

Mathematics Preschool Learning Foundations



*A Focus on the
Geometry Strand*



Agenda

- The relationship between the NCTM Standards, the Preschool Learning Foundations and the DRDP-R
- The Research
- Exceptional Children--Division of Early Childhood Recommended Practices
- English Learner Strategies
- Taking It Back to the Classroom



Outcomes

- Become familiar with the mathematics foundations with an emphasis on the Geometry strand.
- Explain how the DRDP-R and the NCTM Standards relate to the mathematics foundations.
- Discover the research behind the practice.
- Explore strategies to make geometry come to life in the classroom.
- Plan for taking it back to your classroom.



Norms

- Start on time and end on time.
- Turn cell phones off.
- Help the group stay on task.
- Listen to thoughts and ideas of others.
- Contribute your thoughts and ideas.



Parking Lot

Please write questions on post-its and place them on chart paper titled “Parking Lot.”

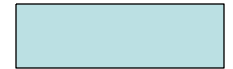
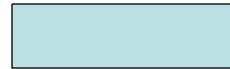
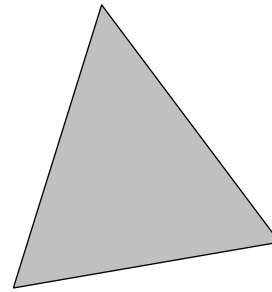
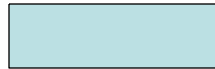
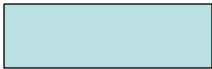
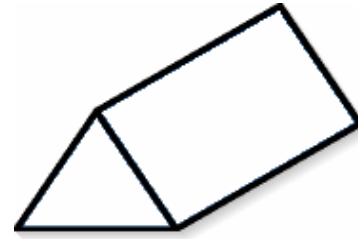
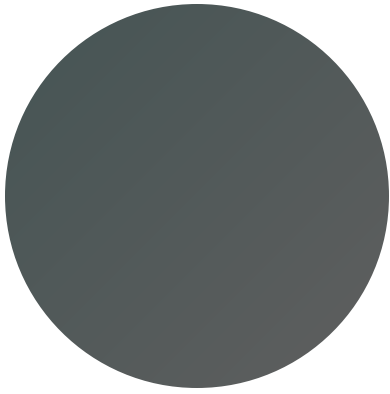


Name That Shape

Squares and circles, rectangles and triangles...but do you know the name of 3-D shapes?

How many of the 3-D shapes on the next slide can your table identify?





NCTM Topics

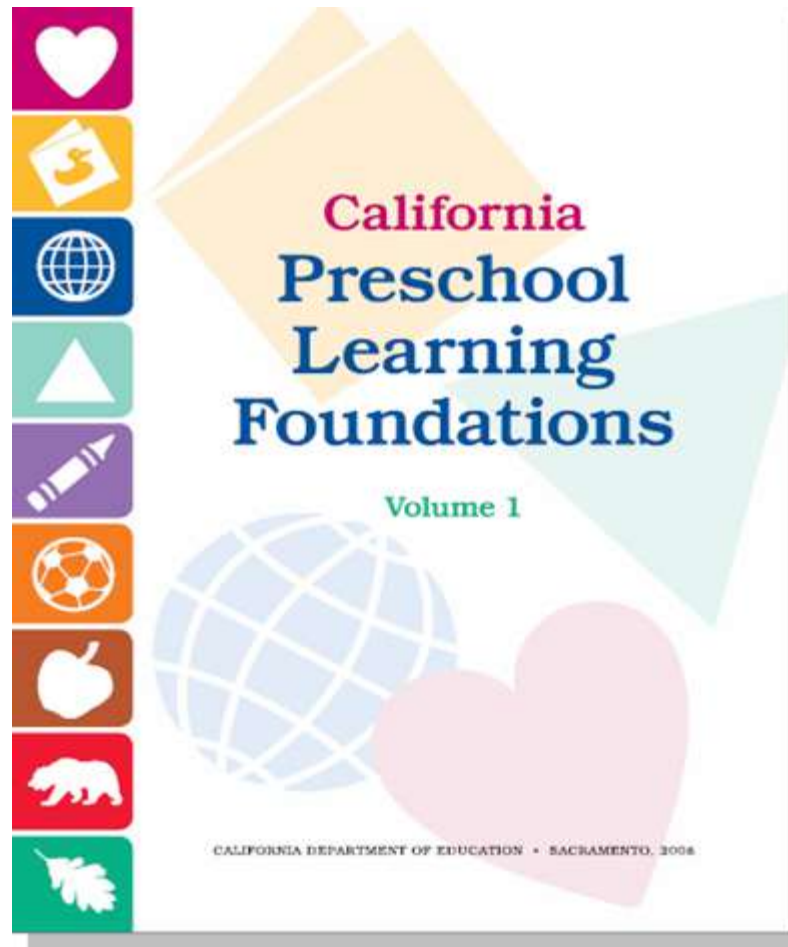
Mathematics Foundations

- Number and Operations
 - Geometry
 - Measurement
 - Algebra
 - Data Analysis & Probability
-
- Number Sense
 - Algebra and Functions (Classification & Patterning)
 - Measurement
 - Geometry
 - Mathematical Reasoning



Peeking Inside the Mathematics Foundations





Purpose

The purpose of the foundations is to promote understanding of preschool children's learning and to guide instructional practice.



The Foundations...

are for all children, including children learning English and children with disabilities. They describe the knowledge and skills that young children typically exhibit:

- at around 48 and 60 months of age;
- as they complete their first or second year of preschool;
- with appropriate support; and
- when attending a high-quality preschool program.



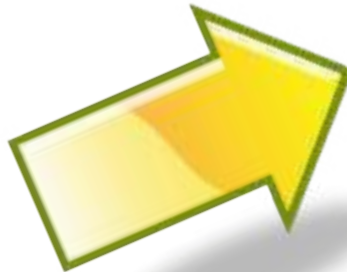
High-Quality Programs Include

- environments and experiences that encourage active, playful exploration and experimentation
- purposeful teaching to help children gain knowledge and skills
- specific support for children learning English
- specific accommodations and adaptations for children with special needs



A Guided Tour

How is the mathematics domain organized?



The Sections

- Introduction
- The Foundations
- Bibliographic Notes
- Glossary
- References and Source Material



Map of the Foundations

Mathematics

Strand	Domain		Substrand
Age	Geometry*		Foundation
Examples	At around 48 months of age	At around 60 months of age	
	1.0 Children begin to identify and use common shapes in their everyday environment.	1.0 Children identify and use a variety of shapes in their everyday environment.	
	1.1 Identify simple two-dimensional shapes, such as a circle and square.	1.1 Identify, describe, and construct a variety of different shapes, including variations of a circle, triangle, rectangle, square, and other shapes.	
	Examples <ul style="list-style-type: none"> • When playing a matching game, communicates, "This is a circle." • While playing shape bingo, indicates or points to the correct shape. • Indicates a shape block and communicates, "This is a square." • Sorts shape manipulatives of varying sizes into different shape groups (e.g., points to the group of triangles and communicates, "Here are the triangles: big, small, and very small triangles"). 	Examples <ul style="list-style-type: none"> • While playing the "I Spy the Shape" game, communicates, "I see a circle—the clock." Later, says, "I see a rectangle—the table." • Correctly identifies shapes as the teacher calls them out in a game of shape bingo. • Uses play dough to construct rectangles of different sizes and orientations. • Sorts manipulatives of different sizes and orientations by shape and explains why a particular shape does or does not belong in a group. • Tears paper shape and communicates, "Look! A triangle!" while making a collage. 	
	1.2 Use individual shapes to represent different elements of a picture or design.	1.2 Combine different shapes to create a picture or design.	
	Examples <ul style="list-style-type: none"> • Uses a circle for a sun and a square for a house in a picture. • Puts together a foam shape puzzle in which each shape is outlined. • Creates a design by putting shape tiles together. 	Examples <ul style="list-style-type: none"> • Uses a variety of shapes to construct different parts of a building. • Uses flannel pieces of different shapes to create a design. • Creates a house, from different shapes, using a computer program. 	
	<small>* Throughout these mathematics foundations many examples describe the child manipulating objects. Children with motor impairments may need assistance from an adult or peer to manipulate objects in order to do things such as count, sort, compare, order, measure, create patterns, or solve problems. A child might also use adaptive materials (e.g., large manipulatives that are easy to grasp). Alternatively, a child might demonstrate knowledge in these areas without directly manipulating objects. For example, a child might direct a peer or teacher to place several objects in order from smallest to largest. Children with visual impairments might be offered materials for counting, sorting, or problem solving that are easily distinguishable by touch. Their engagement is also facilitated by using containers, trays, and so forth that contain their materials and clearly define their work space.</small>		

Foundations Organization

Domain

Age

Strand

Substrand

Foundation

Examples



Strand - Substrand Order

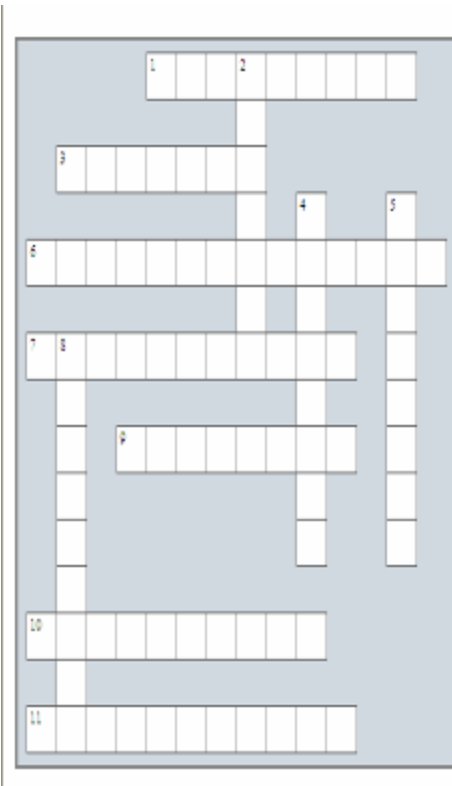
- There is a developmental progression from three- to four-years-old within a substrand.
- The order in which the strands and substrands are presented is not meant to indicate a developmental progression.



Bibliographic Notes



Ready for a Challenge?



- Can you complete this crossword puzzle?
- Answers can be found in the *Bibliographic Notes* from pages 161-166.



Answer Key

A crossword puzzle grid with 11 numbered words filled in. The words are:

- 1. REASONING
- 2. P
- 3. ALGEBRA
- 4. P
- 5. C
- 6. CLASSIFICATION
- 7. C
- 8. ARDINALITY
- 9. GEOMETRY
- 10. SUBITIZING
- 11. MEASUREMENT

The grid is a 15x15 square. The words are placed as follows:

- 1. REASONING: Row 1, Column 4 to 11.
- 2. P: Row 2, Column 5.
- 3. ALGEBRA: Row 3, Column 1 to 6.
- 4. P: Row 4, Column 8.
- 5. C: Row 4, Column 13.
- 6. CLASSIFICATION: Row 5, Column 1 to 14.
- 7. C: Row 6, Column 1.
- 8. ARDINALITY: Row 6, Column 2 to 9.
- 9. GEOMETRY: Row 7, Column 4 to 10.
- 10. SUBITIZING: Row 8, Column 1 to 8.
- 11. MEASUREMENT: Row 9, Column 1 to 10.

Vertical words (7, 8, 10, 11) start at column 1. Vertical words (2, 4, 5) start at column 5. Vertical words (3, 6) start at column 1. Vertical words (9) start at column 4. Vertical words (1) start at column 4. Vertical words (8) start at column 2. Vertical words (10) start at column 1. Vertical words (11) start at column 1.



Foundations and the DRDP-R

How the Foundations and the DRDP-R
Work Together



Foundations and the DRDP-R

Foundations

At about 48 and 60 months

A guide and teaching tool

DRDP-R

Developmental continuum

An assessment tool



Foundations and the DRDP-R

Foundations

At around 48 months

1.0: Children begin to identify and use common shapes in their environment.

At around 60 months

1.0: Children identify and use a variety of shapes in their everyday environment.

DRDP-R

Preschool

Exceeds Grade 3: Children are effective learners
Indicator: MATH – Preschoolers demonstrate competence in real-world mathematics.

Measure 24: Shapes
Definition: Children demonstrate increasing knowledge of shapes and their characteristics.
1.0: Children demonstrate the highest developmental level the child has mastered.

Exploring	Developing	Building	Integrating
Recognizes differences among shapes without naming them.	Correctly names at least two shapes (circles, squares, triangles).	Recognizes shapes when they are presented in new orientation or as parts of other objects.	Describes characteristics and differences of several shapes.
<p>Examples:</p> <ul style="list-style-type: none"> • Finds circle-shaped pasta pieces from the mixed bowl. • Flips shapes in variety of four-board tangram puzzles. • Finds out circles from a unit that contains circles, squares, and triangles. 	<ul style="list-style-type: none"> • "The star has a circle." • "My sandwich is a square." • Points to a plate and indicates that it is the same shape as a circle. 	<ul style="list-style-type: none"> • Identifies that the wheels of a car are circles and the windows are squares. • Shows another child that he or she can put two straight sticks together to make a diamond shape. • Uses and flips shapes to construct orientation in complete tangram picture book or Tangram puzzles. 	<ul style="list-style-type: none"> • Looking at a circle and a square, says, "This one has a curvy part and all four, but mine is sharp, but it still is." • Says, "A triangle has three sides, a square has four sides." • Describes the difference between a circle and an oval, says, "That one looks like an egg."

2. Record evidence for this rating here. (Use back for more space.)

3. Mark here if child is emerging to the next level.

4. If you are unable to rate this measure, explain why.

Measure 24 Shapes **MATH 3 (of 7)**



Geometry

It's more than
shapes!



Geometry - It's More Than Shapes

- Shapes
- Locations, Directions, and Spatial Orientation
- Visualization and Spatial Reasoning
- Transformation and Symmetry

Source: NTCM Showcasing Mathematics for the Young Child pages 56-57



California Preschool Learning Foundations

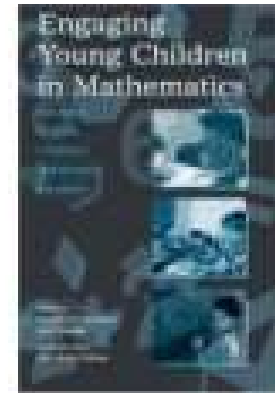
“Geometry is the study of space and shape (Clements, 1999). Geometry and spatial reasoning offer a way to describe, interpret, and imagine the world.”

Source: Preschool Learning Foundations, Bibliographic Notes, page 164



Geometry Research

Clements, D. H., Sarama, J., & DiBiase, A.-M. (Eds.). (2003). *Engaging Young Children in Mathematics: Standards for Pre-school and Kindergarten Mathematics Education*. Mahwah, N.J.: Lawrence Erlbaum Associates.



Young Children and Shape: Two Studies

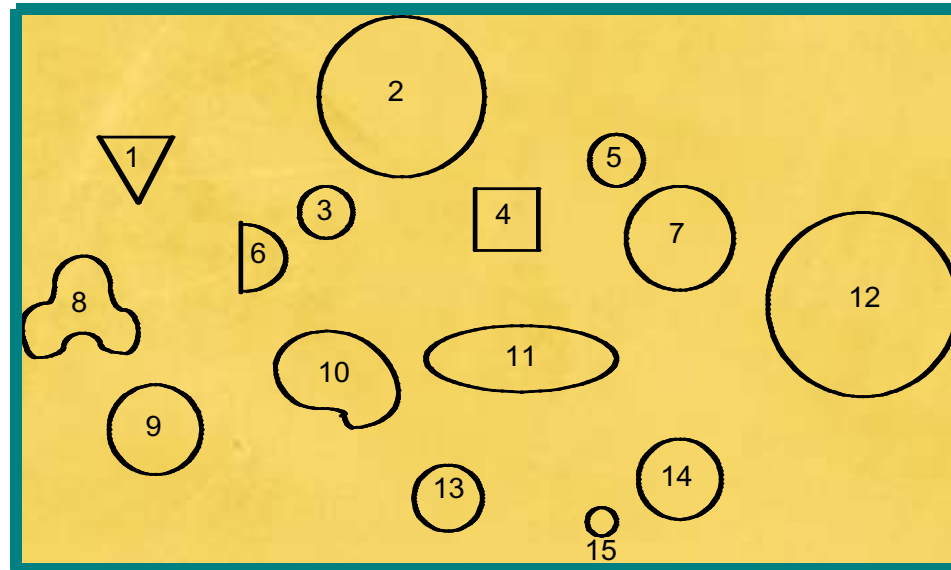
- Hundreds of children, 3 to 6 years old
- First study used same tasks as used in previous research with older students



Circles

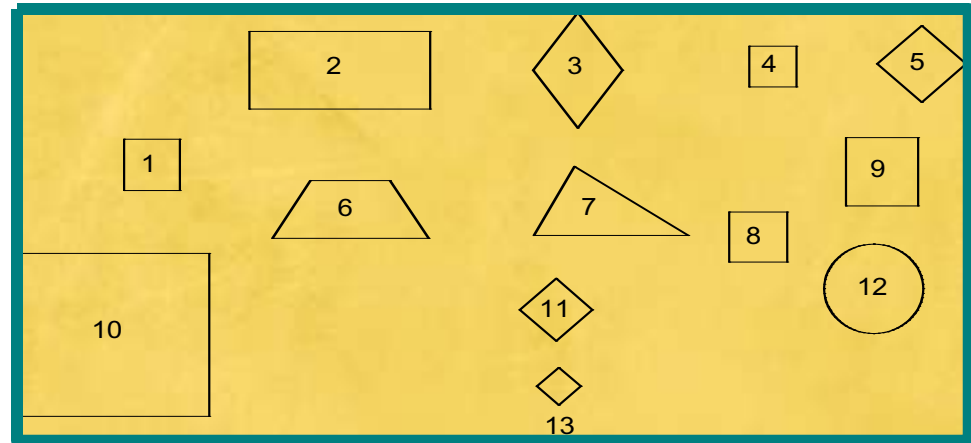
Correctness

- 92% - 4 year olds
- 96% - 5 year olds
- 99% - 6 year olds
- Few youngest chose ellipse and curved shape
- Described as “round”
- Thus, easily recognized but difficult to describe



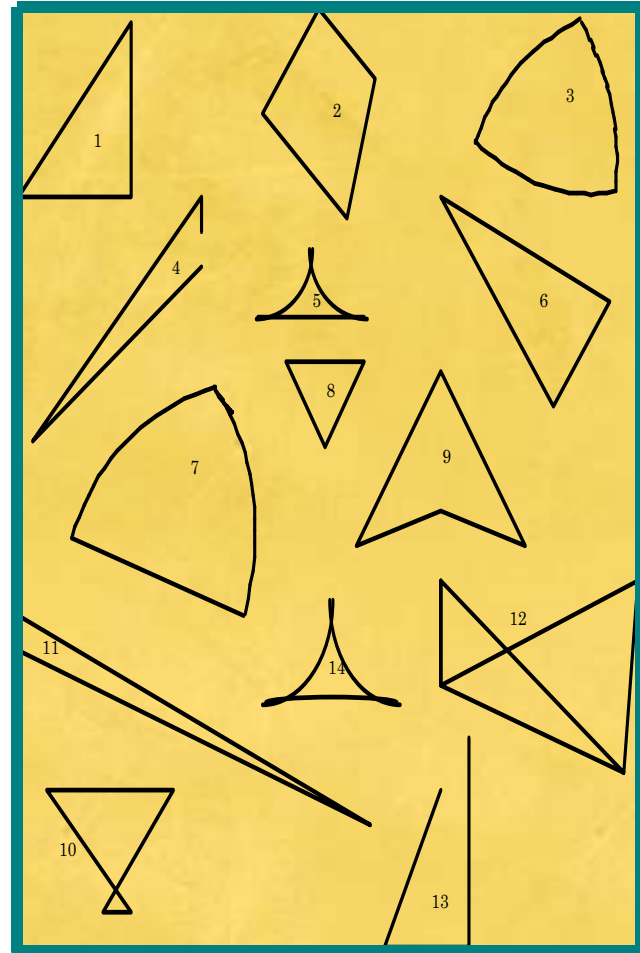
Squares

- Only slightly less accurate in identifying squares:
82%, 86%, and 91%
- Youngest lower on nonsquare rhombi but not on “tilted squares”
- Minority reasoned about properties, but was relationship between such responses and correct selections



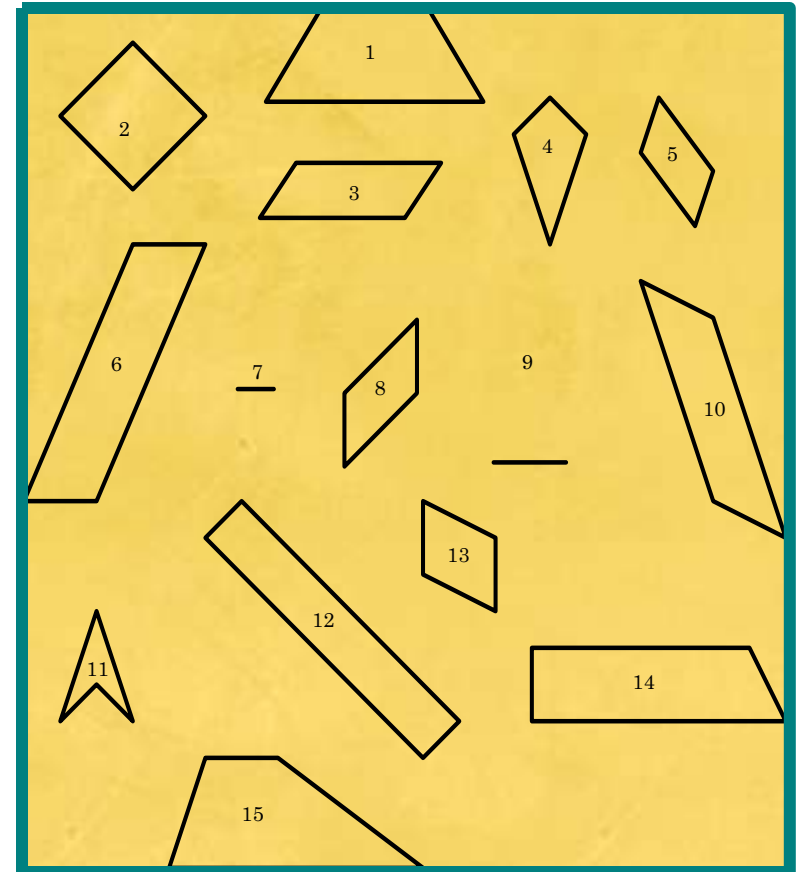
Triangles Task

- Lower, but not low: about 60%
- Property responses present, but only 18%
- Inverse-U pattern: 5's more likely than 4's or 6's accept both non-standard triangles and those with curved sides

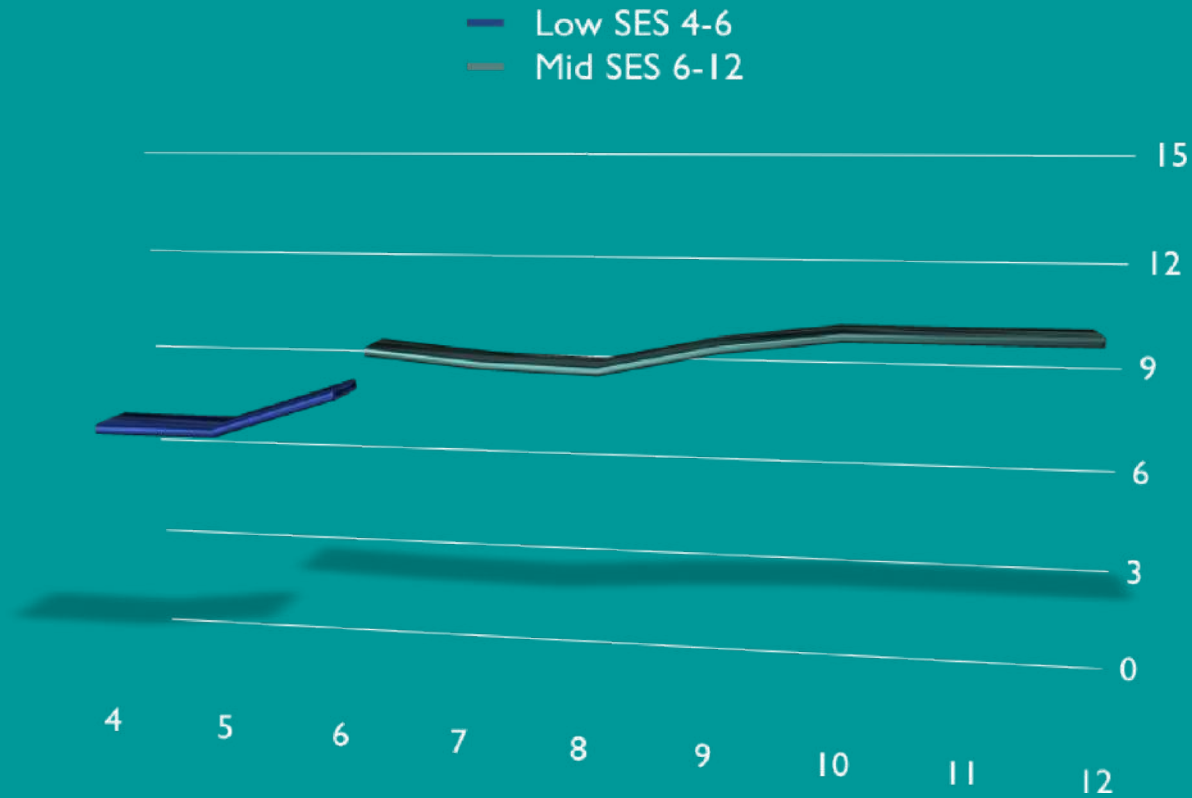


Rectangles

- Slightly more than 50%
- 4's were more likely to accept the squares
- All accepted “long” quads w/ pair of parallel sides #3, 6, 10, and 14
- Properties less frequently

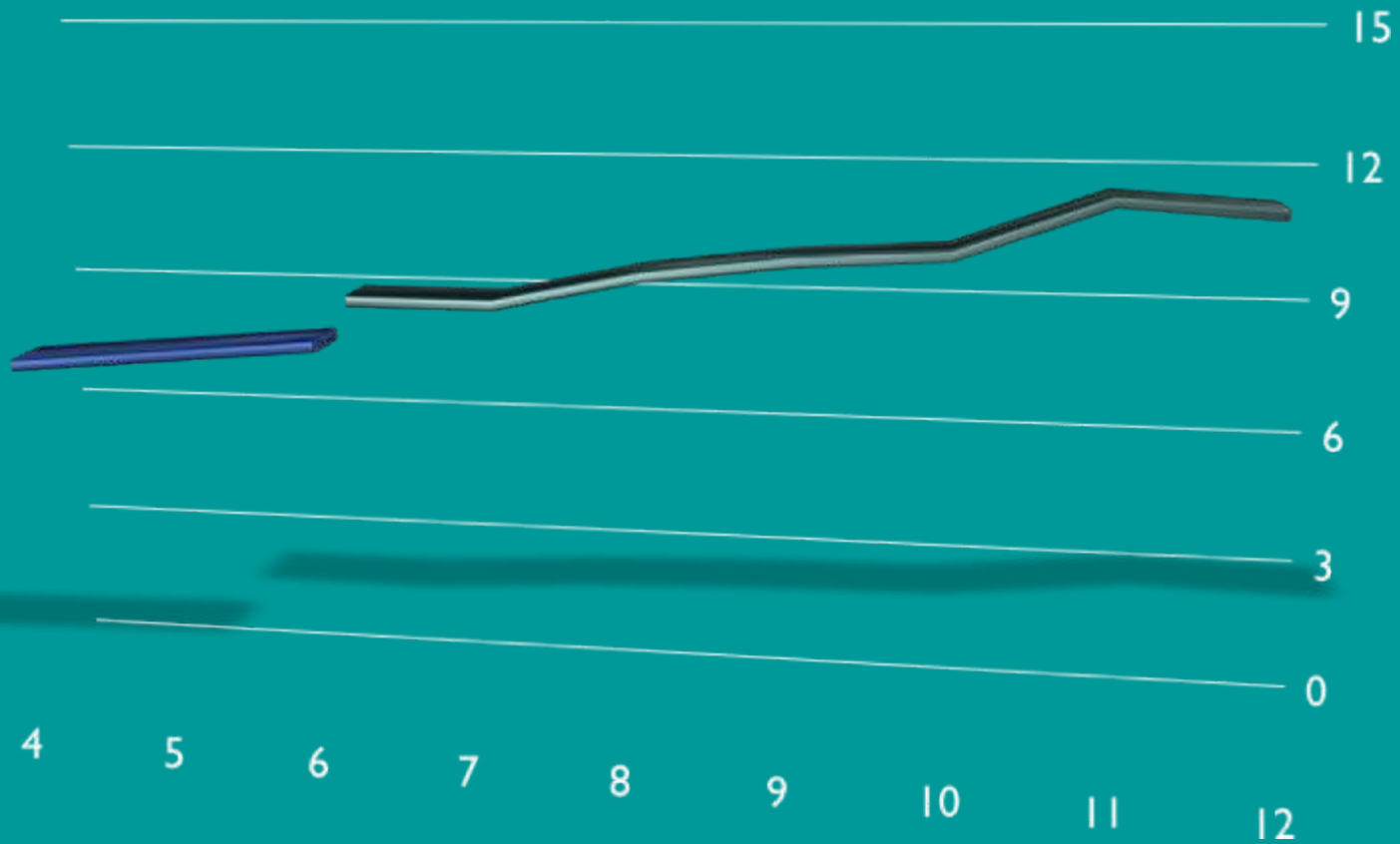


Compare to Elementary—Rectangles



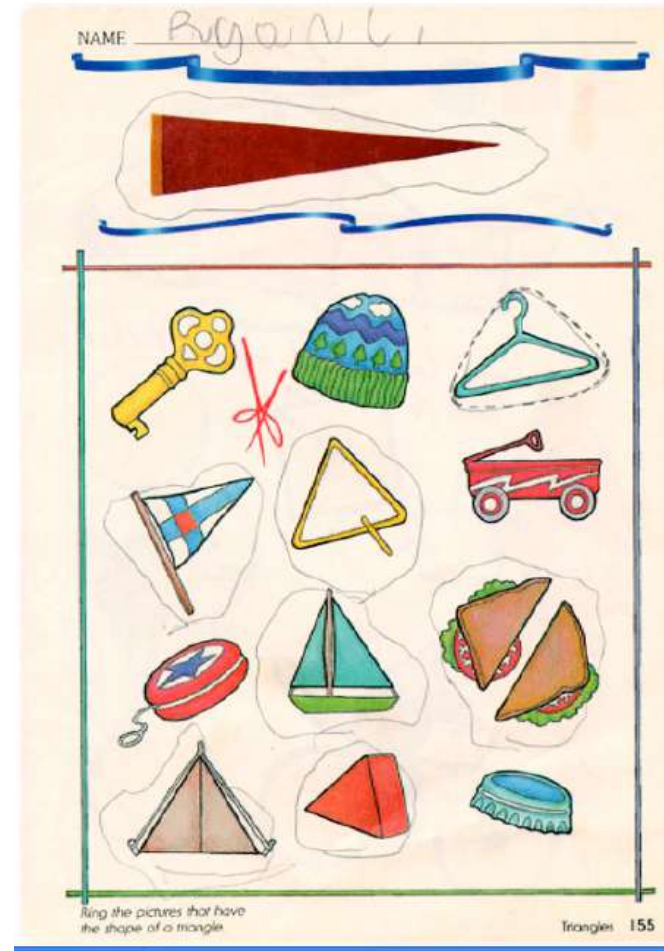
Compare to Elem.—Triangles

— Low SES 4-6
— Mid SES 6-12



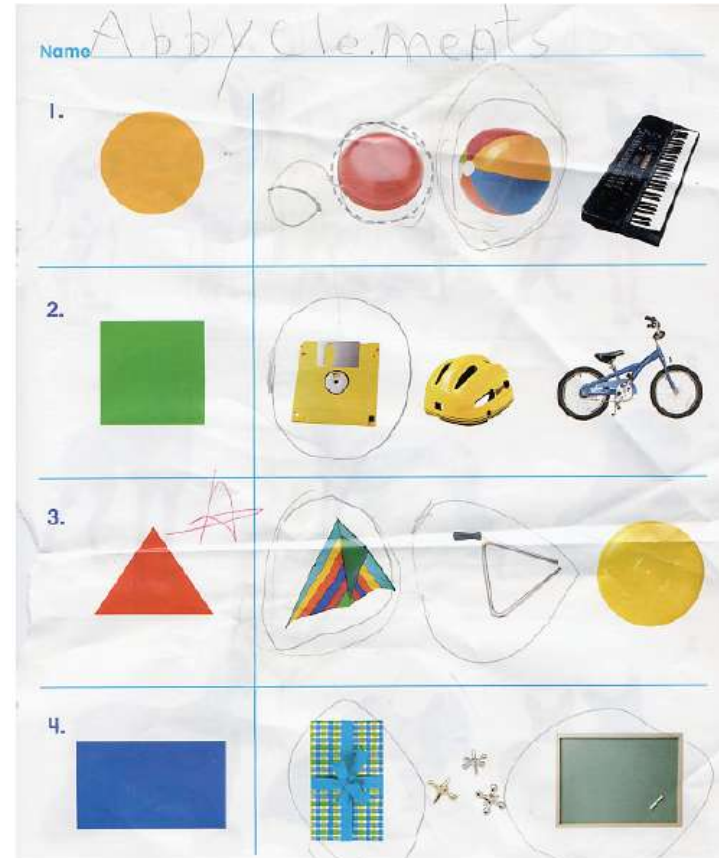
What Children See

Ring the triangle



What Children See

More recent, but not
more mathematically
precise



Geometry Must Move Beyond “Basic” Shape Naming to:

- Parts & Properties
 - Shape attributes
 - Include analysis and description
- Mental images and transformations
- Composing and decomposing



Learning Trajectory for Shapes

- Shape Matcher
- Shape Prototype Recognizer
- Shape Recognizer
- Side Recognizer
- Angle Recognizer
- Shape Class Identifier



▽ Desired Result 2: Children are effective learners

▽ Indicator: MATH – Preschoolers demonstrate competence in real-life mathematical concepts

► Measure 24: Shapes

Definition: Child shows increasing knowledge of shapes and their characteristics

1. Mark the highest developmental level the child has mastered.

<p>Exploring</p> <p><input type="radio"/></p> <p>Recognizes differences among shapes without naming them</p> <p><input type="radio"/> Not yet at first level</p>	<p>Developing</p> <p><input type="radio"/></p> <p>Correctly names at least two shapes (circles, squares, triangles)</p>	<p>Building</p> <p><input type="radio"/></p> <p>Recognizes shapes when they are presented in new orientation or as parts of other objects</p>	<p>Integrating</p> <p><input type="radio"/></p> <p>Describes characteristics and differences of several shapes</p>
<p>Examples</p> <ul style="list-style-type: none"> ► Puts a circle-shaped puzzle piece into the correct hole. ► Places shapes in variety of form boards/simple puzzles. ► Picks out circles from a set that contains circles, squares, and triangles. 	<ul style="list-style-type: none"> ► "The clock is a circle." ► "My sandwich is a square." ► Points to a plate and indicates that it is the same shape as a circle. 	<ul style="list-style-type: none"> ► Identifies triangles even though some have equal sides, some have longer sides, and some are pointed downward. ► Identifies that the wheels of a car are circles and the windows are squares. ► Shows another child that he or she can put two triangles together to make a diamond shape. ► Turns and flips shapes to correct orientation to complete simple pattern block or Tangram puzzles. 	<ul style="list-style-type: none"> ► Looking at a circle and a triangle, says, "This one has a pointy part and it's big; this one is curvy, but it's little." ► Says, "A triangle has three sides; a square has four sides." ► Describing the difference between a circle and an oval, says, "An oval looks like an egg."

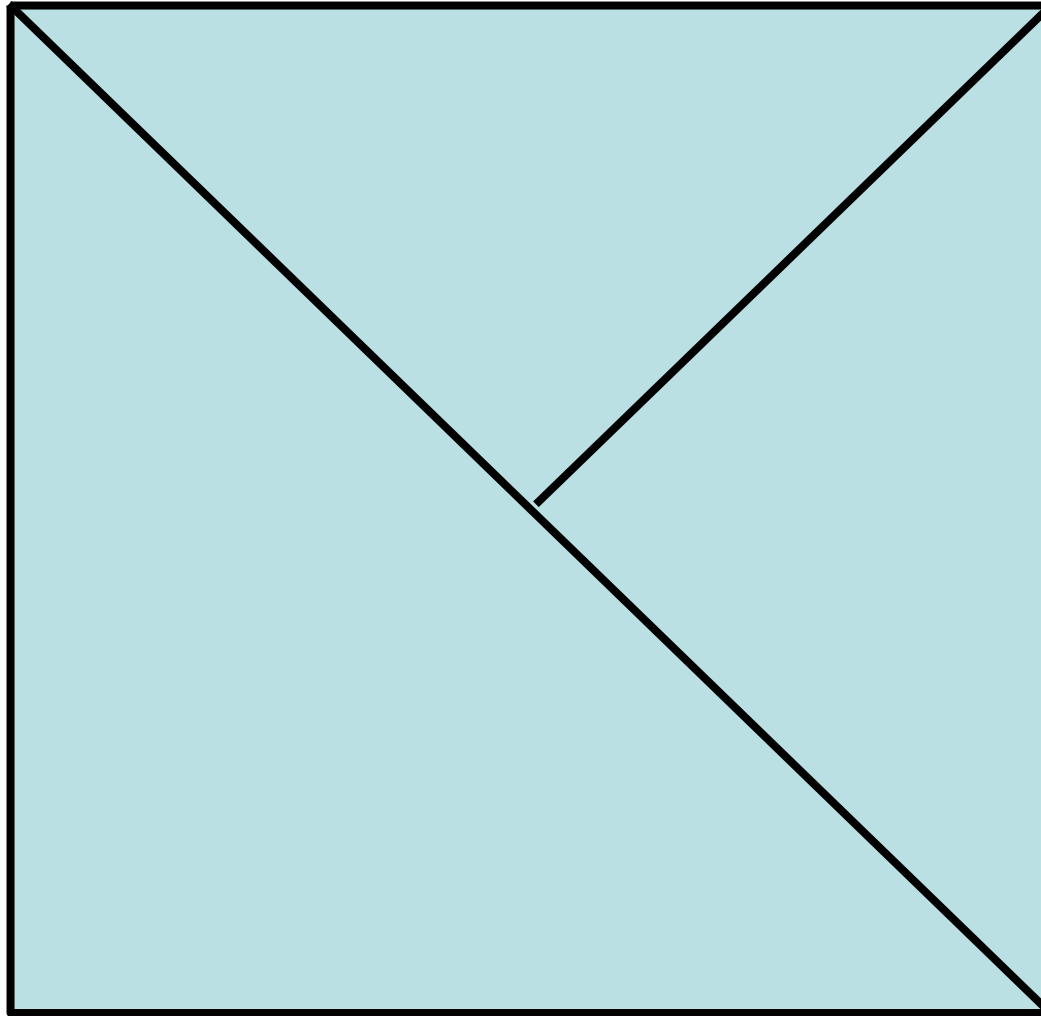
2. Record evidence for this rating here. (Use back for more space.)

3. Mark here if child is emerging to the next level.

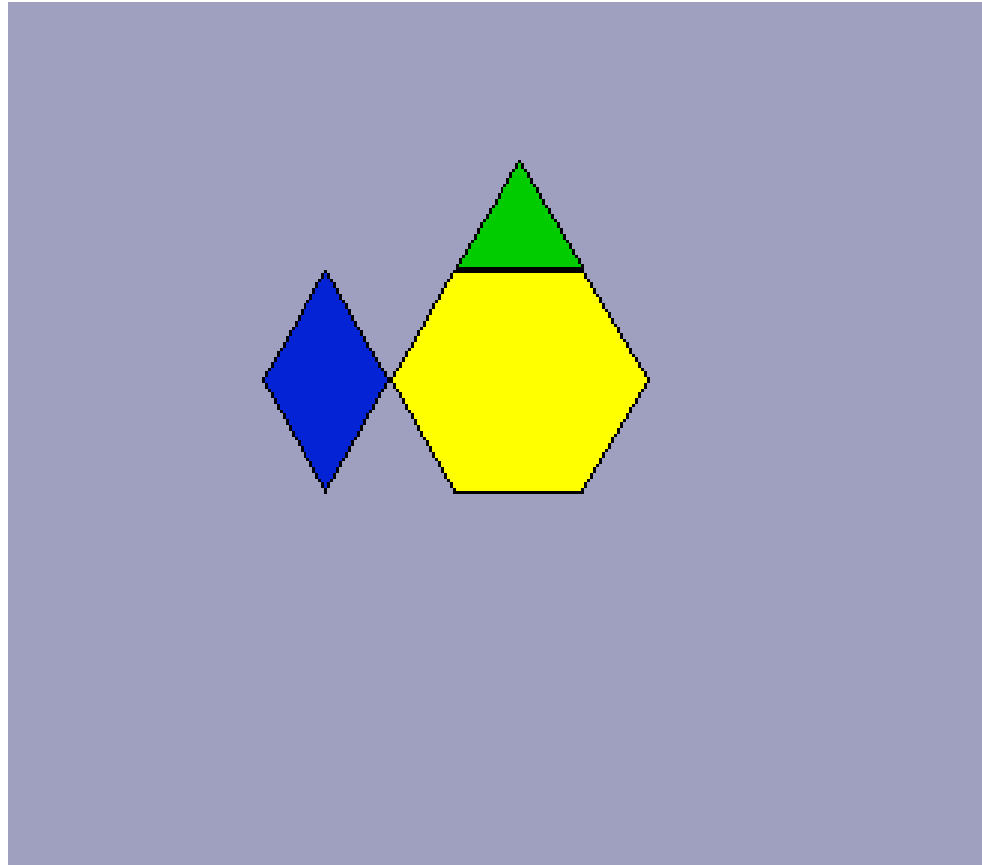
4. If you are unable to rate this measure, explain why.

Geometry *and* Spatial Sense





Geometry Snapshots
Ready...?



Snapshots with
Pattern Blocks
Ready...?

Learning Trajectory for Composing Geometric Shapes

- Pre-composer
- Picture maker
- Shape composer
- Substitution composer



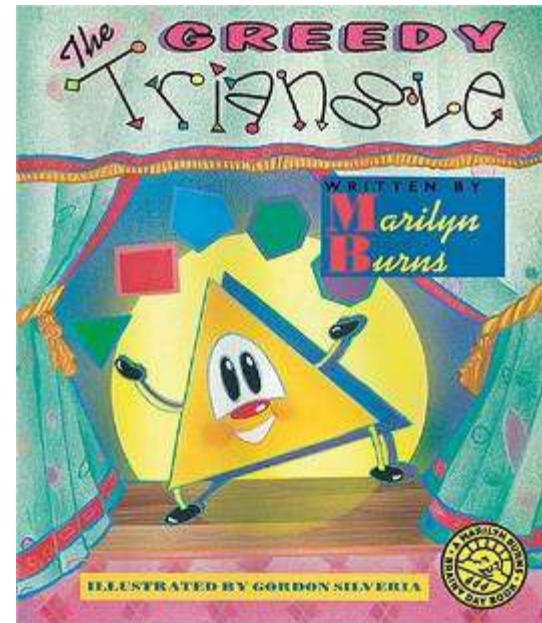
DRDP-R Measure 24: Shapes Developmental Levels

Preschool			
Desired Result 2: Children are effective learners Indicator: MATH – Preschoolers demonstrate competence in real-life mathematical concepts Measure 24: Shapes Definition: Child shows increasing knowledge of shapes and their characteristics			
1. Mark the highest developmental level the child has mastered.			
Exploring <input type="radio"/>	Developing <input type="radio"/>	Building <input type="radio"/>	Integrating <input type="radio"/>
Recognizes differences among shapes without naming them	Correctly names at least two shapes (circles, squares, triangles)	Recognizes shapes when they are presented in new orientation or as parts of other objects	Describes characteristics and differences of several shapes
<input type="radio"/> Not yet at first level			
Examples <ul style="list-style-type: none"> ▶ Puts a circle-shaped puzzle piece into the correct hole. ▶ Places shapes in variety of form boards/simple puzzles. ▶ Picks out circles from a set that contains circles, squares, and triangles. 		<ul style="list-style-type: none"> ▶ <i>"The clock is a circle."</i> ▶ <i>"My sandwich is a square."</i> ▶ Points to a plate and indicates that it is the same shape as a circle. 	
<ul style="list-style-type: none"> ▶ Identifies triangles even though some have equal sides, some have longer sides, and some are pointed downward. ▶ Identifies that the wheels of a car are circles and the windows are squares. ▶ Shows another child that he or she can put two triangles together to make a diamond shape. ▶ Turns and flips shapes to correct orientation to complete simple pattern block or Tangram puzzles. 		<ul style="list-style-type: none"> ▶ Looking at a circle and a triangle, says, <i>"This one has a pointy part and it's big; this one is curvy, but it's little."</i> ▶ Says, <i>"A triangle has three sides; a square has four sides."</i> ▶ Describing the difference between a circle and an oval, says, <i>"An oval looks like an egg."</i> 	
2. Record evidence for this rating here. (Use back for more space.)		3. Mark here if child is emerging to the next level. <input type="radio"/>	
		4. If you are unable to rate this measure, explain why.	
Measure 24		Shapes <small>DRDP-R Copyright © 2005 CDE – All rights reserved.</small>	
		MATH 3 (of 7)	

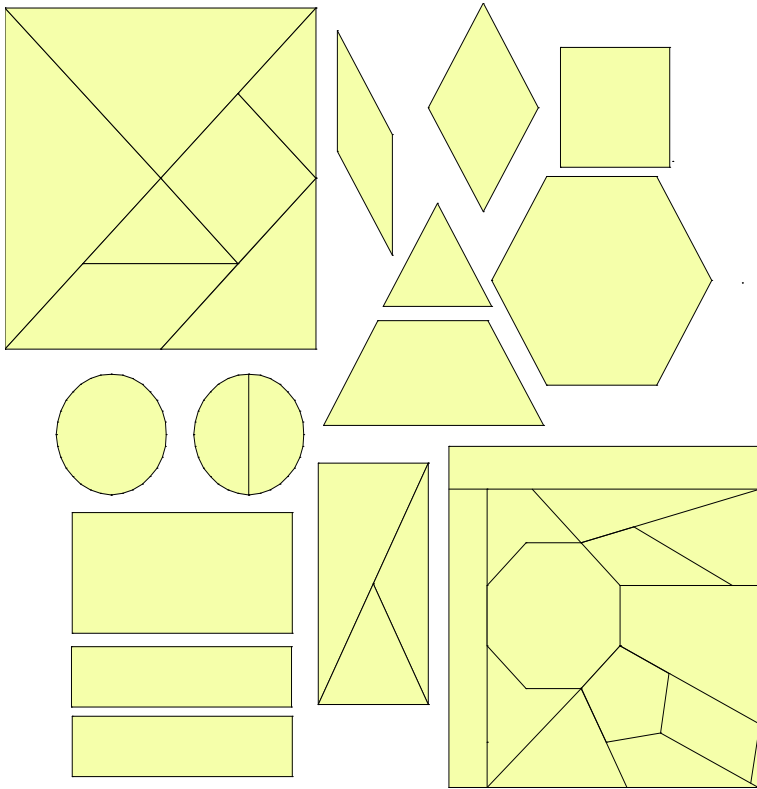


Books

- Shape Flip Book!
- The Greedy Triangle
- Mirror books
- The Shape of Things
- Dot and Line
- (What other books do you know about?)



Shape Set Activity



- Designed based on research and wisdom of expert practice
- Consistency: Pattern blocks, tangrams
- Diversity: Circles and sections, different rectangles and triangles, other shapes

Clements, D. H., & Sarama, J. (2007). *Building Blocks-SRA Real Math, Grade PreK*. Columbus, OH: SRA/McGraw-Hill.



Geometry in the Classroom



Let's Play



- Use the materials on your table and the direction card to play the game.
- You have 20 minutes to play the game and to identify what foundations the game addresses and what kind of documentation you might gather to demonstrate children's growth and development.
- Share your game with the group.



Let's Play

Name of the Geometry Game: _____

Which foundations are addressed in this activity?	
How might you document children's growth and development?	
How might you adapt this for children with disabilities?	
What are some strategies for EL Learners?	



Council for Exceptional Children

Division of Early Childhood (DEC) Recommended Practices

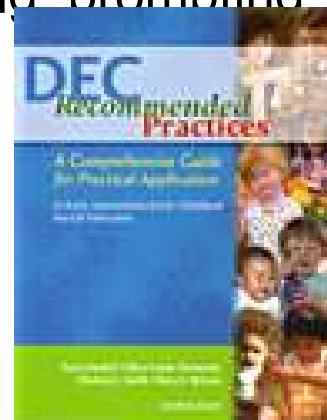


Division of Early Childhood

Practices are individualized for each child based on:

- child's current behavior and abilities across relevant domains instead of the child's diagnostic classification
- the demands, expectations, and requirements of the child's current environment
- team planning that incorporates the input of family and various providers
- staff knowledge of validated strategies including prompting and fading procedures to ensure acquisition of skills
- IEP consideration and/or requirements

DEC Recommended Practices, 2005



Division of Early Childhood

Physical space and materials are structured and adapted to promote engagement, play, interaction, and learning by attending to children's preferences, interests, using novelty, responsive toys, providing adequate amounts of materials and using defined spaces.

DEC Recommended Practices, 2005



Preschool Learning Foundations and Children with Disabilities

- Where in the Geometry strand can you find information about children with disabilities?
- What does it say about children with disabilities?



Geometry Foundations and Children with Disabilities

Children may need:

- assistance to manipulate objects
- adaptive materials that are easy to grasp
- to demonstrate knowledge in alternative ways without directly manipulating objects
- clearly defined work space
- materials that are easily distinguishable by touch

Preschool Learning Foundations, page 157



Revisit The Name Game

- What adaptations might you try to make your game more accessible to children with special needs?
- Record your ideas in the space provided.



Preschool English Learners



Walk and Talk

- Misconception: Math is about numbers, therefore, understanding the language of instruction isn't so crucial.
- Reality: Math is abstract in nature and requires specific vocabulary to talk about it!



Through using language creatively and interactively, children develop the thinking necessary to communicate mathematically to solve real problems with their everyday experience.



Scaffolding as a Strategy

When children are given opportunities to build on their existing knowledge base, words in their new language are more easily mastered because they are linked to familiar concepts.



Minor Adjustments

- Check for understanding.
- It is more than eye contact.
- Use of primary language, use of icon, use of actual object.
- Use follow-up questions.



PRINCIPLE 1

The education of English learners is enhanced when preschool programs and families form meaningful partnerships.

PRINCIPLE 2

Children benefit when their teachers understand cultural differences in language use and incorporate them into the daily routine.

From Preschool English Learners - A Resource Guide, CDE Press 2007



PRINCIPLE 4

Language development and learning are promoted when preschool teachers and children creatively and interactively use language.

PRINCIPLE 6

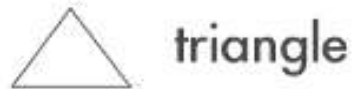
Continued use and development of the child's home language will benefit the child as he or she acquires English.

From Preschool English Learners- A Resource Guide, CDE Press 2007

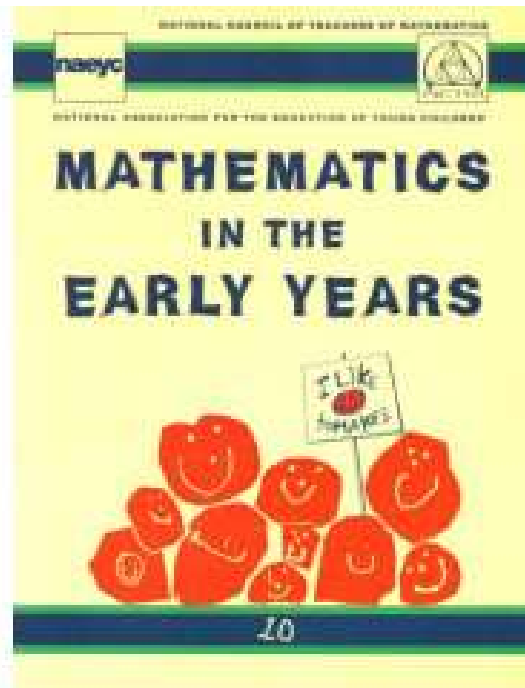


Mathematical Vocabulary

- Determine the proficiency levels of each English-language learner in the classroom.
- Identify key vocabulary words and phrases to introduce and use in your lesson with English-language learners.



Nine strategies for working with English-language learners



Adapted from *Mathematics in the Early Years*, edited by Juanita Copley, 1999.



Strategies 1, 2, 3

- Modify language.
- Use manipulatives.
- Use modeling and gestures.



Strategies 4, 5, 6

4. Use oral descriptors.
5. Respect the observation and listening time.
6. Match questions to the child's proficiency level in English.



Strategies 7, 8, 9

- Incorporate the child's first language.
 - Consider cultural issues.
9. Connect with parents and math in the home.



One More Time

Revisit the Name Game

- How might you adapt your game for English-language learners?
- Record your ideas in the space provided.



Q & A



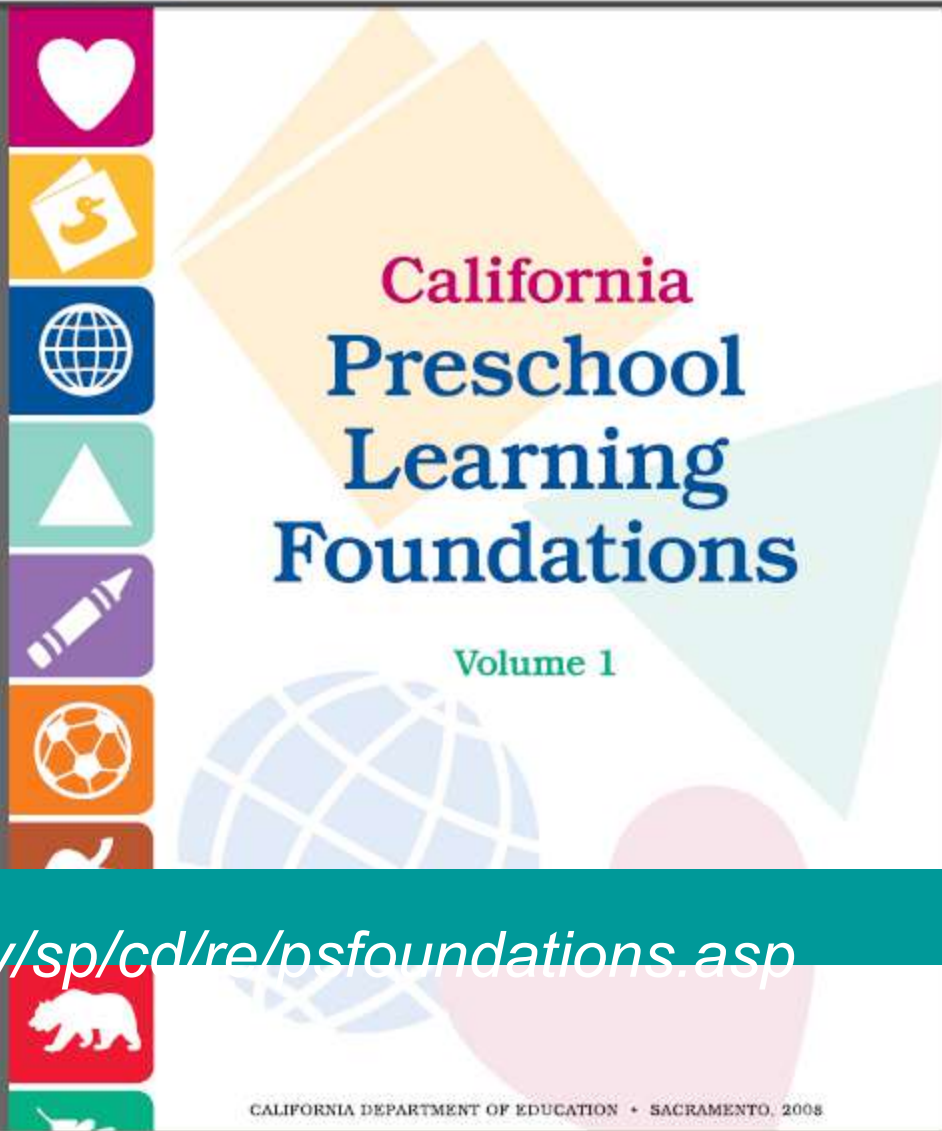
CDE Web site

- At the Web address, the underlined Preschool Learning Foundations link takes you to the publication. There you will have easy access to the chapters and sections within the 192 page publication.
- The *Appendix*, on pages 173-192, provides a summary list of the foundations.
- *Frequently Asked Questions (FAQ)* are posted on the website. Questions can be sent to psfoundations@cde.ca.gov



Bookmarks Options

- Contents
- Message from State Superintendent
- Acknowledgments
- Introduction
- ⊕ Social-Emotional Development
- ⊕ Language and Literacy
- ⊕ English-Language Development
- ⊕ Mathematics
- ⊕ Appendix: The Foundations



<http://www.cde.ca.gov/sp/cd/re/psfoundations.asp>

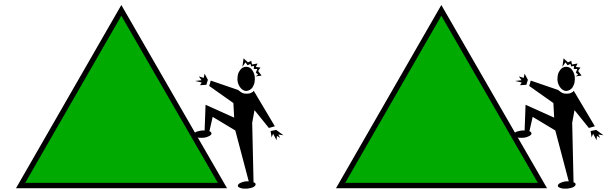
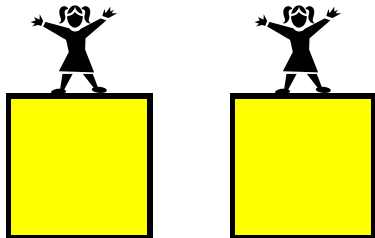
To Purchase

- The Preschool Learning Foundations publication is available for purchase from the CDE Press for \$19.95.
- Ordering information can be found at the CDE Web site www.cde.ca.gov or by calling 800-995-4099.



Make and Take-Shape Memory Game

- Take 12 cards
- Take 2 of each shape sticker to make matching card sets



Thank you for coming

- Put your CPIN information here.
- Announce next event.



Evaluation

- Please complete your evaluation.
- Put your specific procedure here.



Optional Slides





Is Mathematizing Appropriate?

Preschool math is not recent phenomenon.

Historical pattern of appropriate, interesting mathematics from Froebel, to Montessori to today's research.





Geometry in the World

Pat H.'s preschool was studying bees.

Children noticed the hexagon.

T: Why do you think they chose?

C1: It popped in their heads.

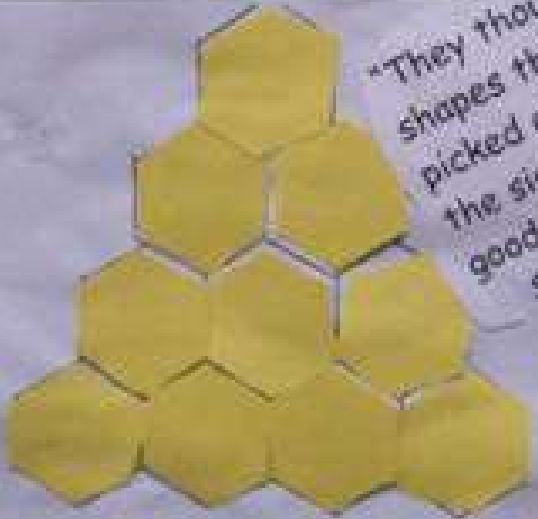
C2: They found one under a tree.

Let's see some of the others...



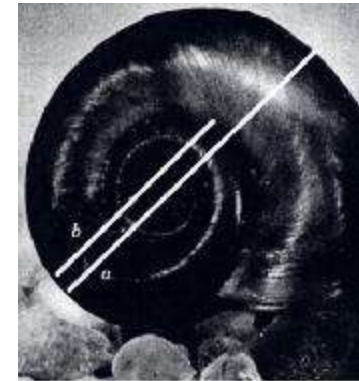
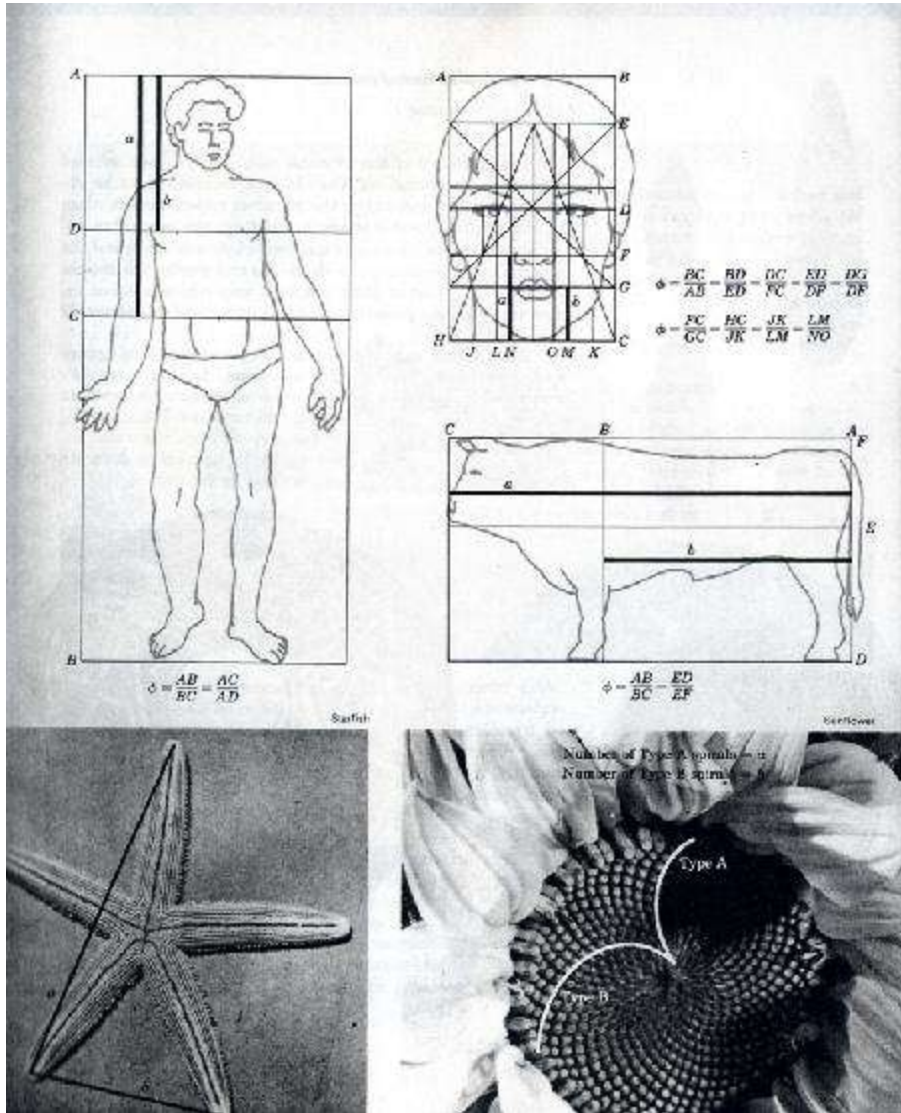
GIRLS
LOCKER

hexagons



"They thought of all the shapes they knew and I picked a hexagon because the sides fit together good."
Spencer





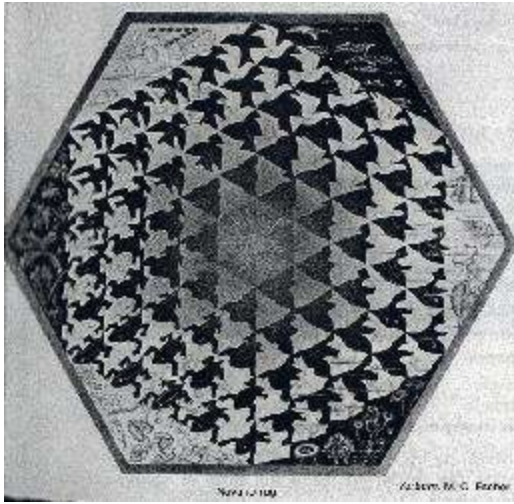
St. Jerome, Divinci

Geometry in the World



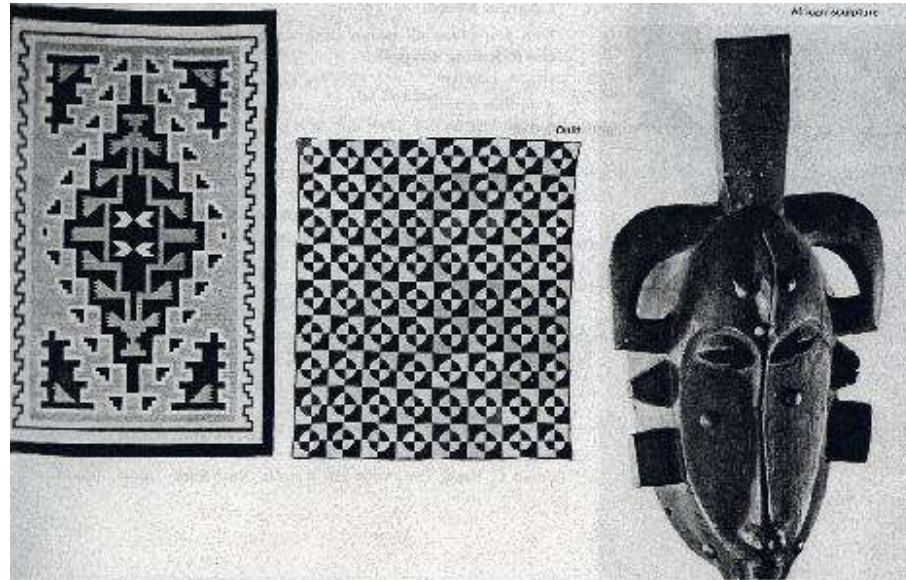
Geometry in the World





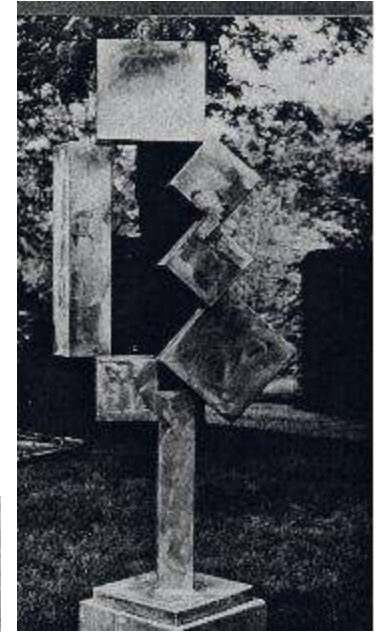
Nava (1988)

Richard M. G. Reiser



Oxley

Alison sculpture



Geometry in the World

