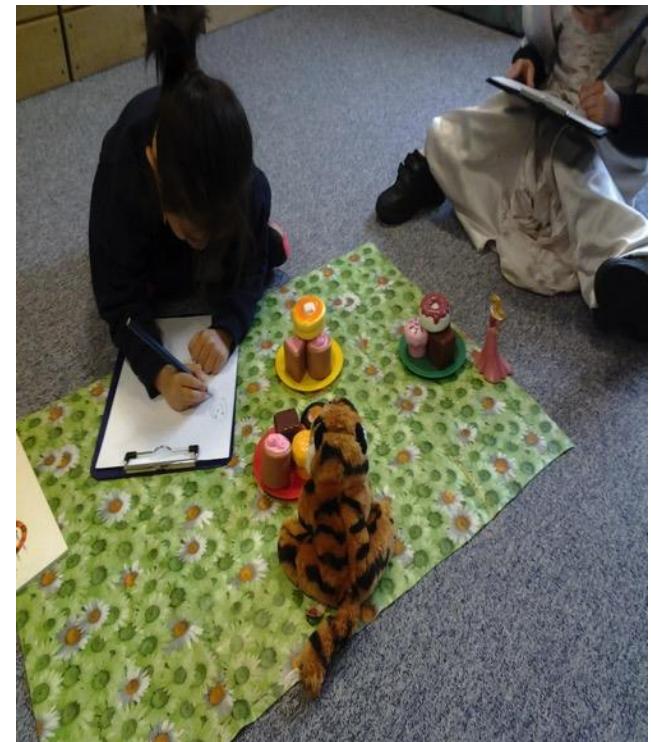


# How do books and stories develop mathematical thinking?

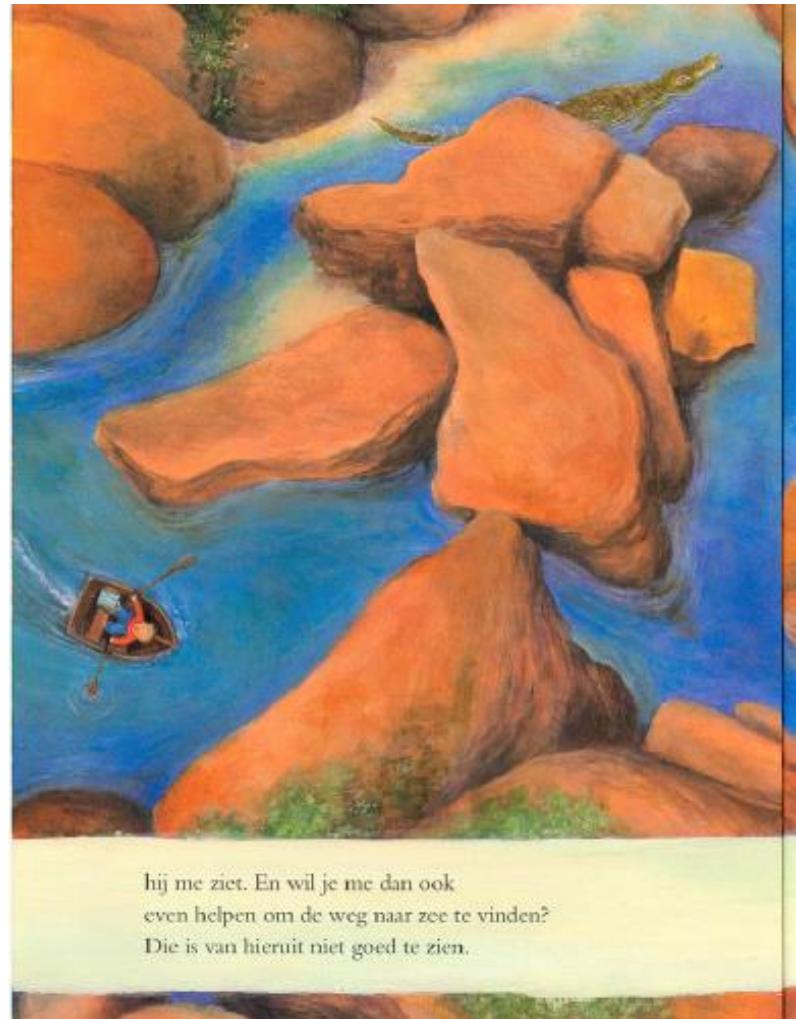
Sue Gifford



# Research evidence

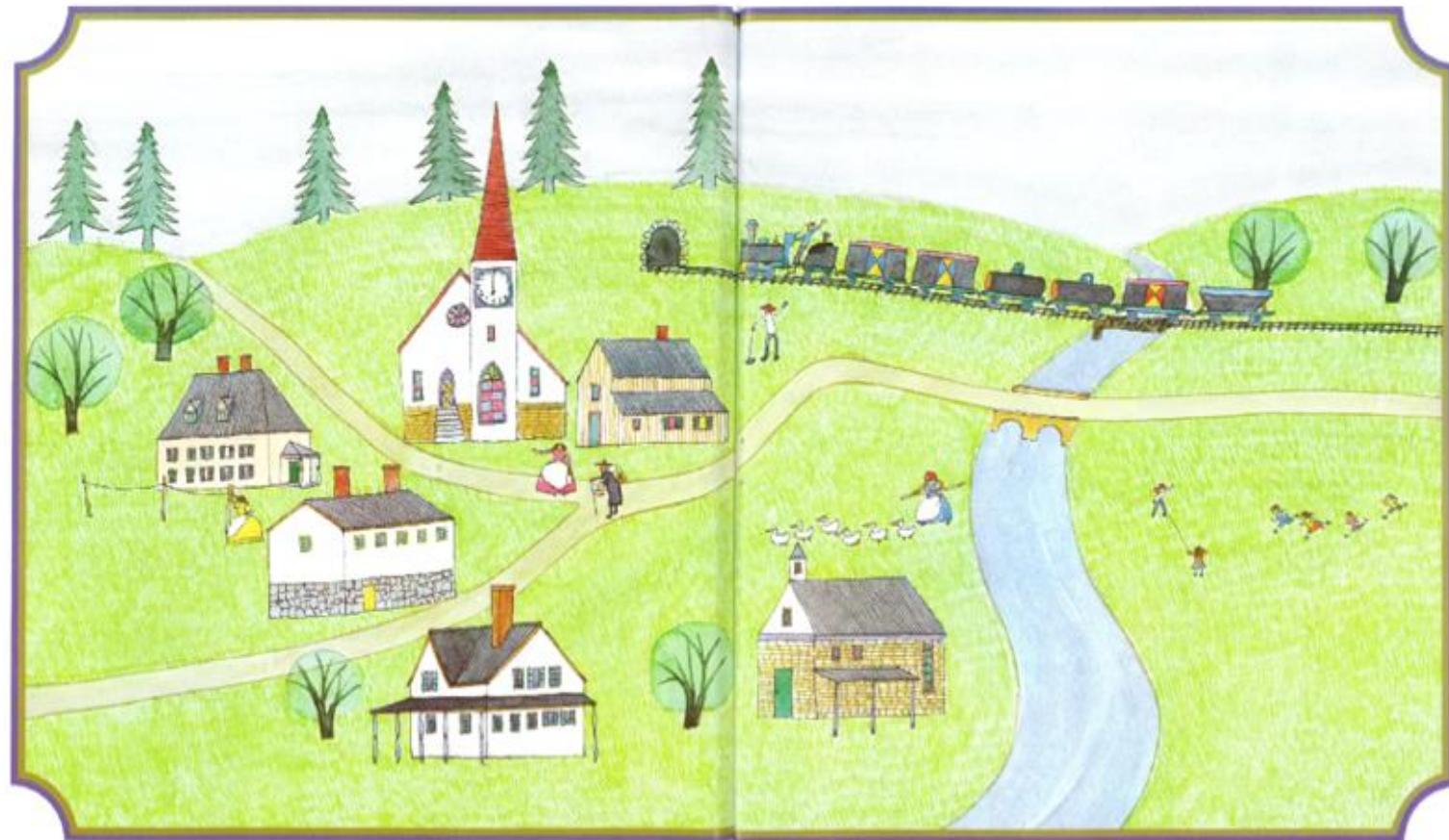
Reading picture books improves 4 to 6 yr olds' maths performance

- incidental questioning
- more improvement for girls



hij me ziet. En wil je me dan ook  
even helpen om de weg naar zee te vinden?  
Die is van hieruit niet goed te zien.

# Books - to develop number concepts



6

Anno's Counting Book, Mitsumasa Anno

tana hoban

**count and see**



*Counting,  
composition  
& subitising*

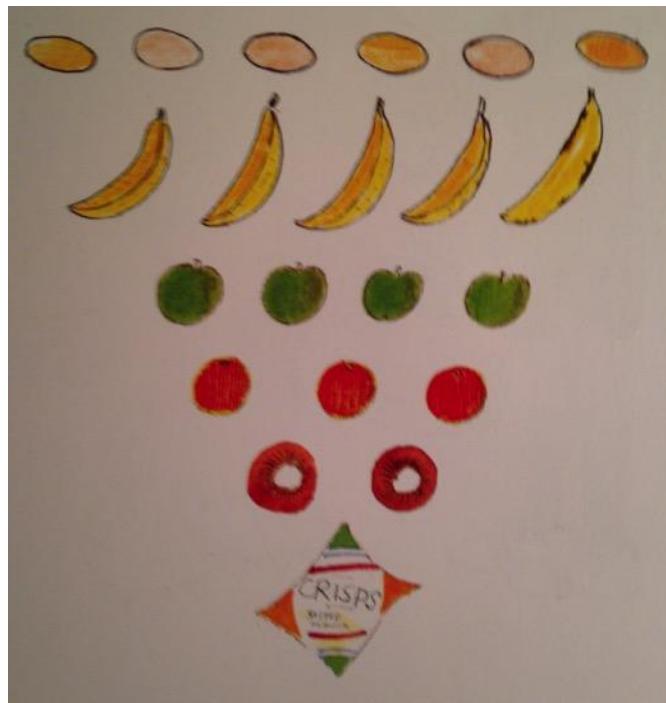
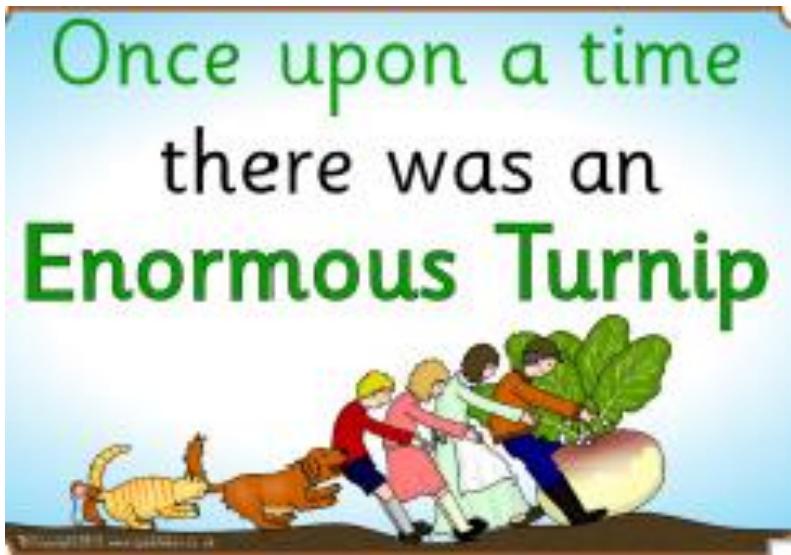
8

EIGHT



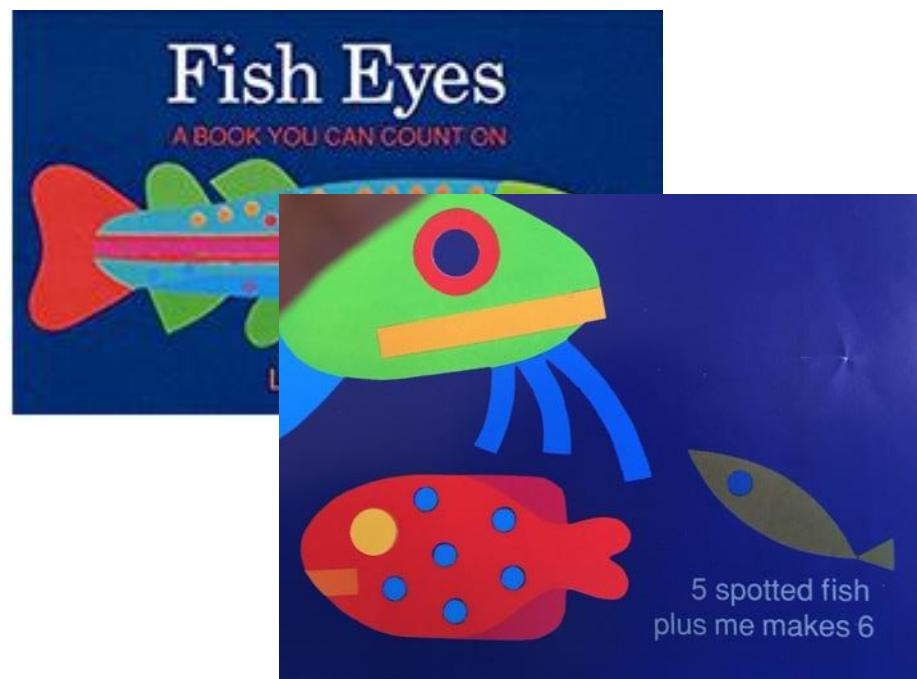
# *Comparison*



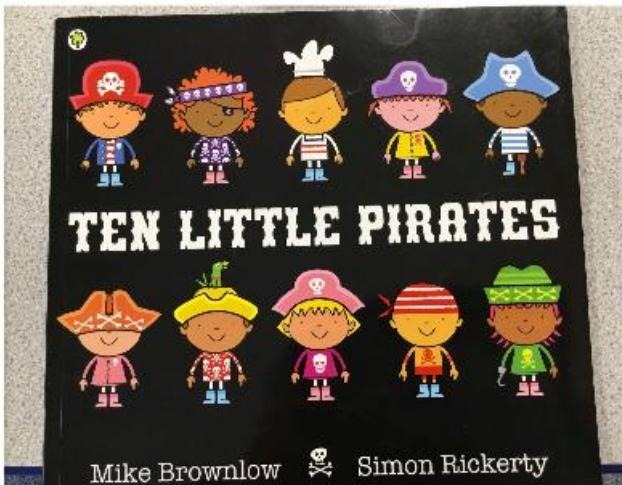
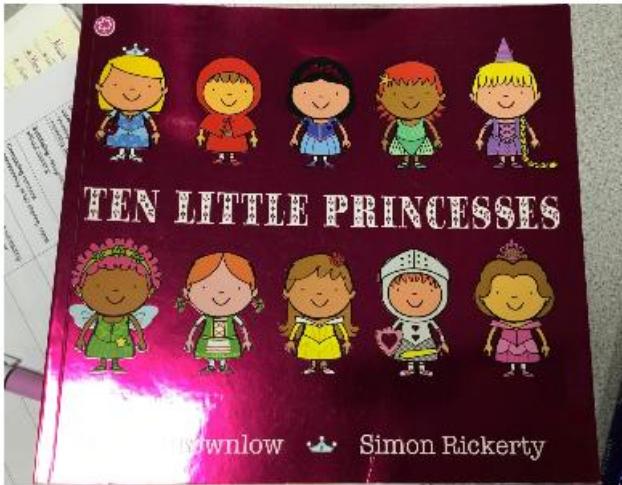


John Burningham Shopping basket

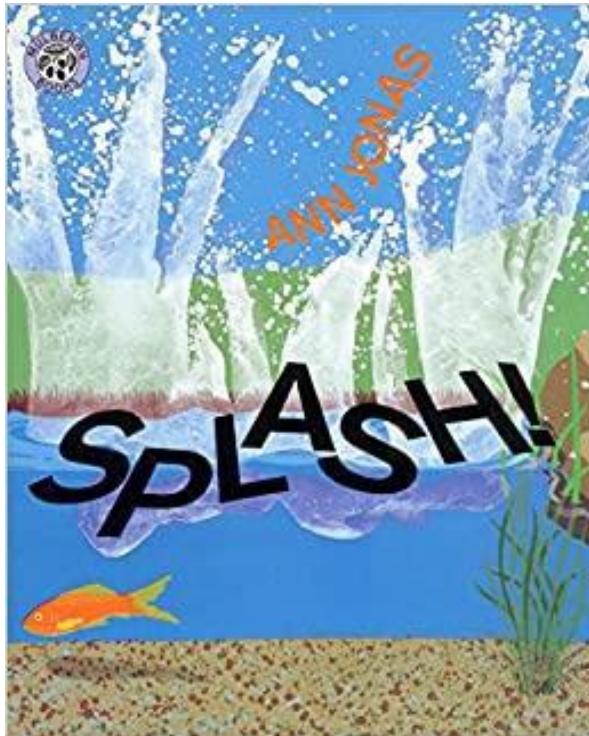
One more..



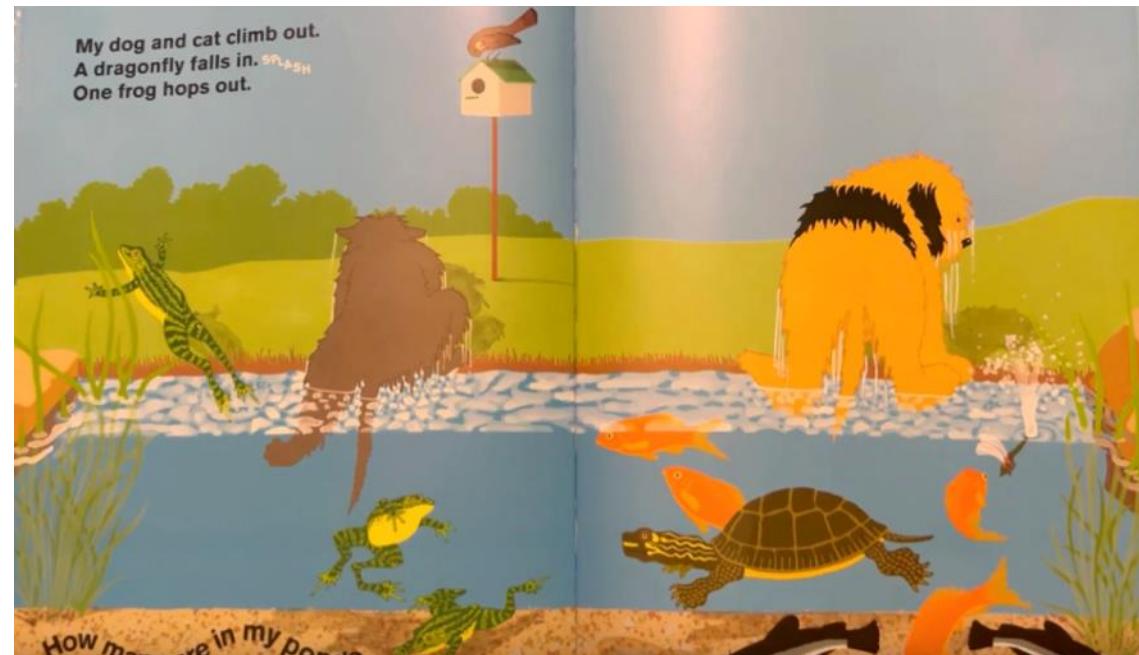
# Subtracting one



I have a pond in my backyard.  
I have one turtle, two catfish,  
three frogs, and four goldfish.  
I feed them every day.



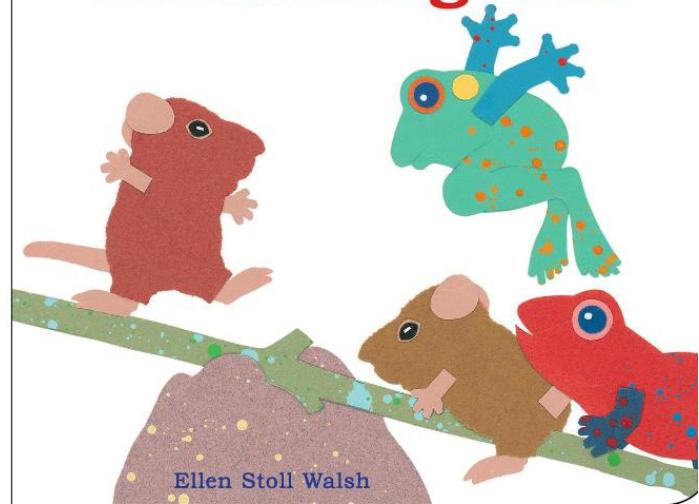
# Addition & subtraction: inverse operations



*How many are in my pond?*

Splash! Ann Jonas <https://www.youtube.com/watch?v=cj4e3i6R3XM>

# Balancing Act



*The balancing act*

<https://www.youtube.com/watch?v=ih0lw0zZRqU>

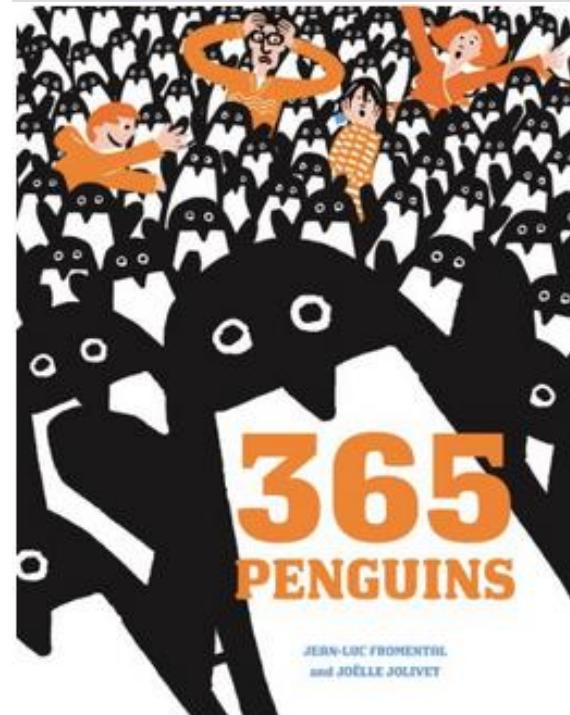
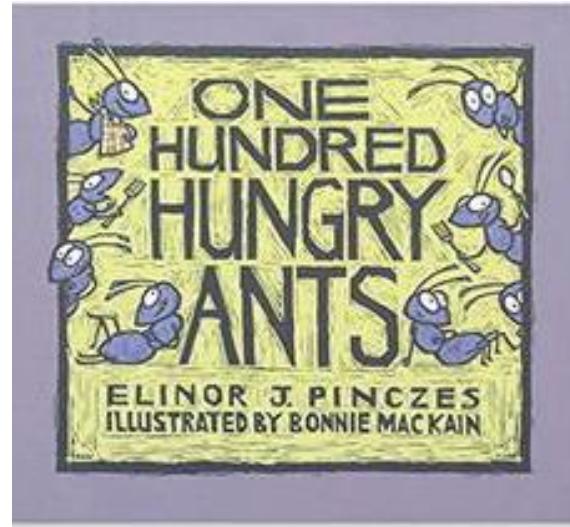
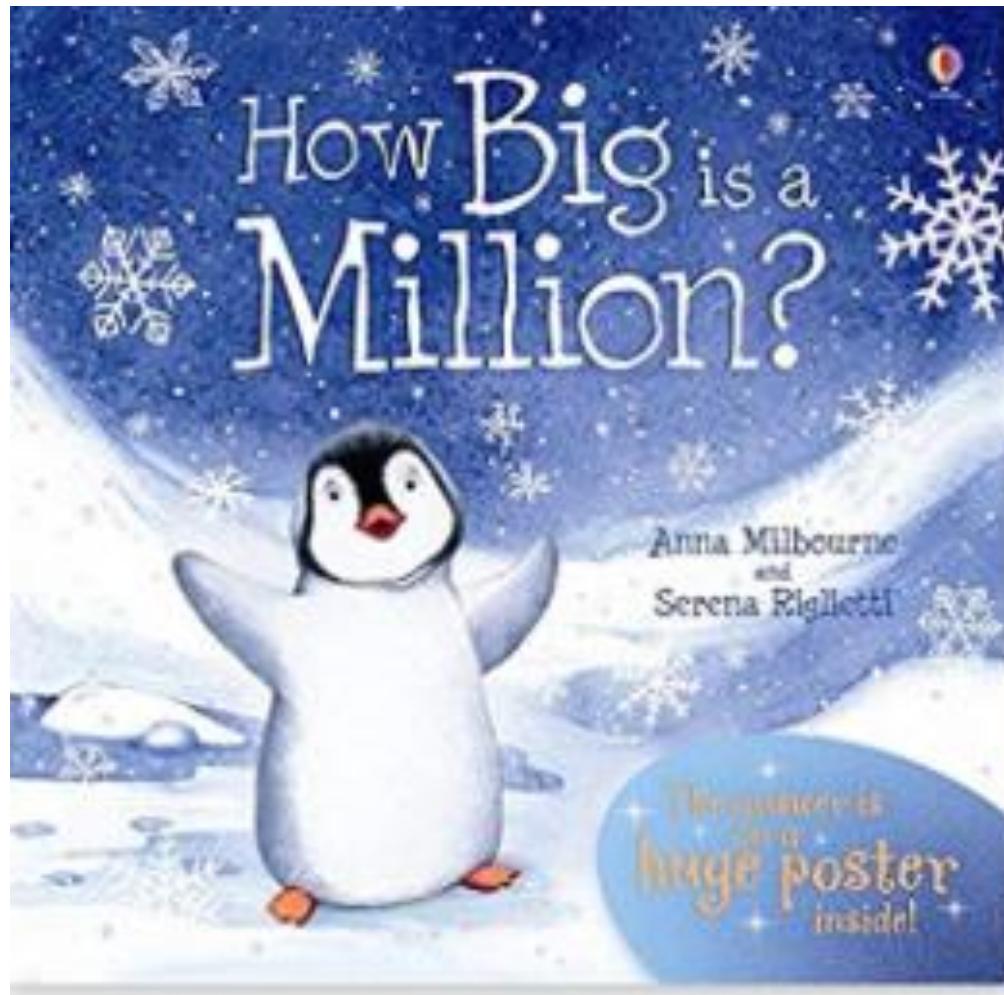
Ellen Stoll Walsh



# Equivalence



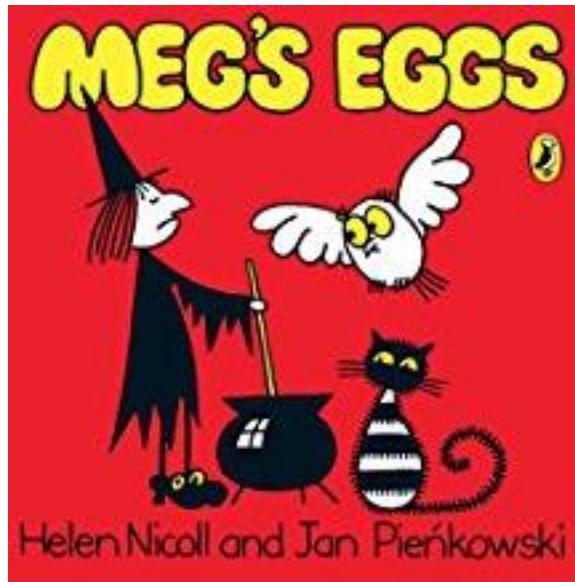
# Bigger numbers



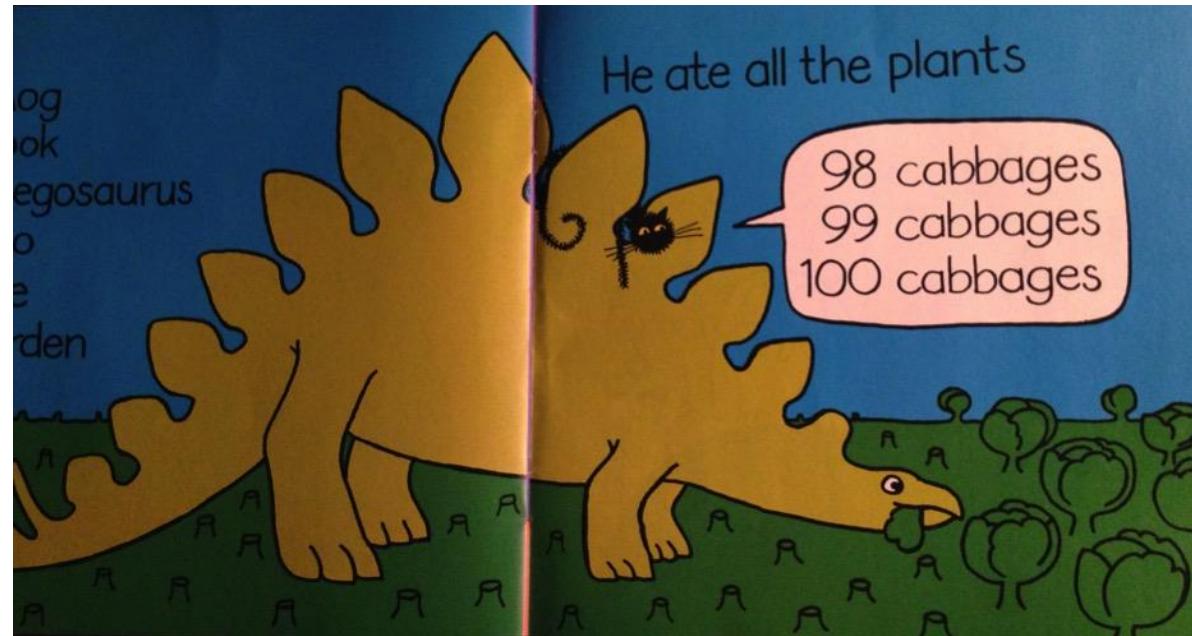


# *I spy numbers*

## Marzollo & Wick



Helen Nicoll and Jan Pienkowski



## Making a counting game

Throw the dice  
and collect  
cabbages for  
your dinosaur.





Ellen Stoll Walsh

<https://www.youtube.com/watch?v=oA5QeZhDJEs>



Two approaches:  
- acting out  
- children retelling



# Using a story structure: Fox and chickens

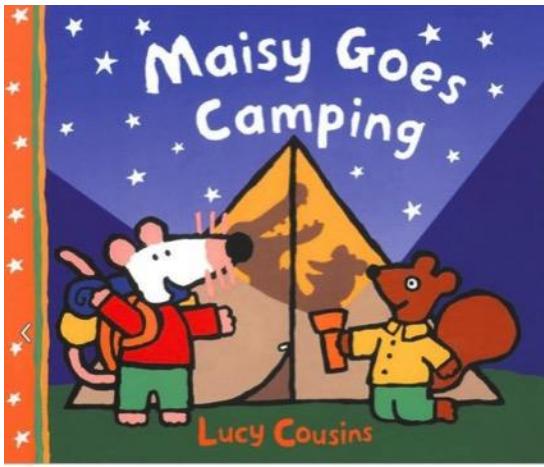
Children use  
their own  
numbers in  
the story.



# *NC: Moving fluently between representations*



*Playing with what they know*



# *How many are left in the tent?*



## Assessing children's thinking



### **Key Ideas**

#### **Instant use of number facts**

- one more / one less
- which bonds for which totals?

#### **Strategies:**

##### fingers/visualising/mentally

- count all
- count on to add
- count those left
- count back
- count up to find the difference

#### **Explaining methods**

#### vocabulary of addition and subtraction

#### **Inverse relations**

*'4 - 2 = 2 because 2+2=4'*

*'10-9=1 because 9+1=10'*

#### **Estimation**

#### **Checking**

#### **Making connections**

##### spotting patterns

##### reasoning

#### **Difficulties &**

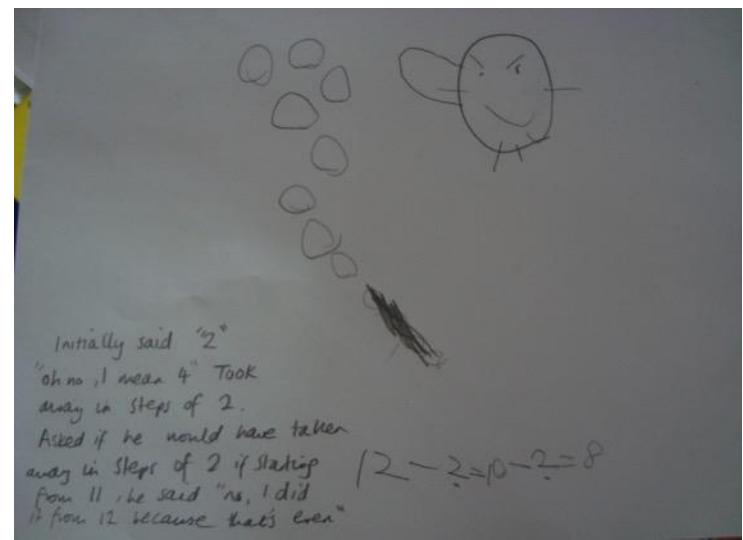
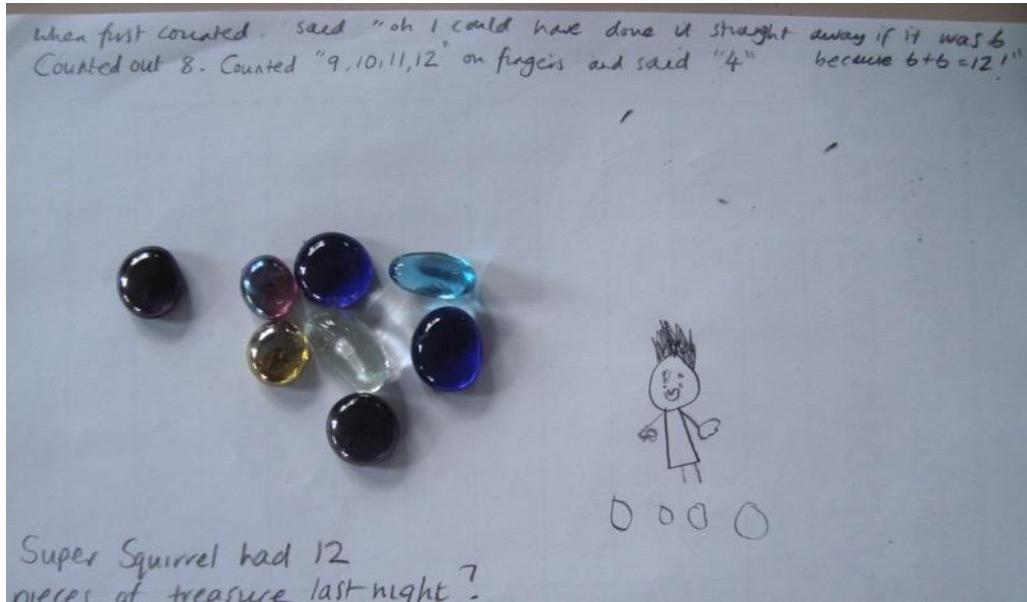
#### **misperceptions**

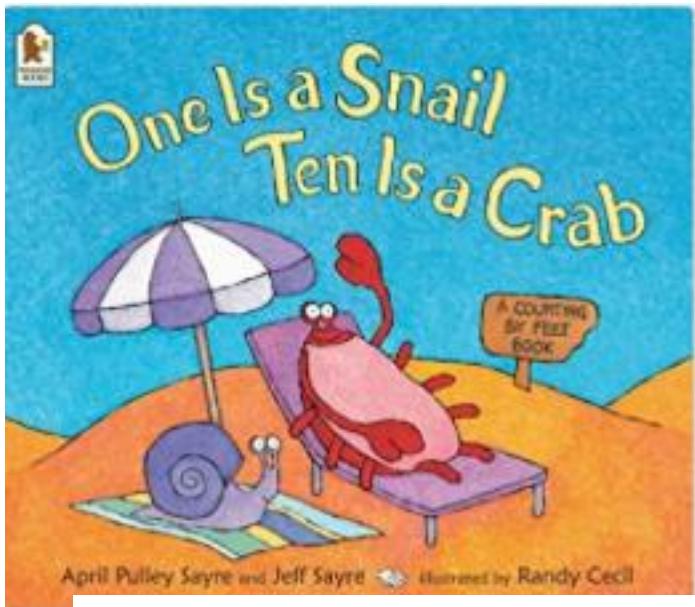
#### **Attitude and confidence**

# The Subtraction Villain: Supertato's Evil Pea has stolen some jewels

## Children's strategies

Warren Mead Infants, Susan Bovill





# Number composition

20 feet:  
snails,  
people  
and dogs

~~4 + 4 + 4 + 4 + 2 + 2~~  
peep  
peep  
peep  
peep  
peep  
  
Yosmin.

Xosmin

Julie Sayle     Headington Prep

Charlayne

(knew that if she had 18 she needed 2 more to make 20).

Olivia.

$$5+1+7+2+10+2+4 = 29$$



too



thish  
Telee



SeVon



too



top



too



Bee

two

*One is a  
snail and  
ten is a  
crab*

St James  
Weybridge

Kelly Frost

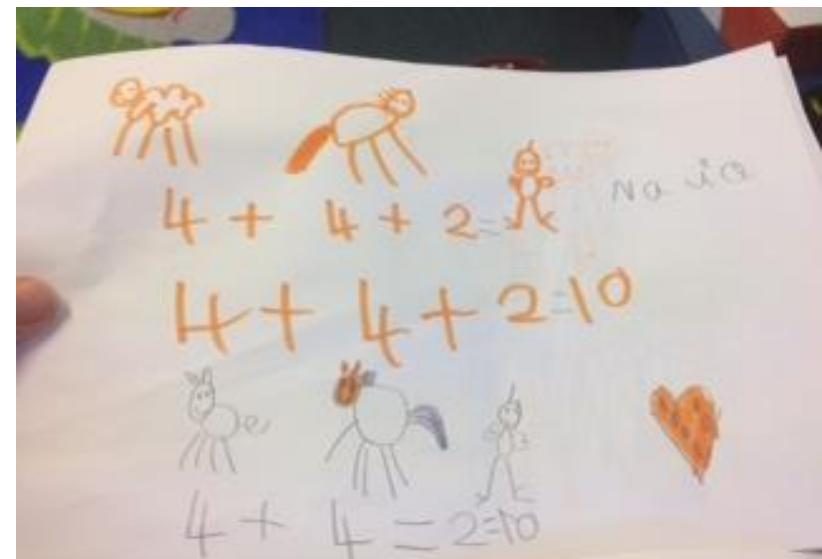


Meet Farmer Bob he has lots of animals on his farm. Can you recognise any of them?



We made up our own story related to our farm topic and asked for the children to help Farmer Bob work out which animals could have escaped.

# 10 legs: the children independently represented their ideas.



Knaphill Lower  
School

Becca Everitt

# Problem solving: making connections

*If children know or are told what method to use then this is not problem solving.*

S. Gifford (2015) <https://nrich.maths.org/12166>

Three things affect the level of difficulty for children:

- *familiar contexts*
- *meaningful purposes*
- *mathematical complexity* (Carr et al, 1994)

# Sharing problems- including remainders

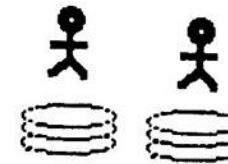
The selfish sharer:  
*Pirate Panda*



## The redistribution problem

PRE-SCHOOL PROBLEM SOLVING

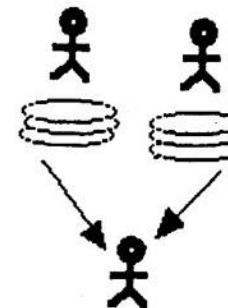
401



6 crackers shared evenly between 2 dolls.

Fig. 1.

The arrival of a third doll who must get an even share, before any crackers are eaten, creates a problem:



Then a third doll arrives

Fig. 2.

# Whole class problem solving



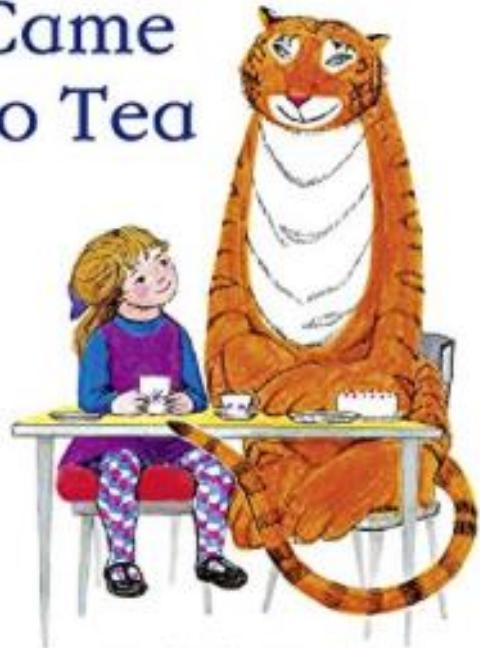
# Independent activities



# Story contexts for sharing



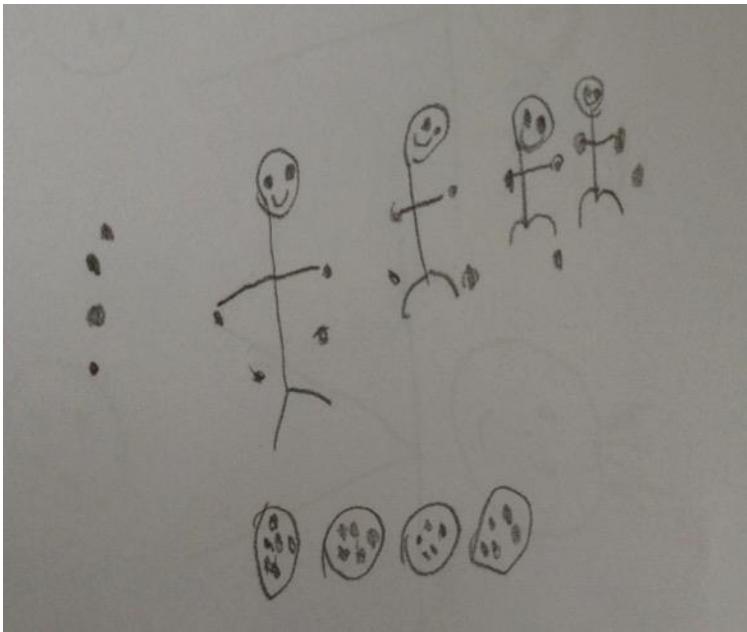
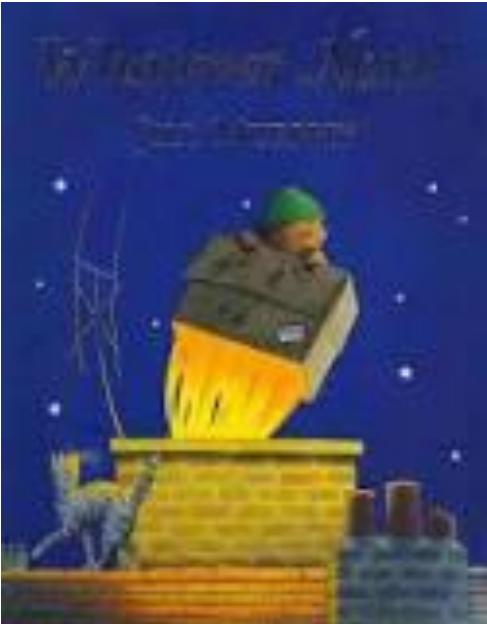
The Tiger Who  
Came  
to Tea



Judith Kerr

*The tiger who  
came to tea*

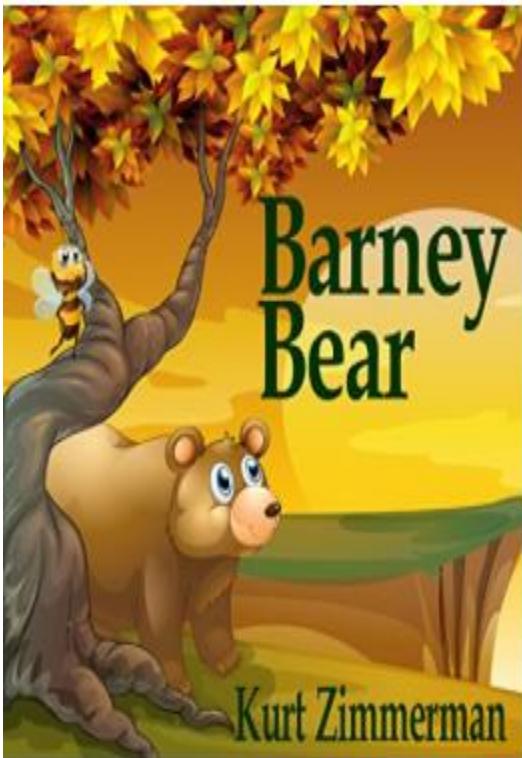
Caroline Mitchell  
Staines Prep



After reading Whatever Next the children enjoyed a picnic on the moon in the role play area. Baby Bear invited 3 friends to join him. And then another one came...

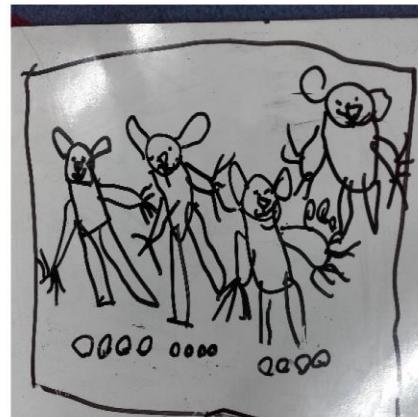


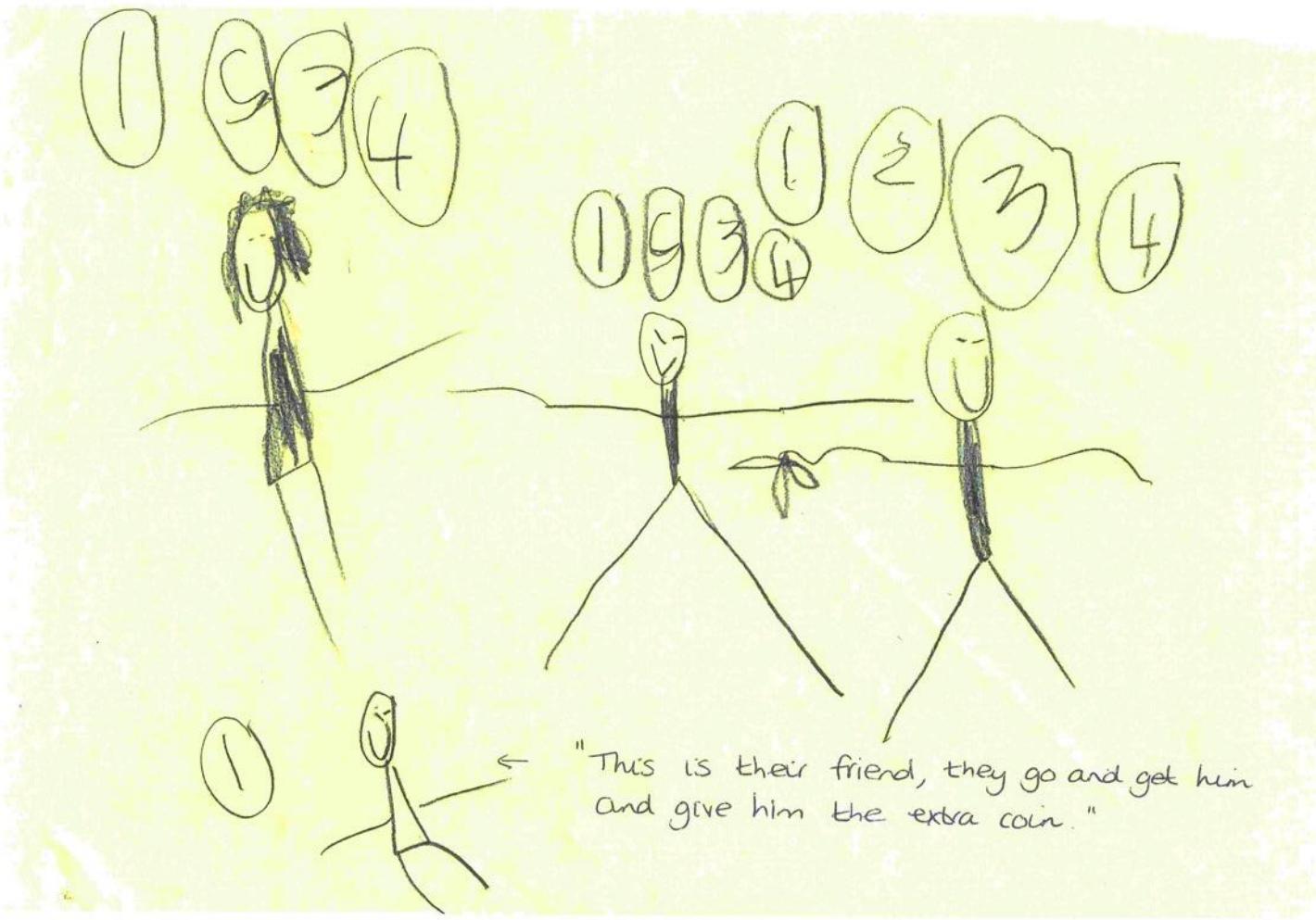
Holy Trinity Pewley Down (Sheena Preston)



## Sharing Equally

The children were asked to share 16 cookies equally between Barney and his friends. They had to record the answer to send to Barney.





0000

0000

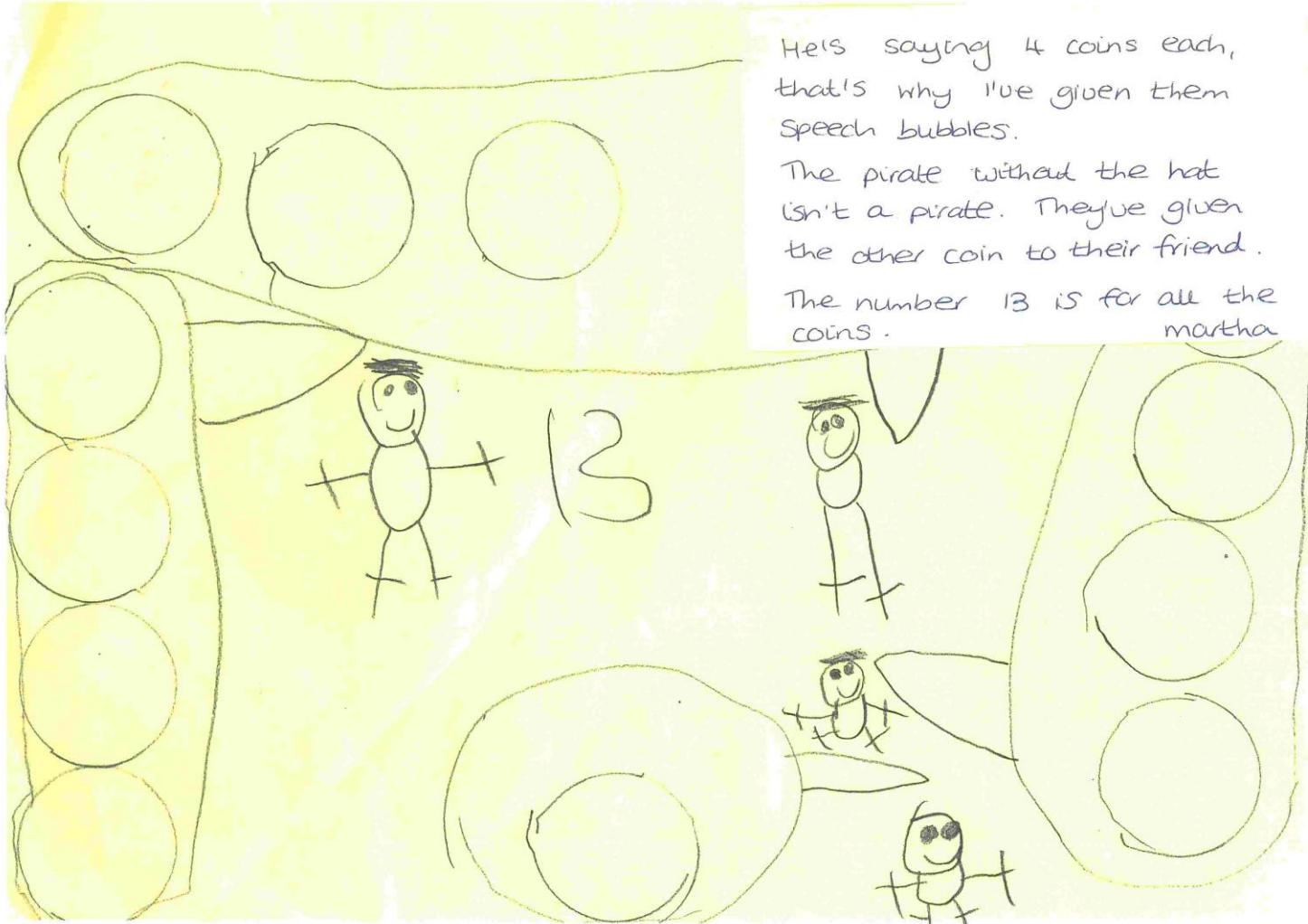
0000

13  
31



"give the last coin to a friend."

$$4+4+\cancel{4}+1=13$$



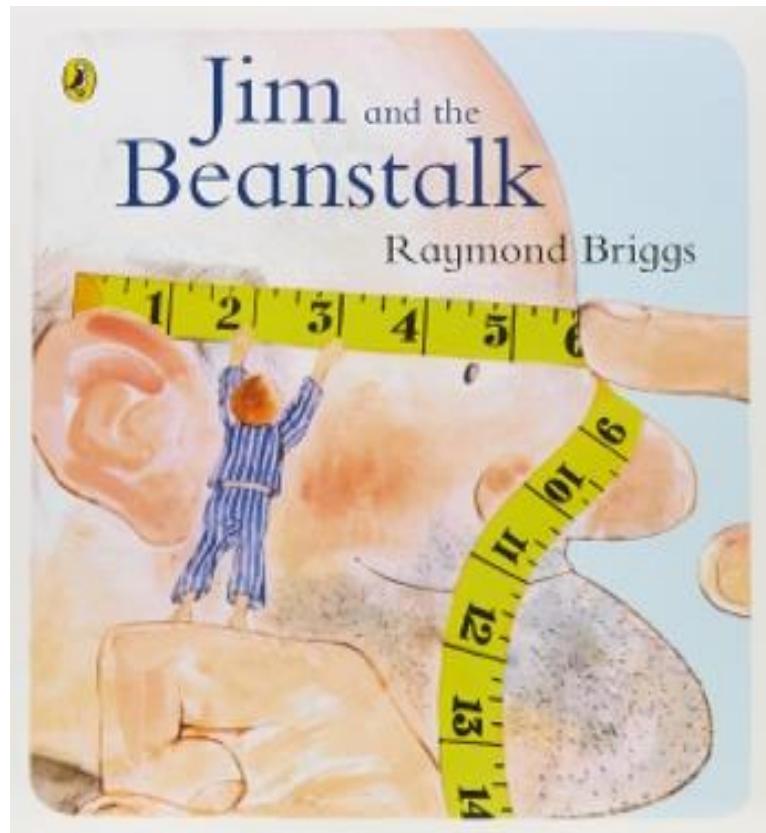
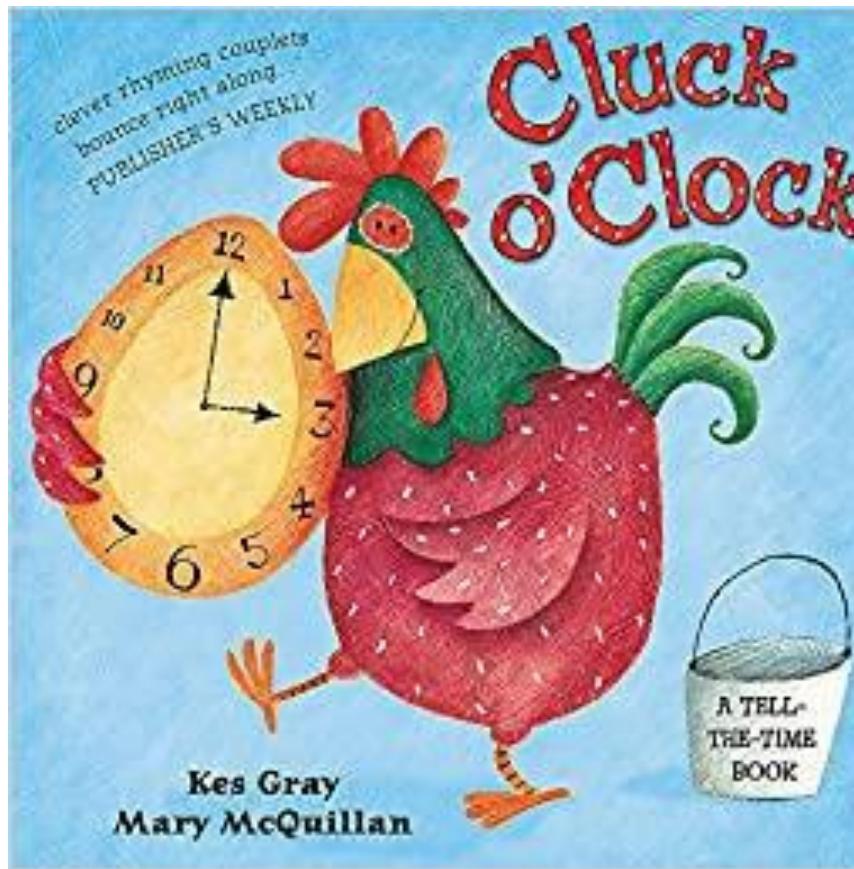
He's saying 4 coins each,  
that's why I've given them  
speech bubbles.

The pirate without the hat  
isn't a pirate. They've given  
the other coin to their friend.

The number 13 is for all the  
coins.

martha

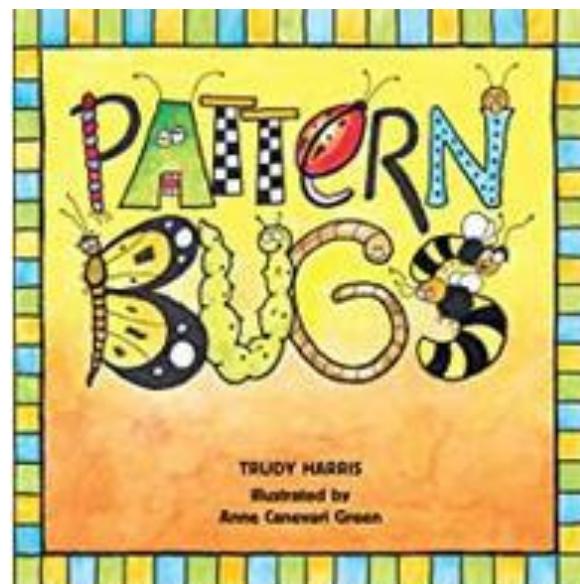
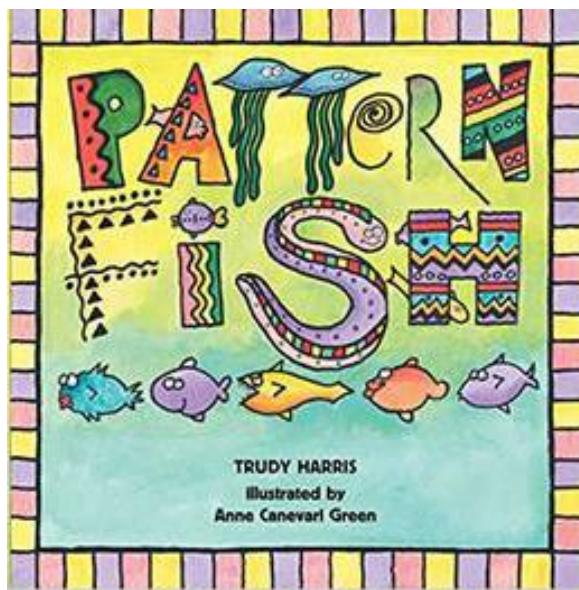
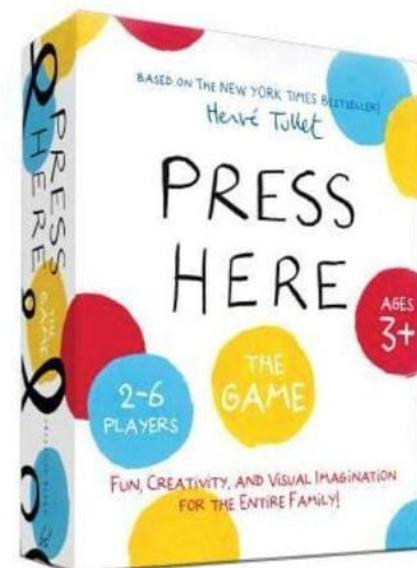
# Time and Measures



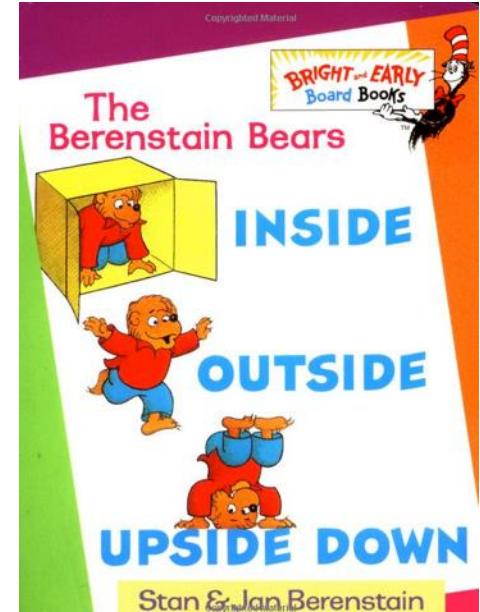
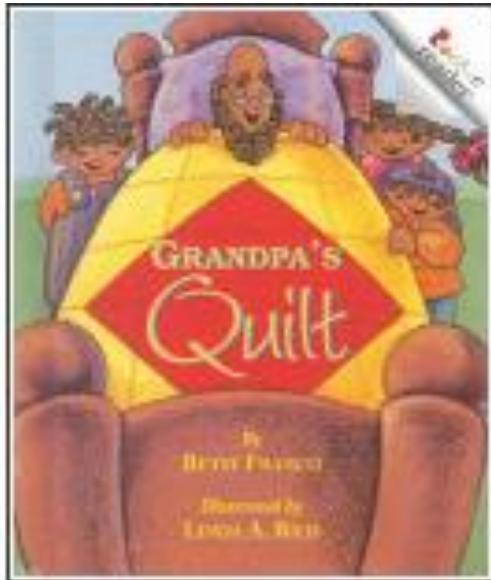
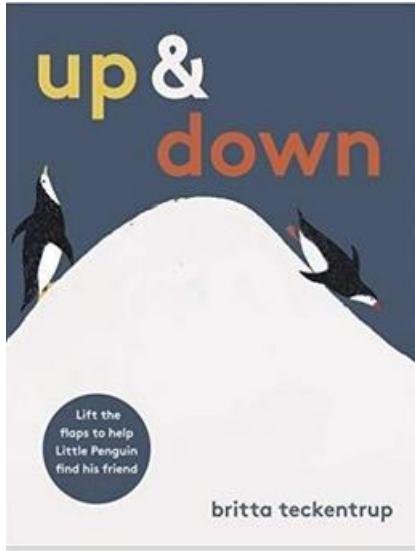
Kes Gray *Cluck o' clock* <https://www.youtube.com/watch?v=lUhK42DYUjo>



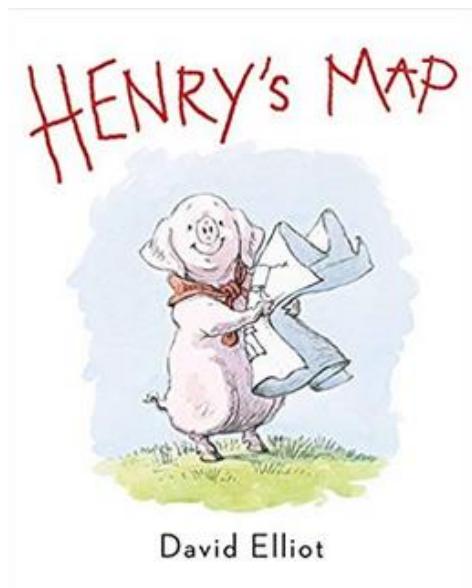
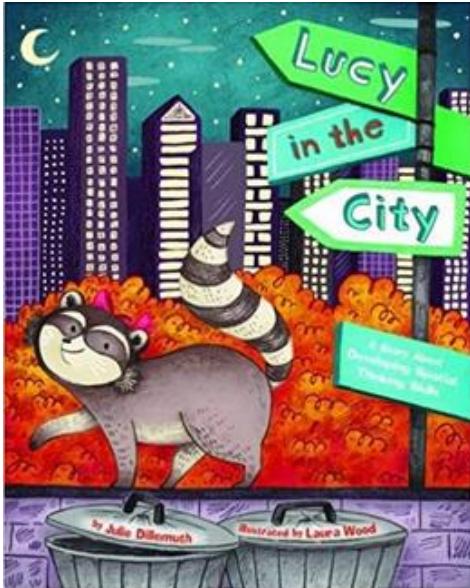
# Pattern

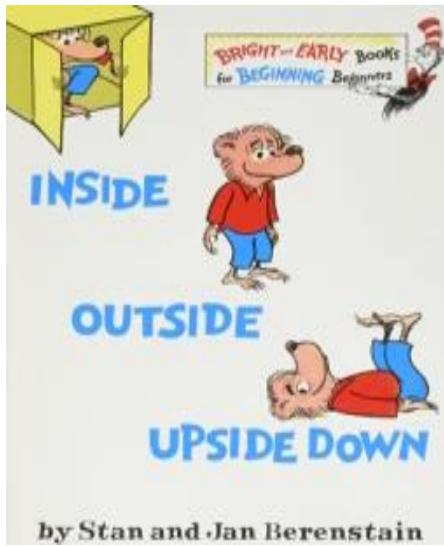


Trudy Harris



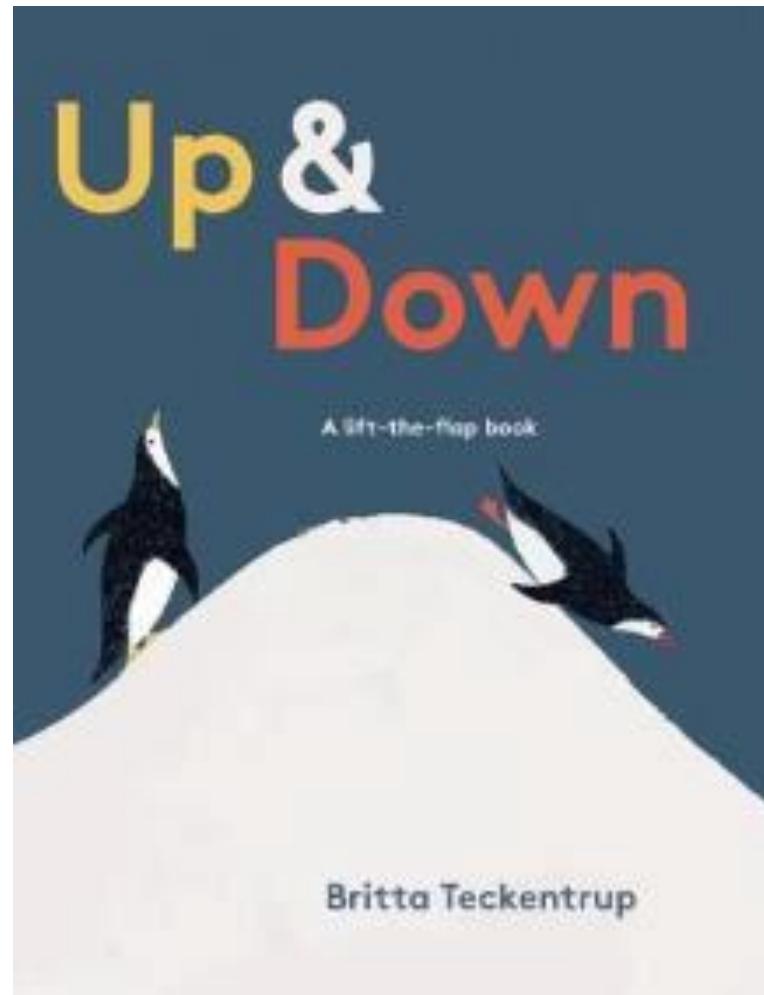
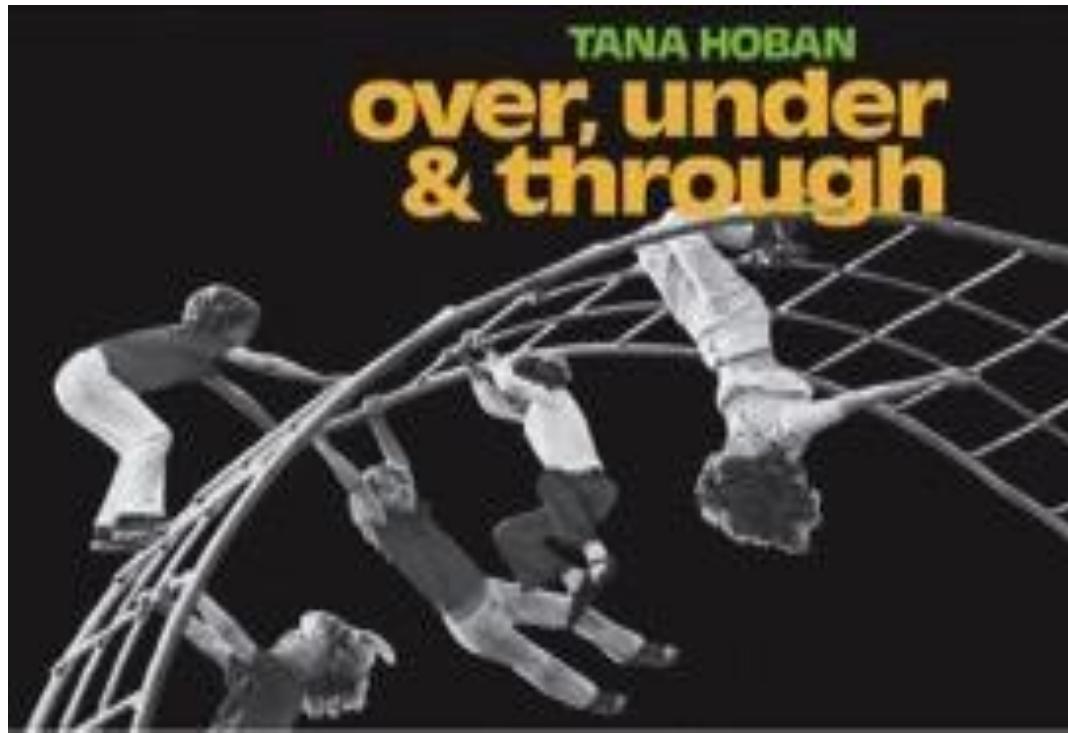
# Picture books for spatial reasoning



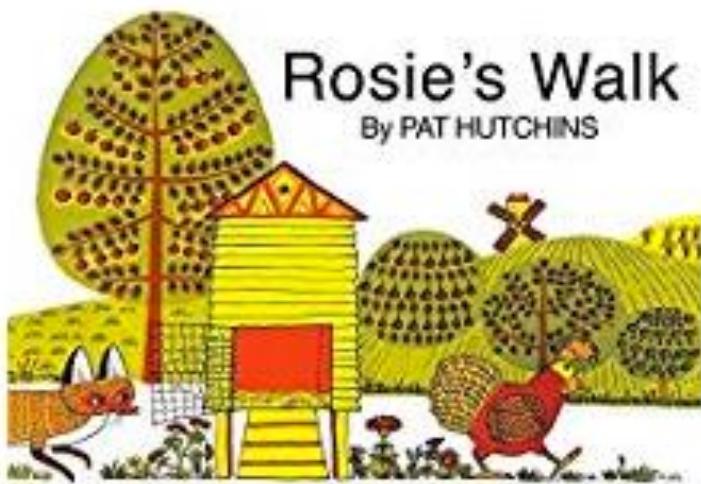


# Directions

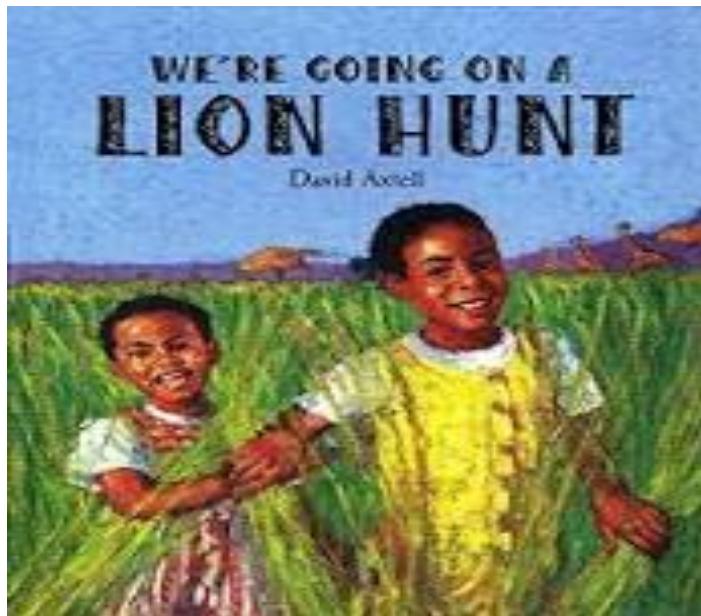
by Stan and Jan Berenstain



# Journeys

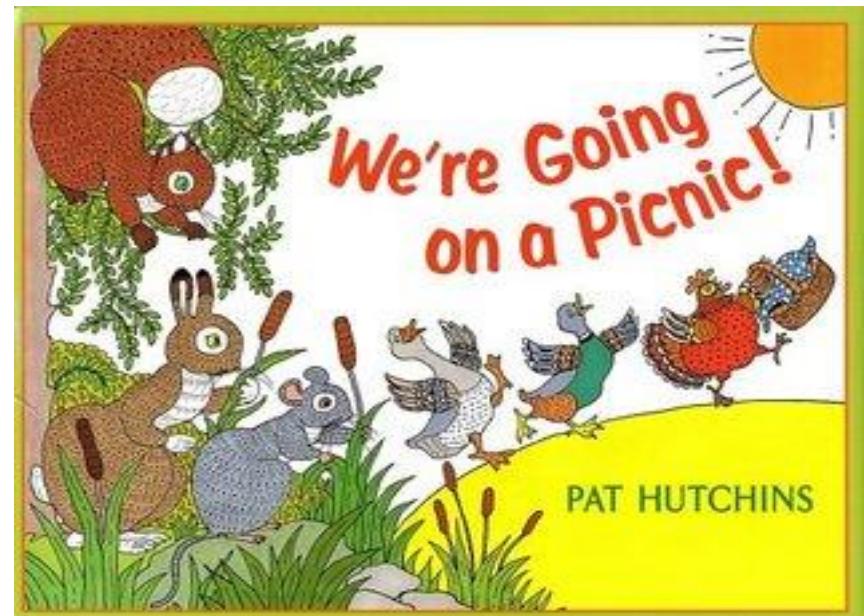


Rosie's Walk  
By PAT HUTCHINS



WE'RE GOING ON A  
**LION HUNT**

David Axelson

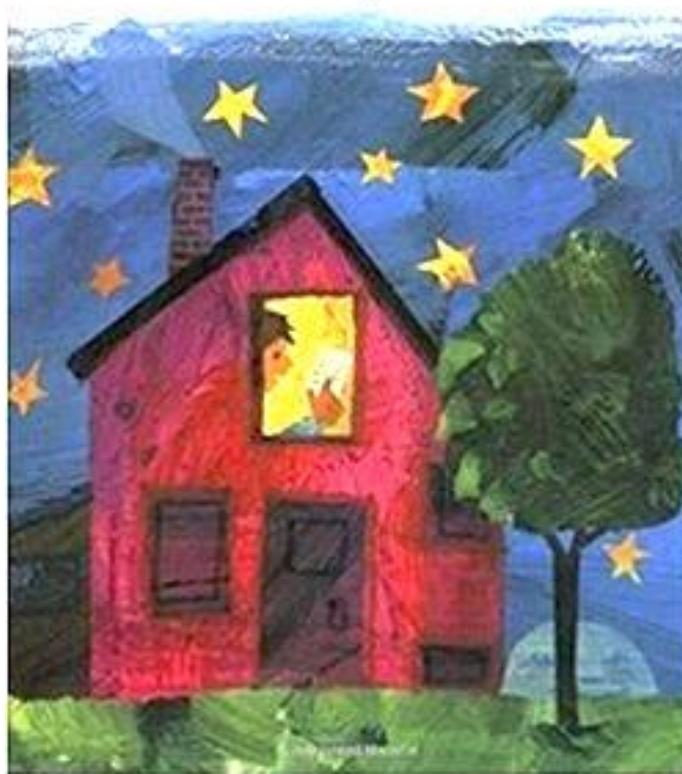


We're Going  
on a Picnic!

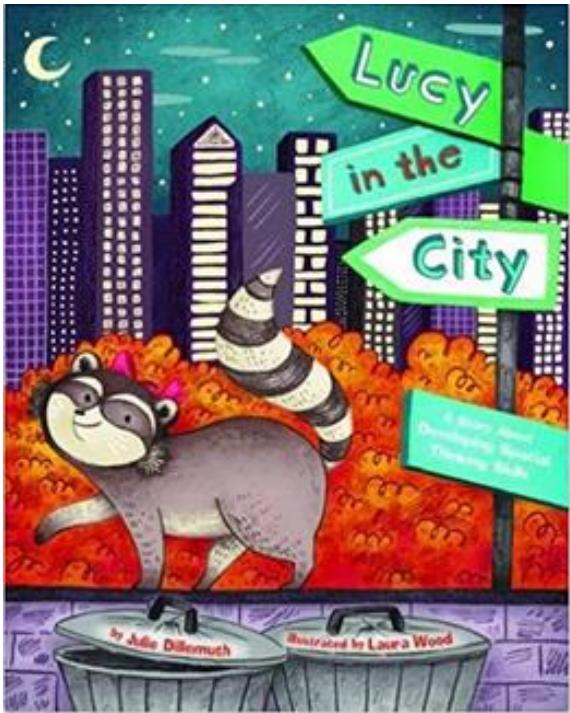
PAT HUTCHINS

# Directions for treasure hunts

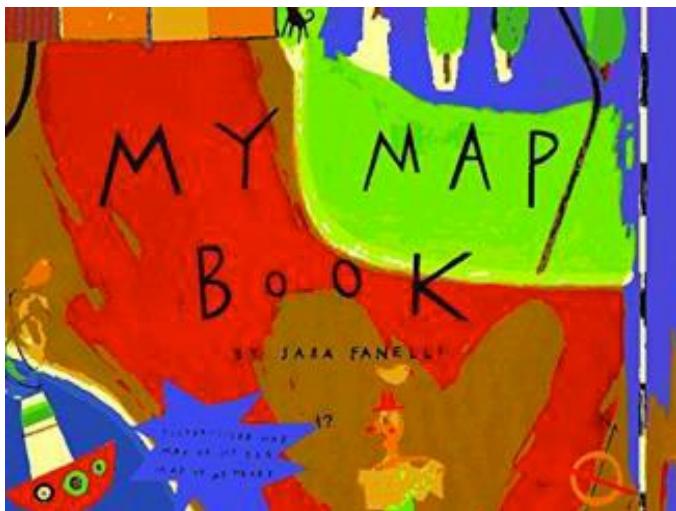
The Secret Birthday Message  
By Eric Carle



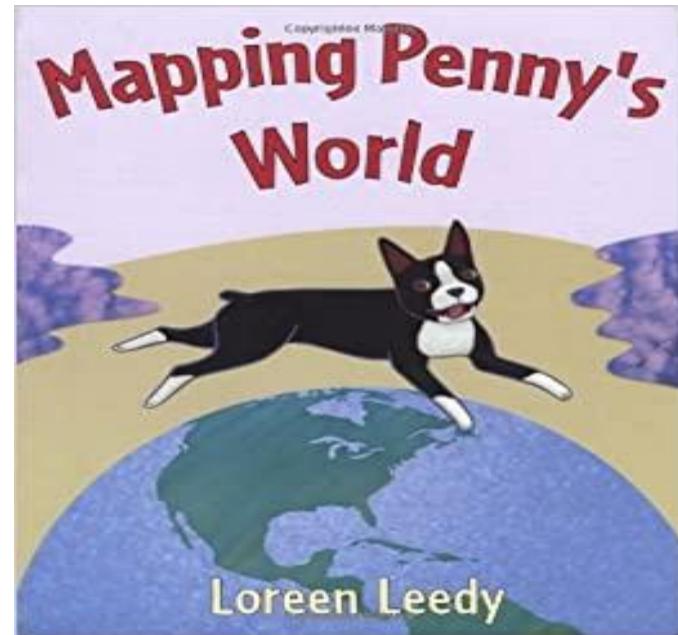
# Maps



Judy Dillemuth



Sara Fanelli

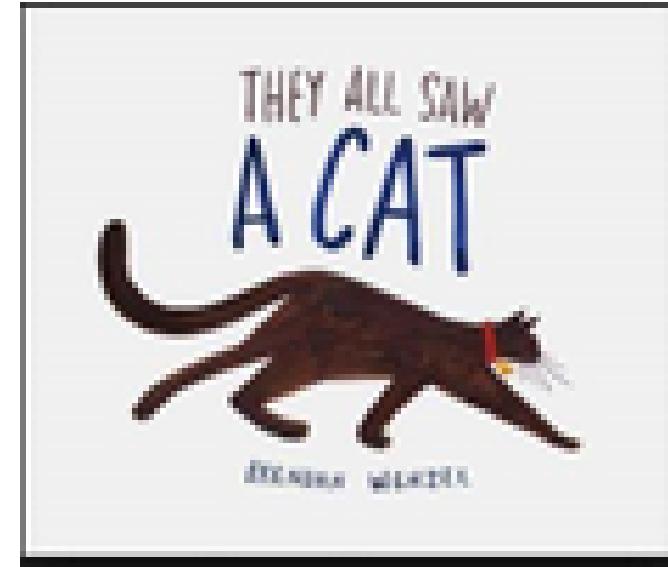
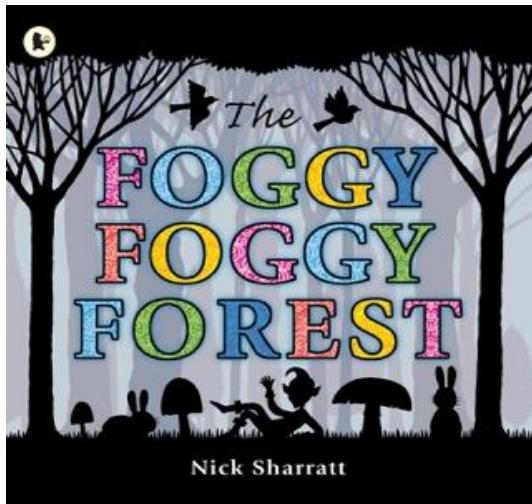
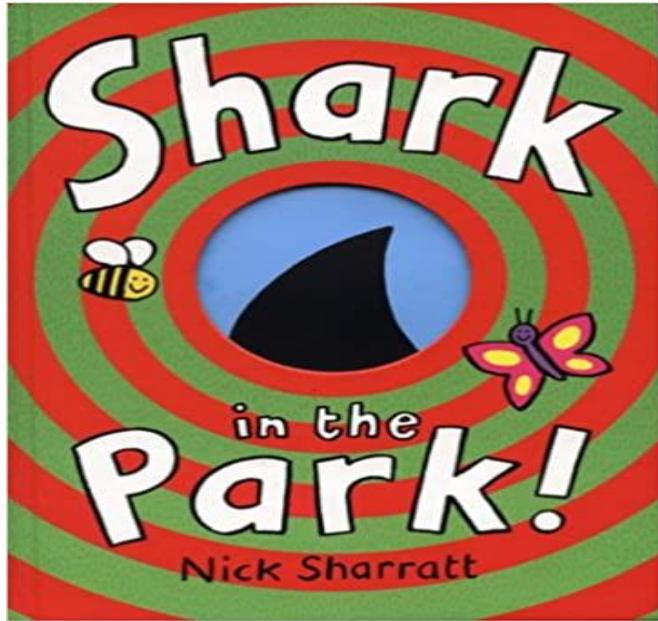


HENRY'S MAP

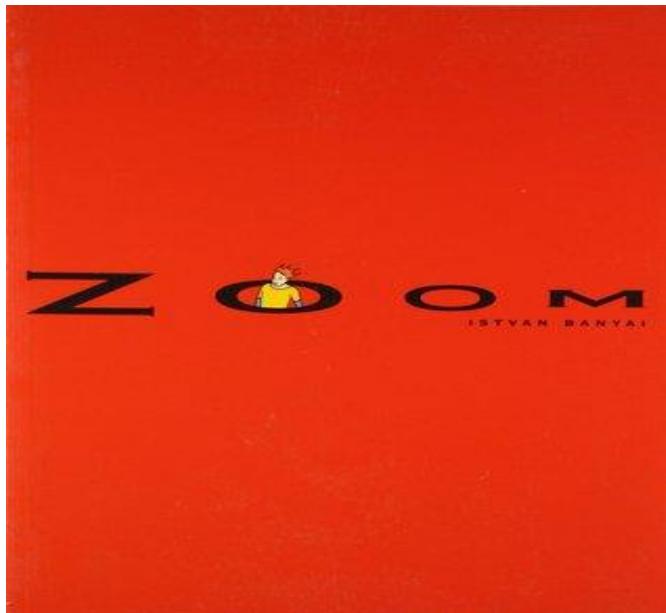
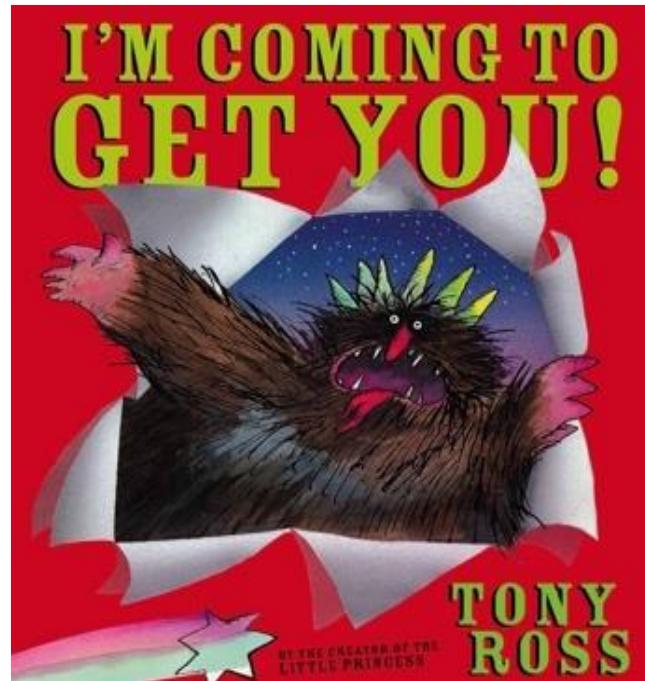
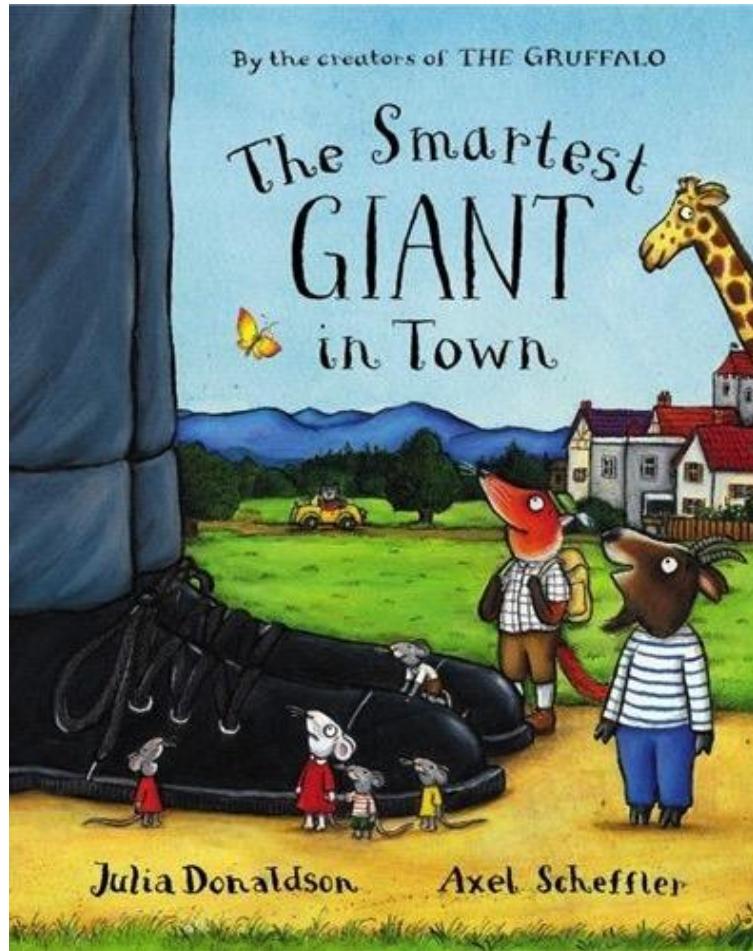


David Elliot

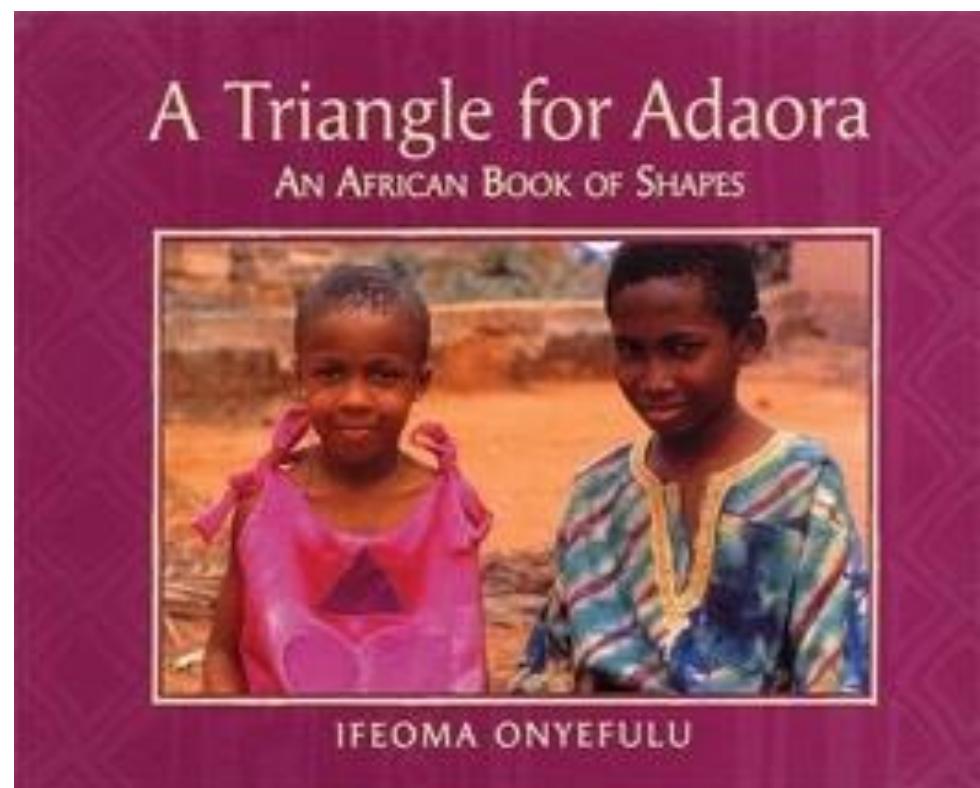
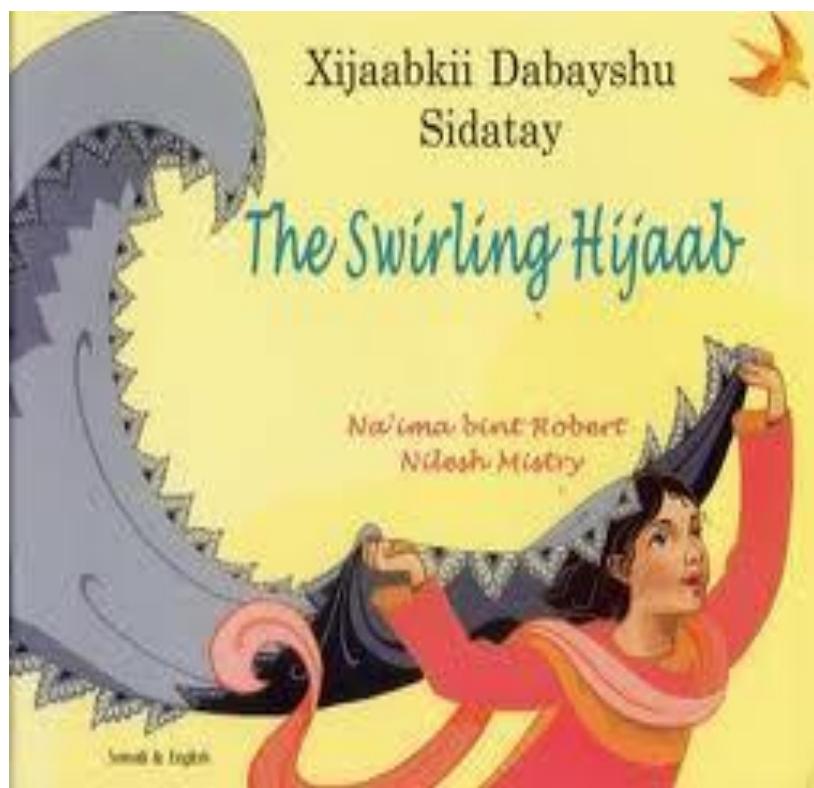
# Perspective taking



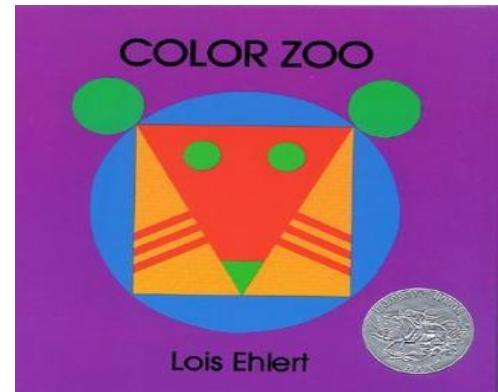
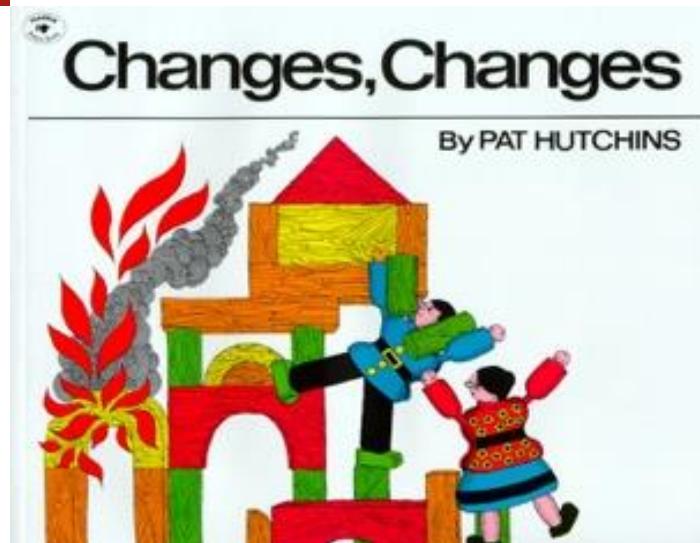
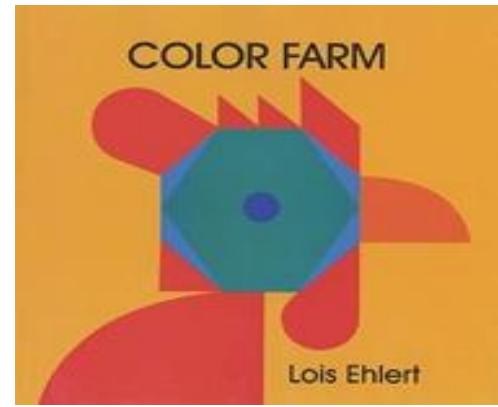
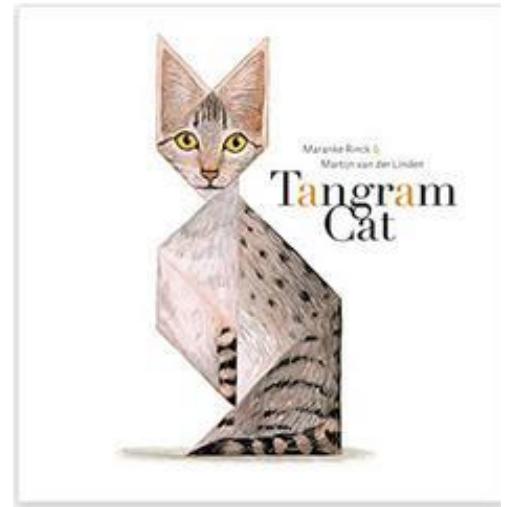
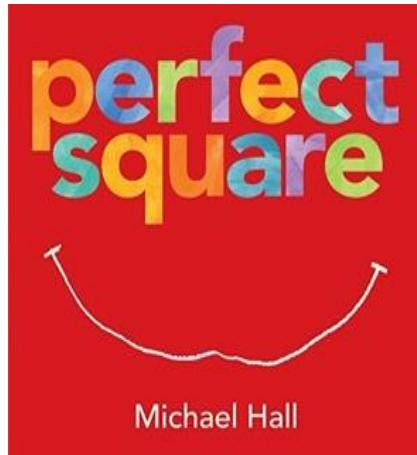
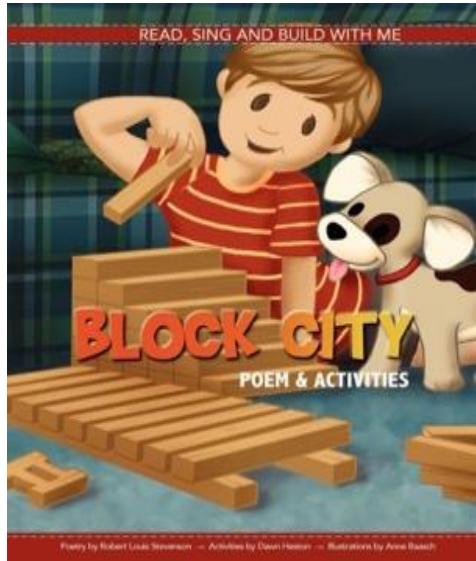
# Scale



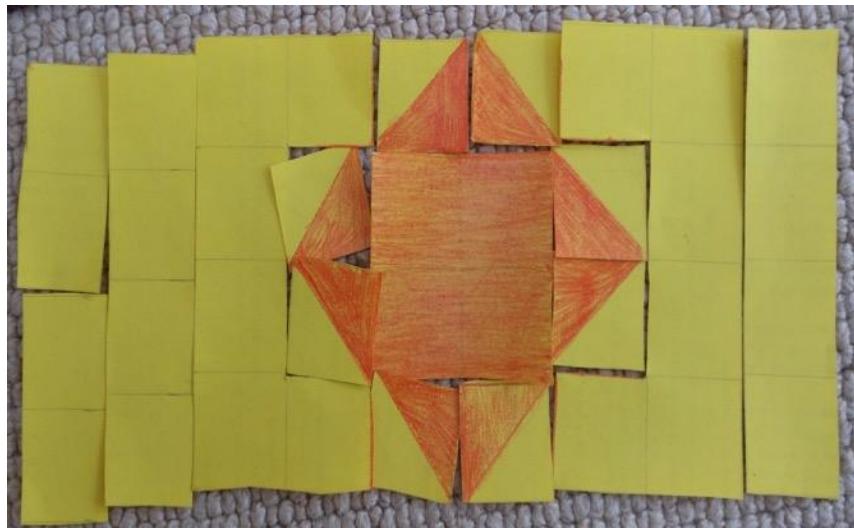
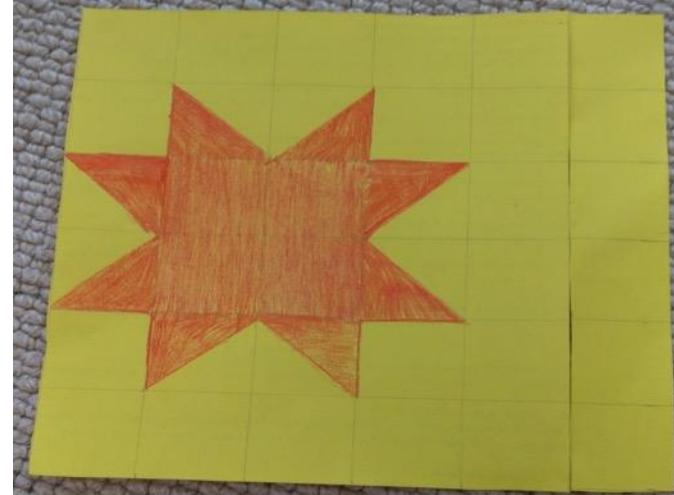
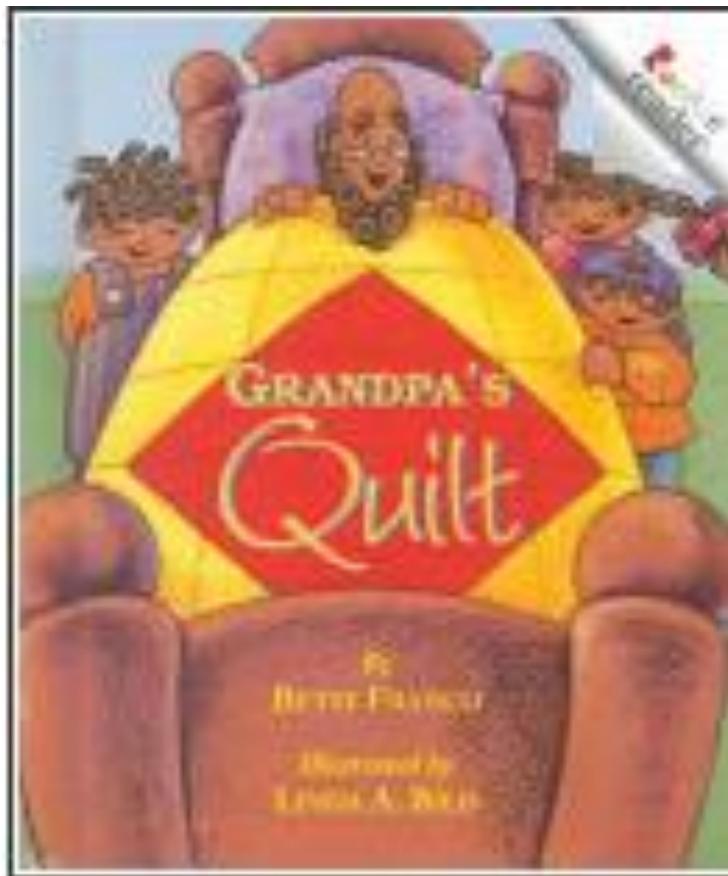
# Shape

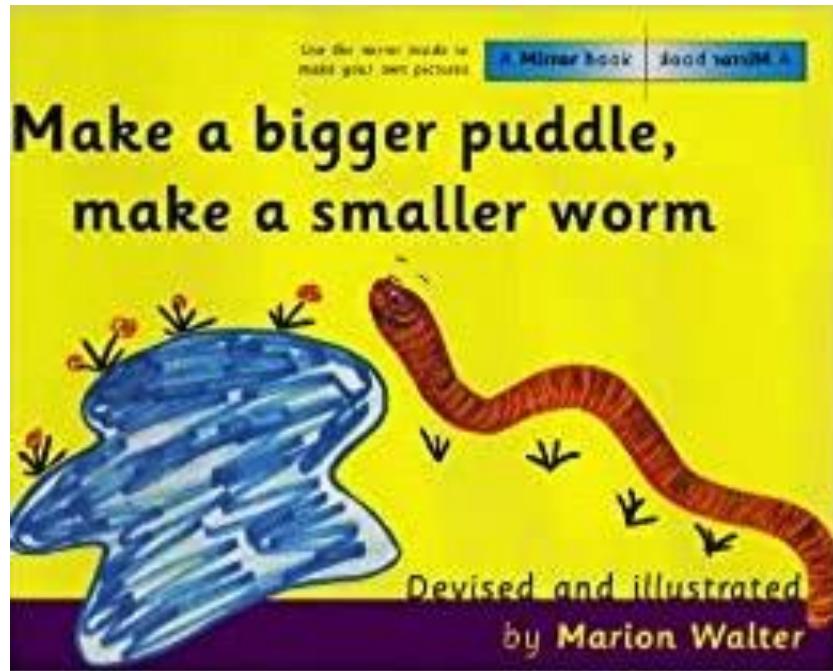


# Shape composition

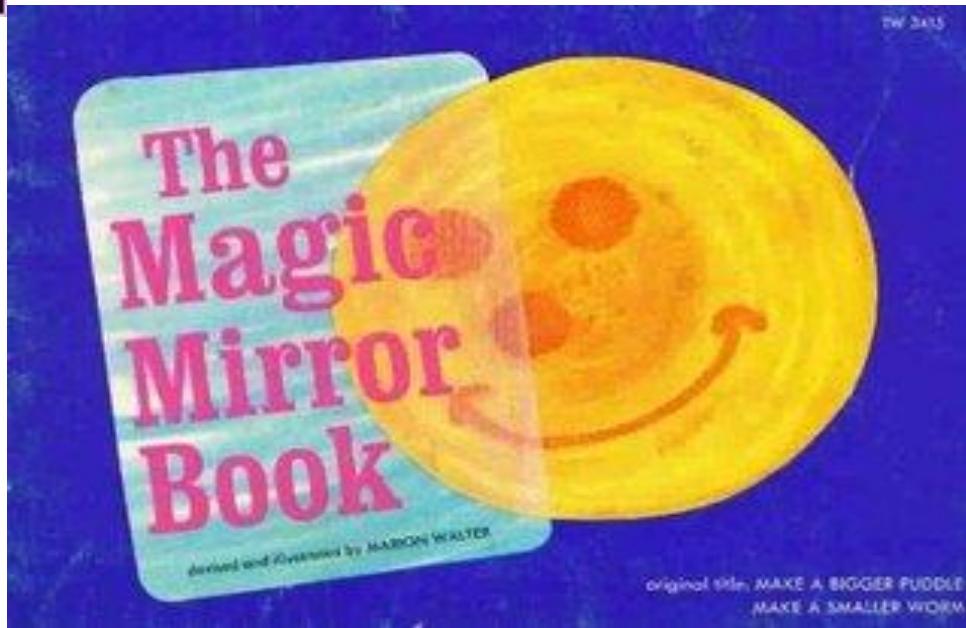


# Transformations



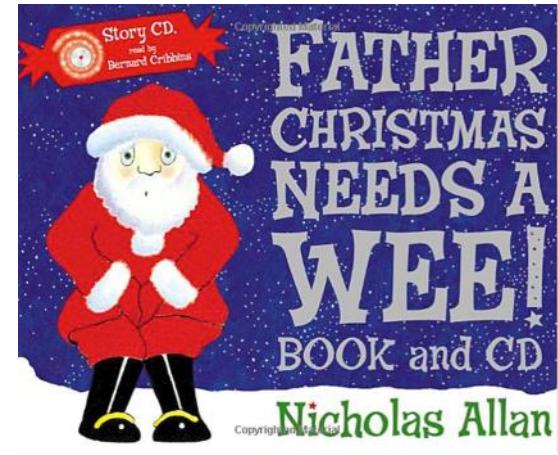
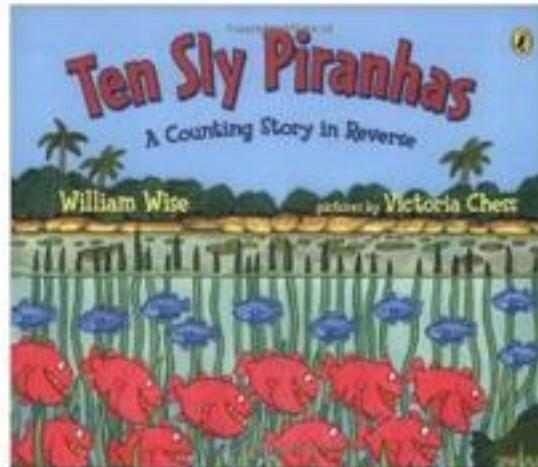
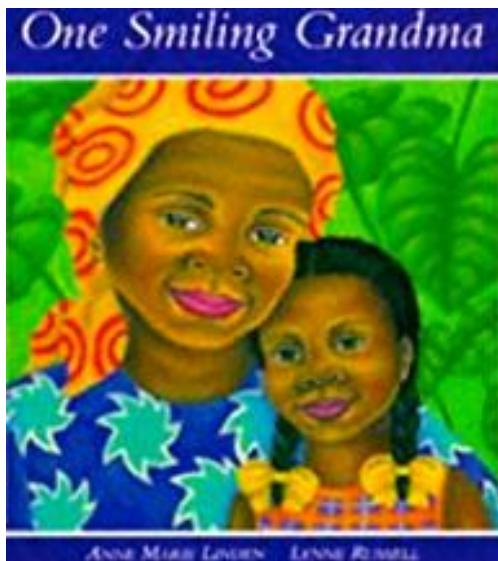


Books with  
mirrors

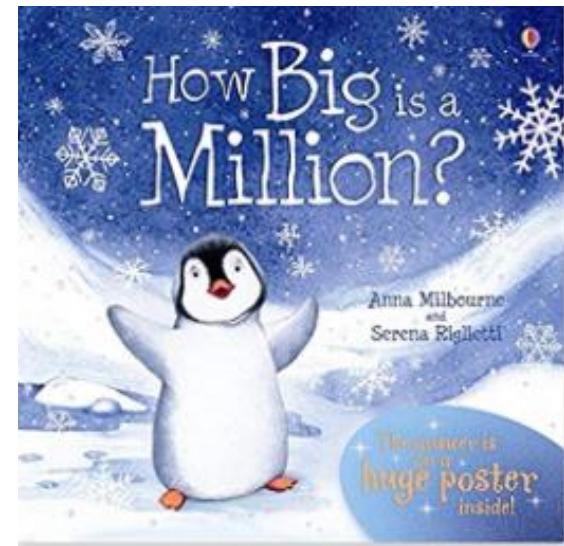
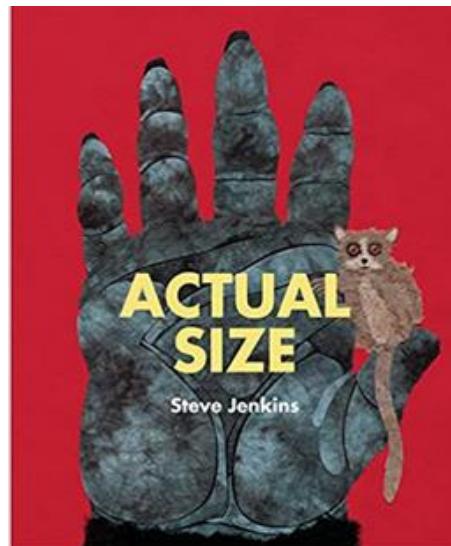


# Transformations

# To promote positive attitudes to maths



For teachers and parents too?



# Maths book websites

## DREME: story book guides

<https://dreme.stanford.edu/storybook-guides>

## Erikson early mathematics

<https://earlymath.erikson.edu/ideas/>

## Maths through stories

[www.mathsthroughstories.org](http://www.mathsthroughstories.org)

## NZ maths

<http://nzmaths.co.nz/picture-books-mathematical-content>

## Early Childhood Maths Group:

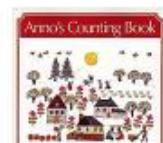
*Building firm foundations* <https://earlymaths.org/building-firm-foundations/>



Pattern Bugs  
Trudy Harris  
Repeating patterns with words and colours analysed as ABBC, etc.



The Balancing Act  
Ellen Stoll Welsh  
Introducing equivalence and potential for the equals sign



Anno's Counting Book  
Mitsumasa Anno  
Images of quantities. Look for number bonds and make up your own pictures



Everybody counts  
Kristin Roskitt  
A counting story from smaller to much larger numbers; Images of quantities



Little Croc's Purse  
Lizzie Flinlay  
Decisions about how to spend a found purse of coins



Man on the moon: a day in the life of Bob  
Simon Bartram  
Ordering events

EARLY CHILDHOOD MATHS GROUP

Five and six year olds



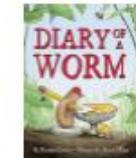
The Shopping Basket  
John Burningham  
Triangular pattern, changing amounts



How Big is a Million?  
Anna Milbourne & Serena Rigitelli  
Discussing big numbers with a fold-out poster of 1 000 000 stars



Dinosaurs' Day Out  
Nick Sharratt  
Following directions



Diary of a Hungry Worm  
Doreen Cronin  
Calendar dates through the year ordering events



One Hundred Hungry Ants  
Elinor J Pinczes  
100 shown in different arrangements



Tangram Cat  
Maranke Rinck  
Traditional 7-piece puzzle (provided) arranged to form many different beasts