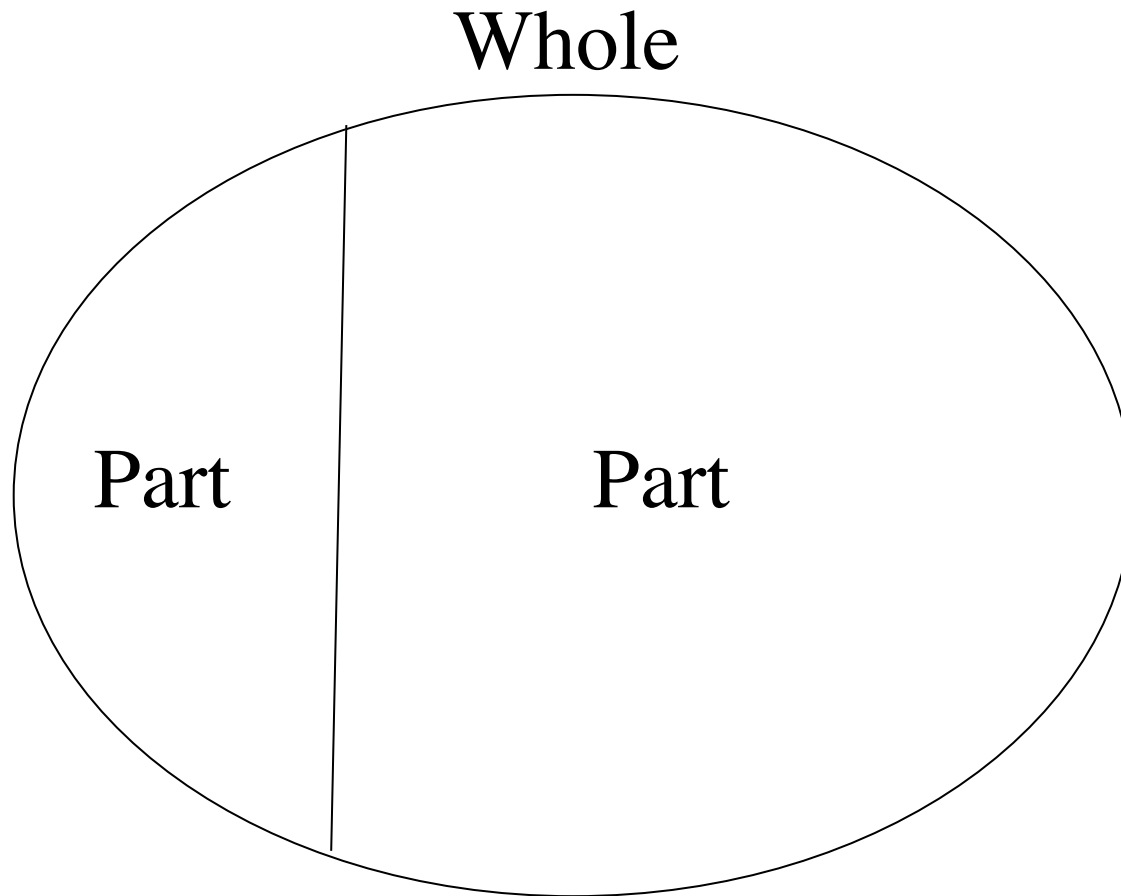
Write the numbers into the schemer.

- Does the problem have a start number?
- Does the problem have an action number?
- Does the problem have an end number?

Find your “?”

# Part/Whole Schemer

Problem  
Learning  
Phase



## Parts & Whole Checklist

### Write it!

Write the numbers into the schemer.

- Does the problem have the whole number?
  - Does the problem have the parts?
- Find your “?”

### Find it!

Plan your strategy to solve the problem.

- How are you going to solve it?
- What strategy will you use?

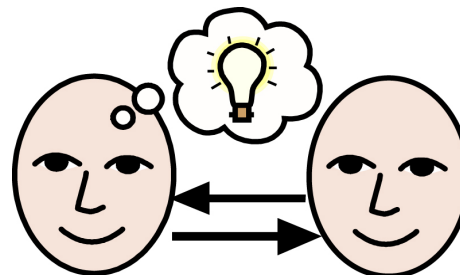
### Do it!

Solve the problem.

- Use your strategy to solve the problem.
- Check your work.

### Share it!

Share your answer with your friends.

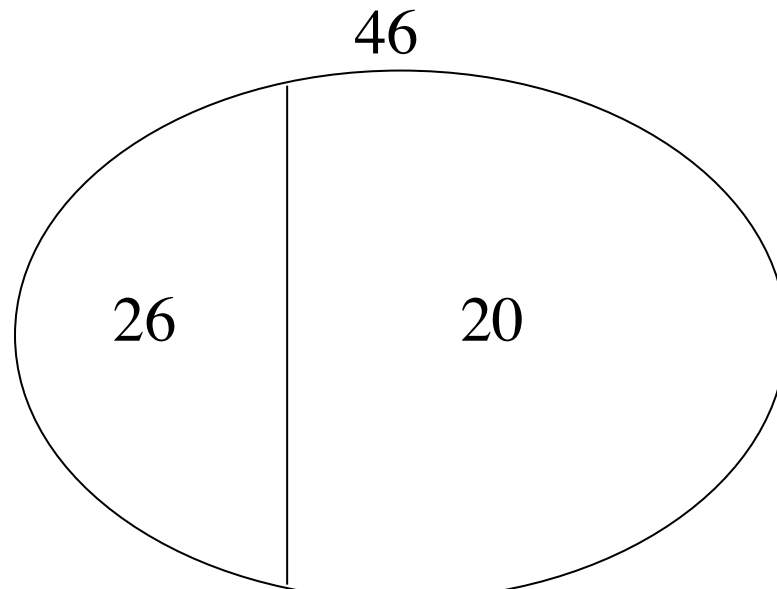




# Part/Whole Schemer

Problem  
Learning  
Phase

There are 46 soccer players on the field.  
There are 26 girls and 20 boys.



## Write it!

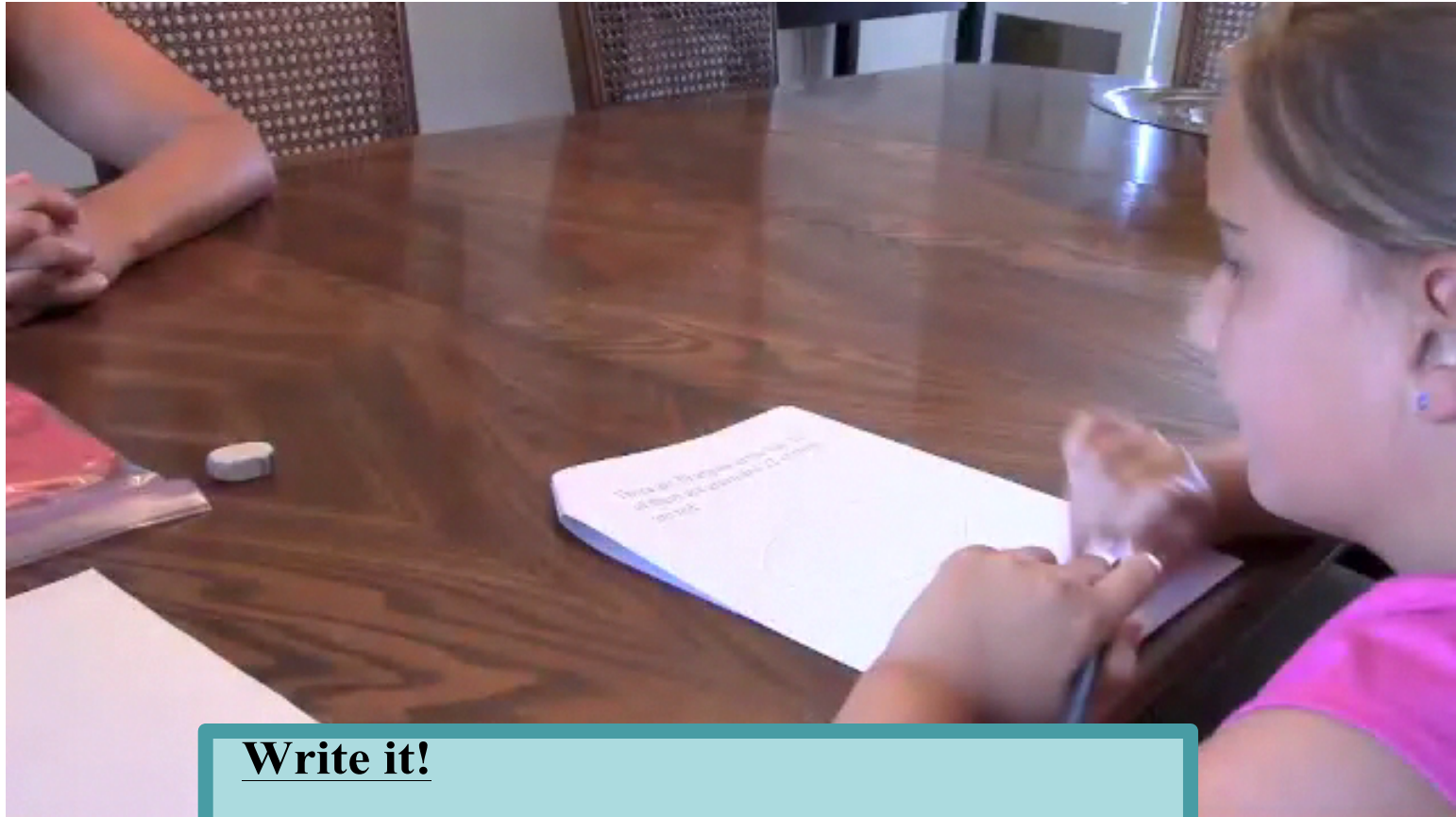
Write the numbers into the schemer.

- Does the problem have the whole number?
- Does the problem have the parts?

Find your “?”

# Problem Learning Phase

*There are 39 apples in the bin. 17 are green and 22 are red.*



## Write it!

Write the numbers into the schemer.

- Does the problem have the whole number?
- Does the problem have the parts?

Find your “?”

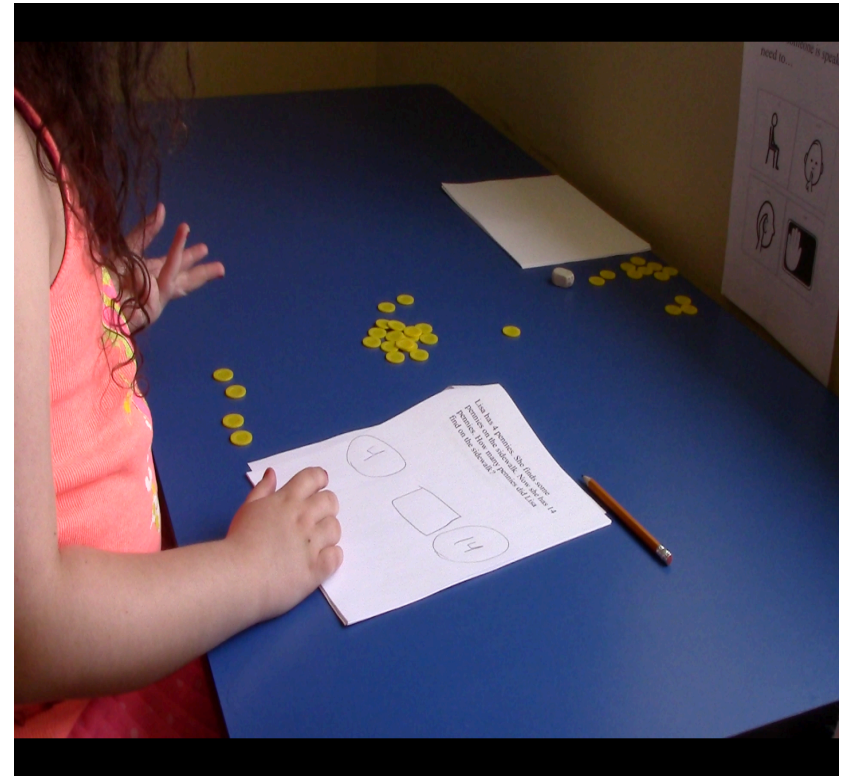
# Schema Based Instruction

## II. Solution Sharing Phase

Diagrams to help guide solution strategy

Encourage children to share their strategies

Uses word problems



# Teaching: Solution Sharing Phase

- Allow ample time before stepping in
- Encourage them to “talk it out”
- Repeat teaching, if needed
- Provide manipulatives
  - Base ten blocks, chips, counters



# Teaching: Solution Sharing Phase

- Fade out diagrams, allow children to draw them
- Encourage strategy sharing
- Encourage use of multiple strategies
  - Avoid rigidity!

# ACTION CHECKLIST

## Solution Sharing Phase

### Write it!

Write the numbers into the schemer.

- Does the problem have a start number?
- Does the problem have an action number?
- Does the problem have an end number?

Find your “?”

### Find it!

Plan your strategy to answer the question.

- How are you going to answer it?
- What strategy will you use?

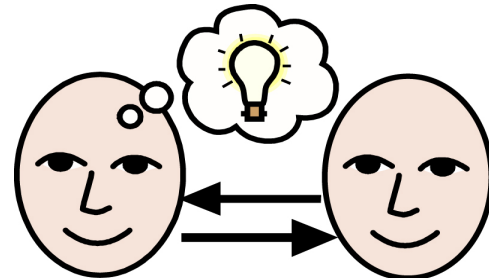
### Do it!

Solve the problem.

- Use your strategy to solve the problem.
- Check your work.

### Share it!

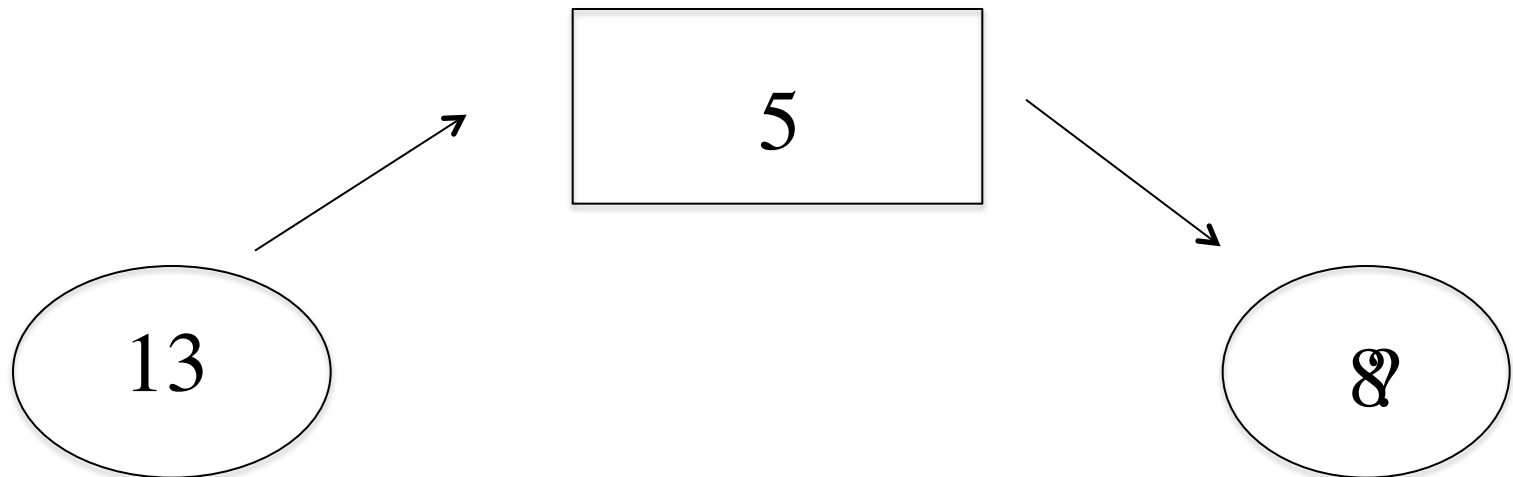
Share your strategy with your friends.



# Action “Schemer”

Solution  
Sharing  
Phase

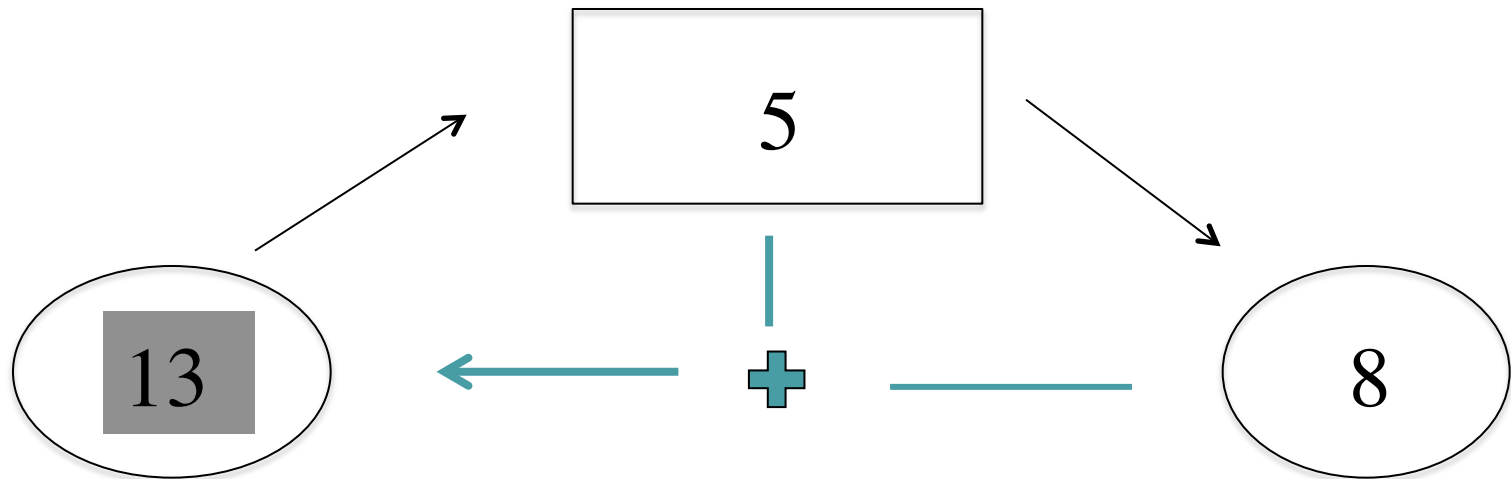
5 apples fall out of the bin. Before, there were 13 apples in the bin. How many apples are left in the bin now?



# Action “Schemer”

Solution  
Sharing  
Phase

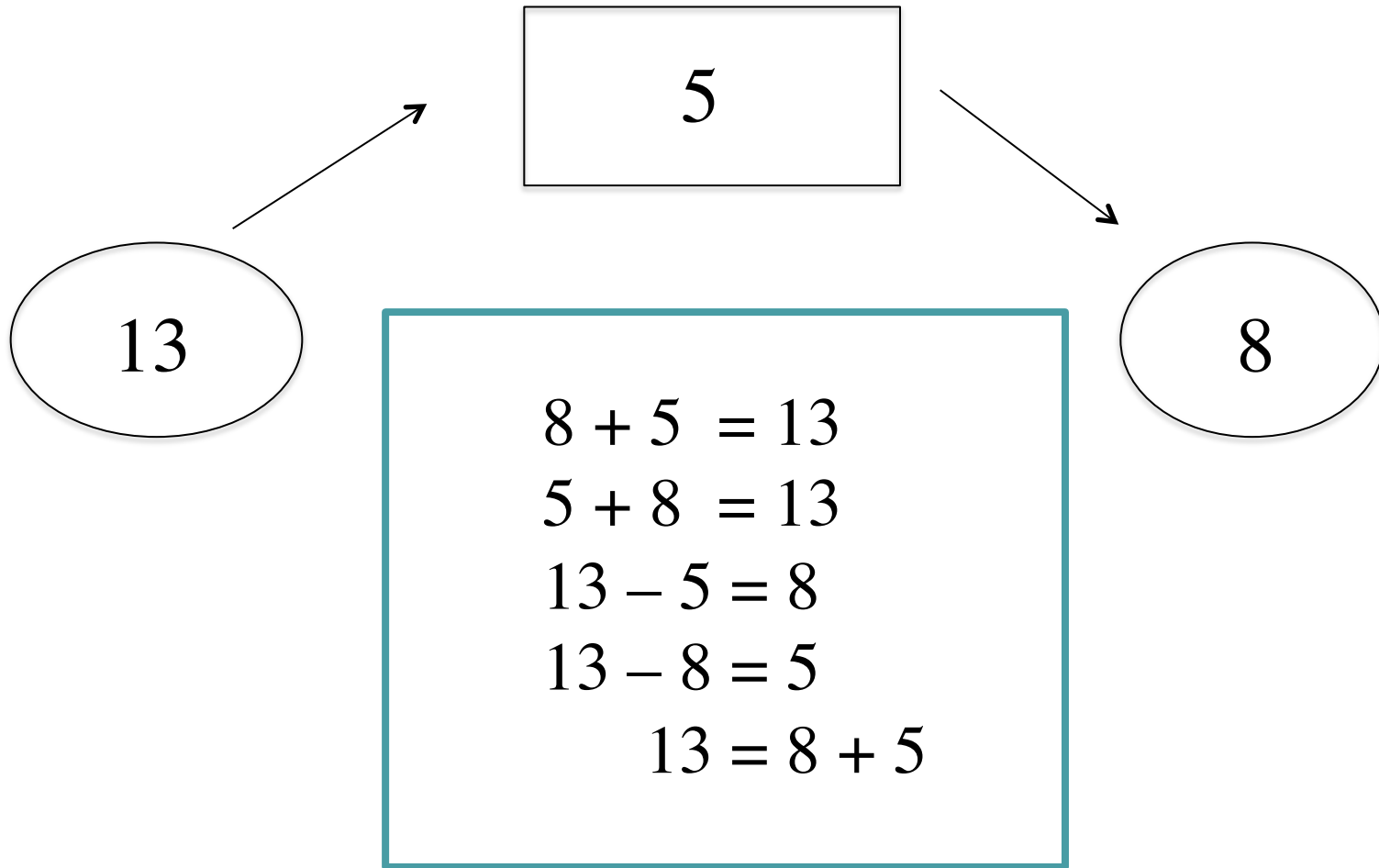
5 apples fall out of the bin. Before, there were 13 apples in the bin. How many apples are left in the bin now?





# Action "Schemer"

Solution  
Sharing  
Phase



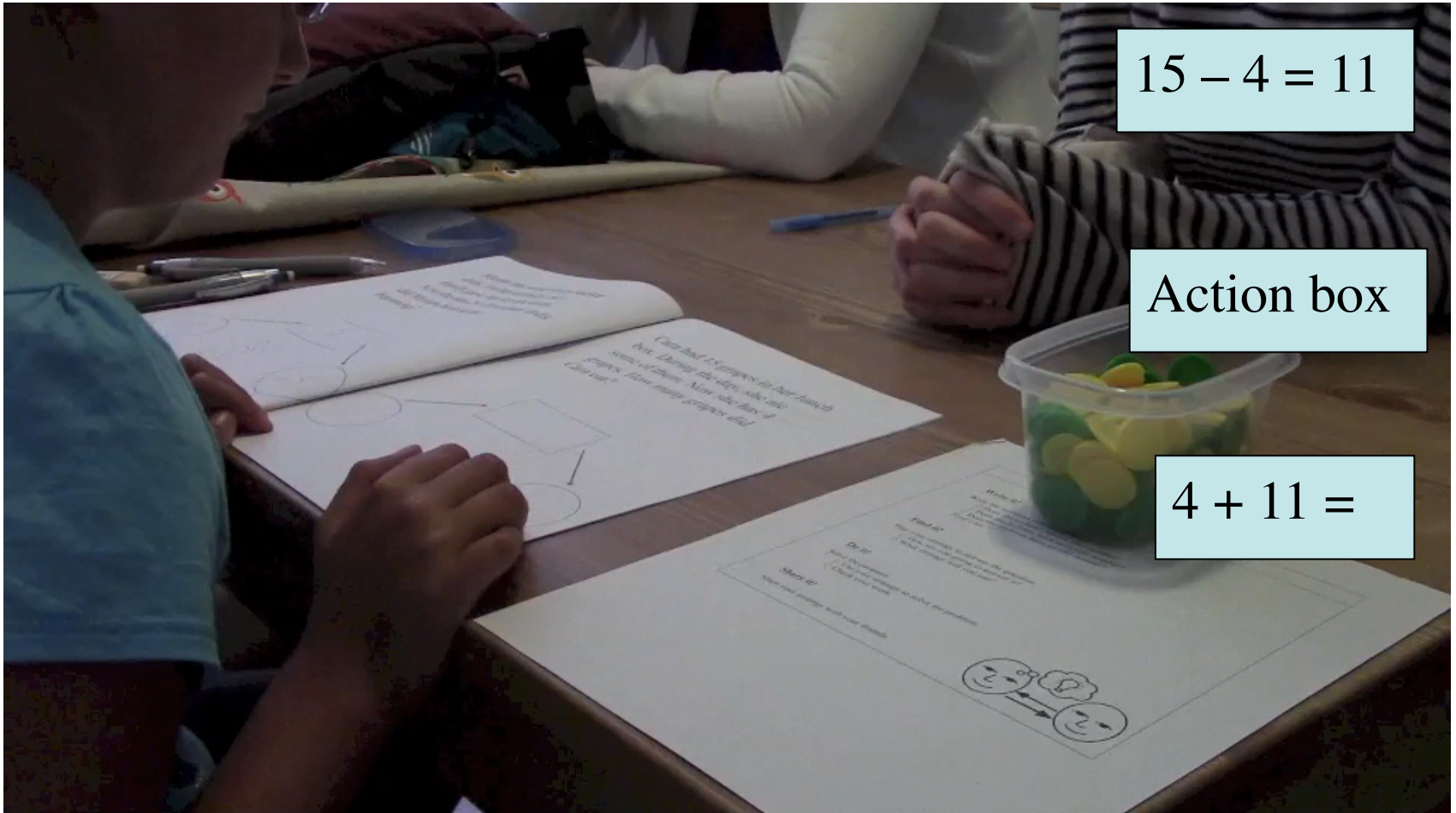
# Solution Sharing Phase

*Cara had 15 grapes in her lunch box. During the day, she ate some of them. Now she has 4 grapes left. How many grapes did Cara eat?*

$$15 - 4 = 11$$

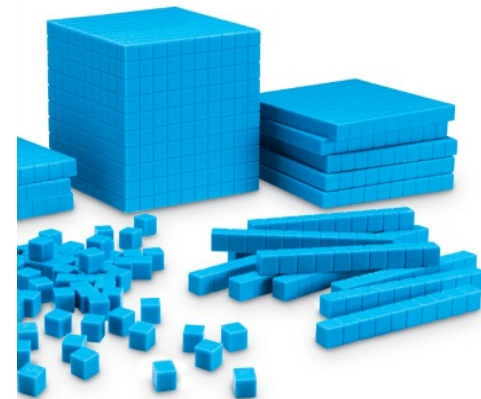
Action box

$$4 + 11 =$$



# When Teaching SBI...

- Teach all problem types
  - One type at a time
- Change placement of unknown
- Make problems “just difficult enough”
- Fade out diagrams, allow children to draw them
- Use manipulatives



# When Teaching SBI...

- Encourage sharing of strategies
- Encourage children to “talk through it”
- Help children progress to more sophisticated strategies
- Show children how to “check their work”
- Reinforce other mathematical concepts

# Benefits of Peer Teaching

- Create environment for open discussions
- Reinforces their own strategies/learning
- Learn new strategies
- Builds children's self-esteem



# Why SBI Works

Use of schemas...

- Organizes information
- Reduces cognitive load
- Teaches a deeper understanding
- Serves as scaffolds
- Facilitates memory retrieval





# Meet Melissa – Solution Sharing Phase

A restaurant sells a lot of food in a day. They sell 27 hot dogs and 25 hamburgers a day. How much food does the restaurant sell in a day?

A restaurant sells a lot of food in a day. They sell 27 hot dogs and 25 hamburgers a day. How much food does the restaurant sell in a day?

$$\begin{array}{r} 1 \\ 27 \\ + 25 \\ \hline 52 \end{array}$$
$$\begin{array}{r} 4 \\ \cancel{5}^{12} \\ - 25 \\ \hline 27 \end{array}$$
$$\begin{array}{r} 1 \leftarrow \\ 27 \\ + 25 \\ \hline 52 \end{array}$$







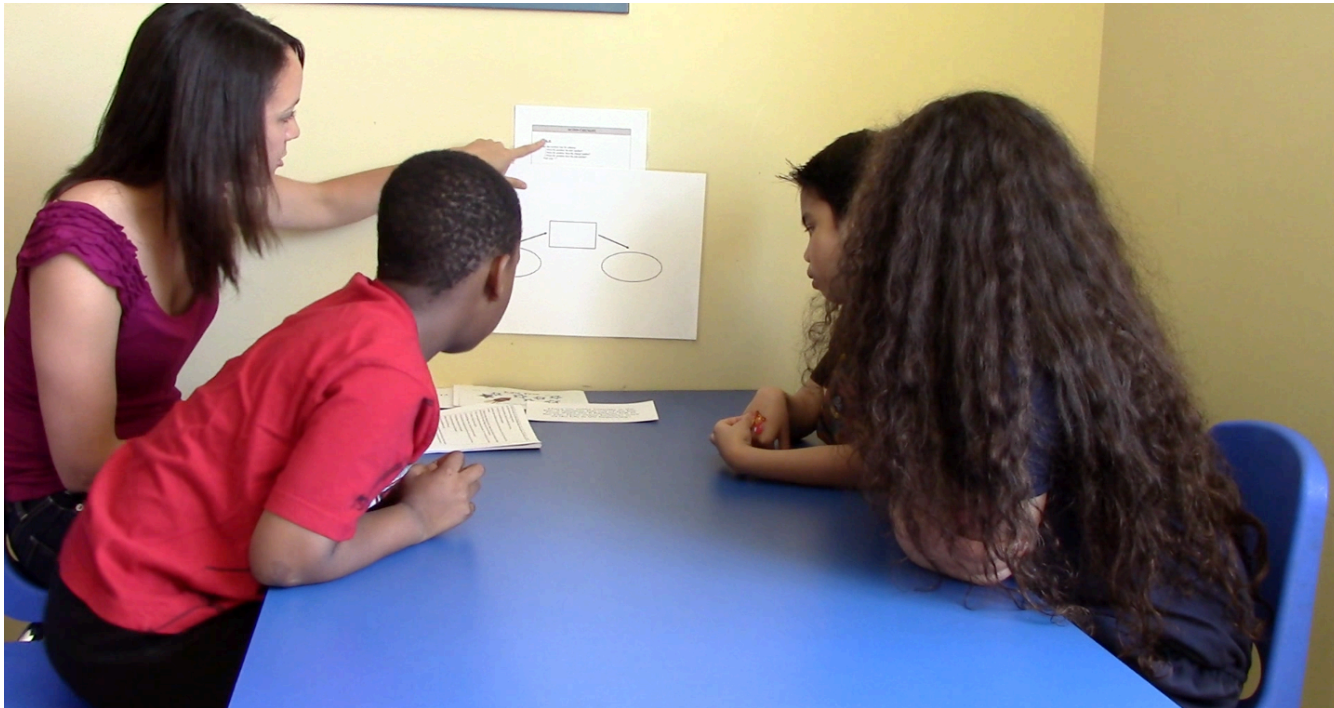
**Canadian Disability Policy Alliance**

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# Thank you

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