# Early Geometry Concepts

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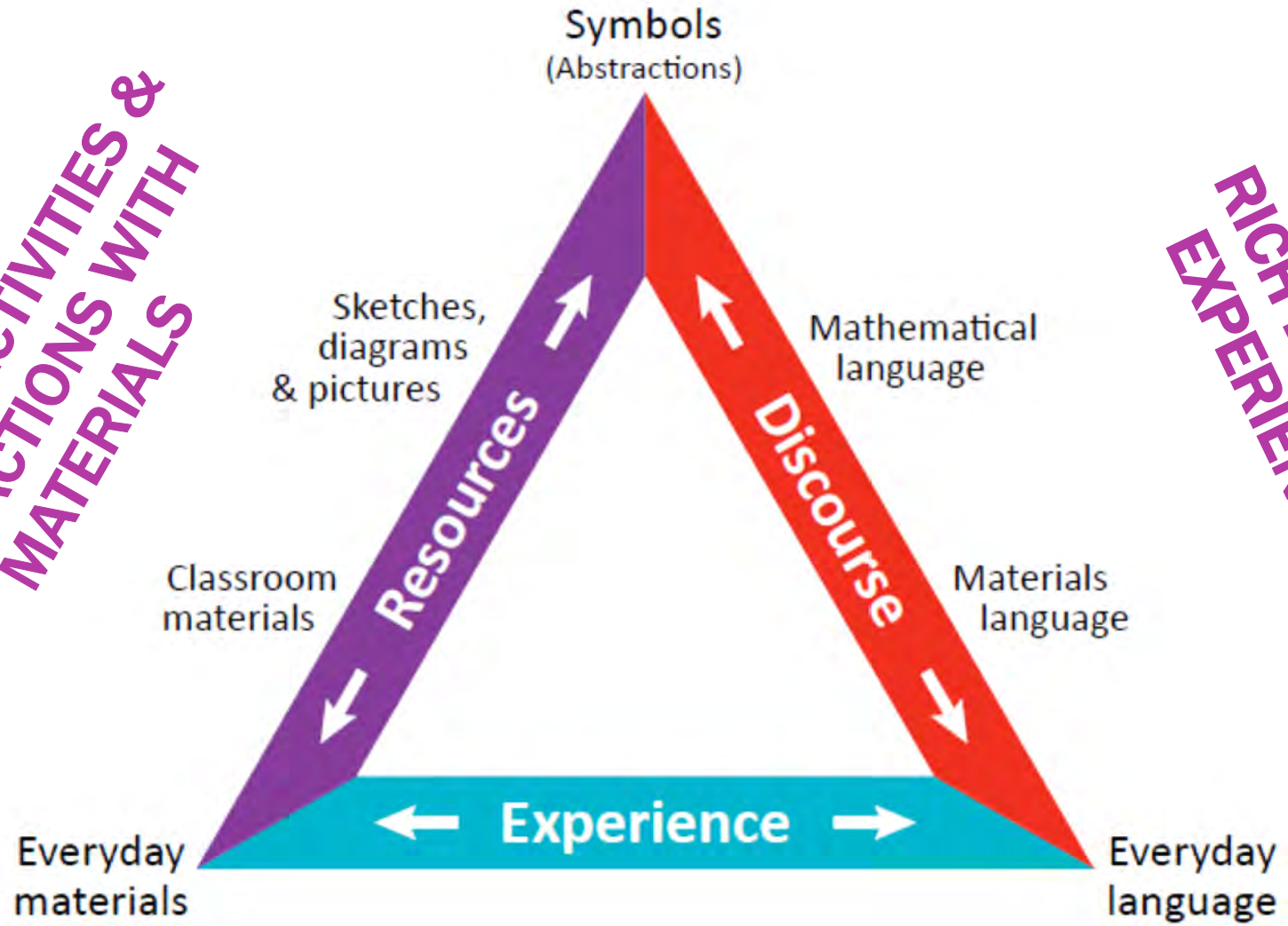
ENGAGING ACTIVITIES & INTERACTIONS WITH MATERIALS

RICH LANGUAGE EXPERIENCES




*Adapted from Ed Rathmell and Joseph Payne.

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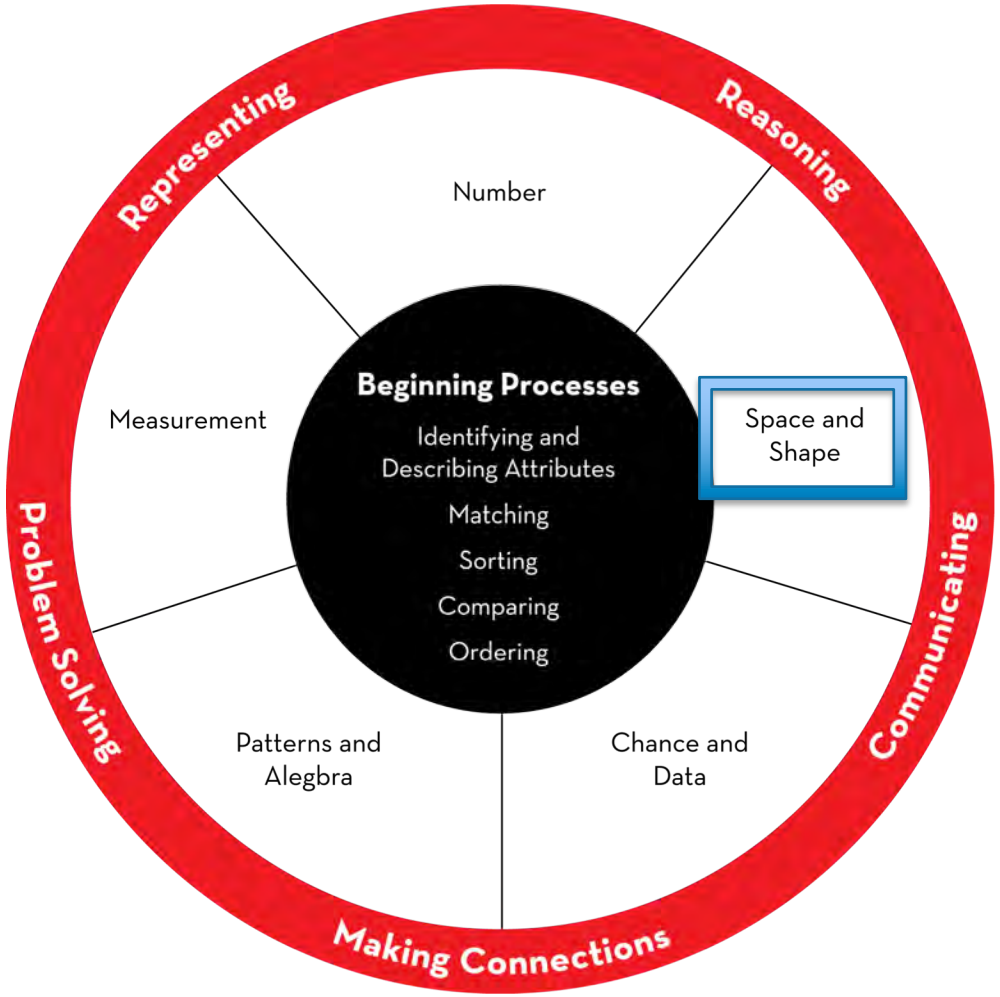
# Pre-requisite Skills: Another Progression




## Early Childhood Mathematics Framework

Irons, 2007

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# Key Components of Executive Function

## Cognitive flexibility

- Use a variety of strategies to solve a problem
- Switch attention from one part of a problem to another

## How many ways can you sort these objects?

Banse, Clements, Sarama, Day-Hess, Joswick. (2021).

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# Key Components of Executive Function

Working memory, managing incoming information

- Maintain
- Update
- Integrate

Pngkey.com

There are 9 leaves.

2 leaves blow away.

How many leaves are left?

Banse, Clements, Sarama, Day-Hess, Joswick. (2021).

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# Key Components of Executive Function

## Inhibitory Control

- Regulation of impulses and suppression of automatic responses
- May be behavioral, cognitive, or both (often difficult to distinguish)

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- Behavioral – physical actions and body support task completion

- Cognitive – mental actions support task completion; suppressing automatic responses

Banse, Clements, Sarama, Day-Hess, Joswick. (2021).

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# Choosing the Best

- Engaging activities that begin with concrete materials, move to pictorial, and then to symbolic
- A progression of language from student language to materials language to mathematical, and then symbolic
- A progression of activities with beginning processes
- Activities that promote executive function

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# Why Study Geometry in School?

- Practical application
  - Why is the hexagon everywhere?
  - Why are manhole covers round?

Vyas, 2018

- Develops spatial thinking, a factor of intelligence and an important predicator of future careers, especially in scientific research, engineering and the arts.

Ivie & Embreston, 2010

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# For Young Learners, Spatial Perception Involves. . .

Eye-motor coordination – the ability to coordinate vision and body movement.

- Gross motor – obstacle course, skipping, and more
- Fine motor – pencil, rulers, stringing beads, working with a computer, and more

Del Grande, 1993

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# For Young Learners, Spatial Perception Involves. . .

Figure-ground perception – the ability to distinguish foreground from background and identifying a figure against a complex background.


Del Grande, 1993

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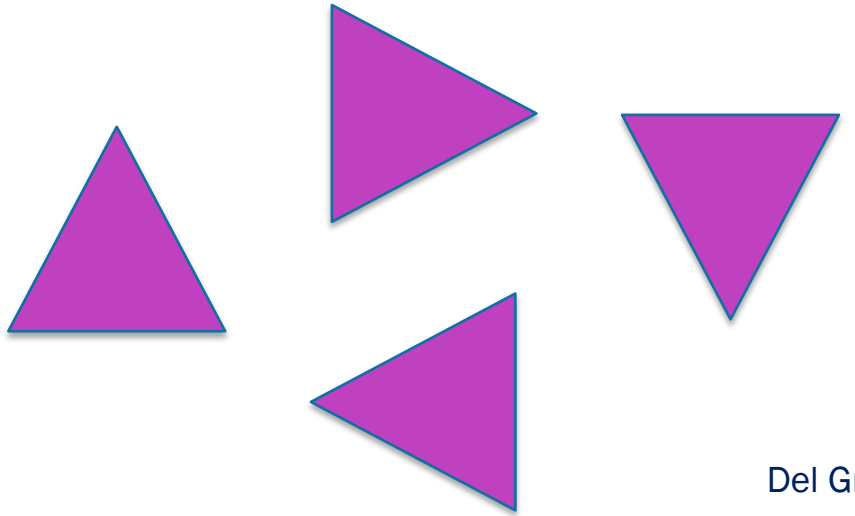
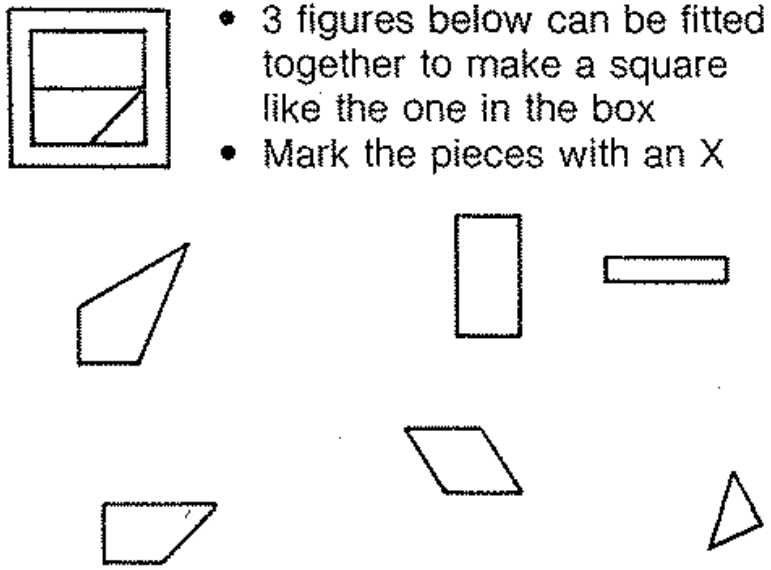
# For Young Learners, Spatial Perception Involves. . .

Perceptual constancy – the ability to recognize figures or objects in space, regardless of size, position, or orientation.






Del Grande, 1993

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# For Young Learners, Spatial Perception Involves. . ..

Position-in-space perception – the ability to recognize how an object in space is related to themselves and how an object has changed positions.

- Interpretation of letters and numerals is dependent upon the relationship to the top and sides of the page.

  p, q, b, d, 6, 9

Del Grande, 1993

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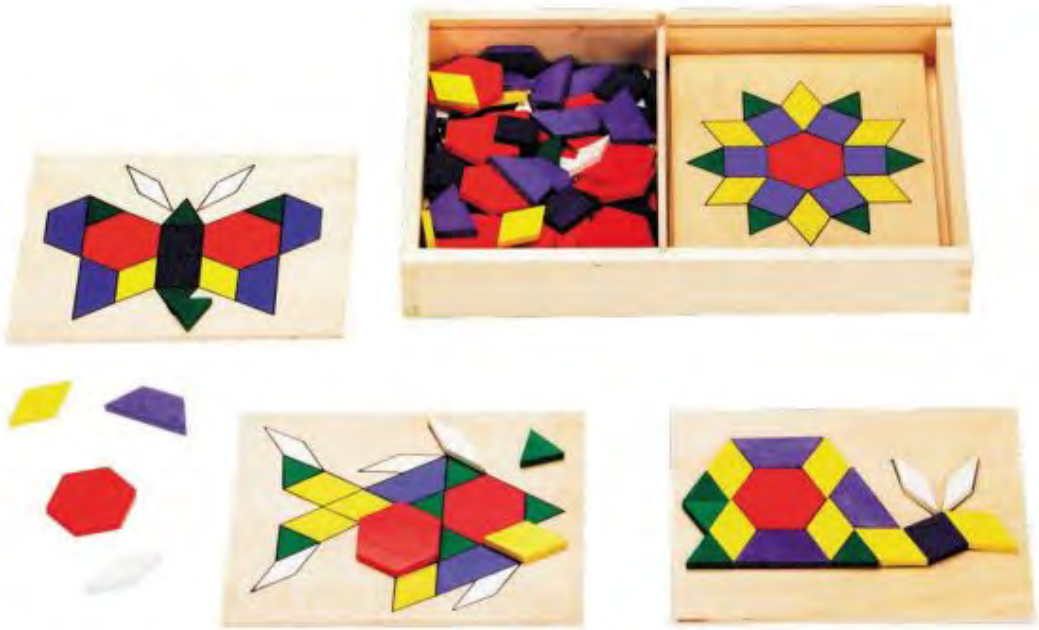
# For Young Learners, Spatial Perception Involves. . .

Perception of spatial relationships – the ability to see the two or more objects in relation to each other or to oneself.



Del Grande, 1993

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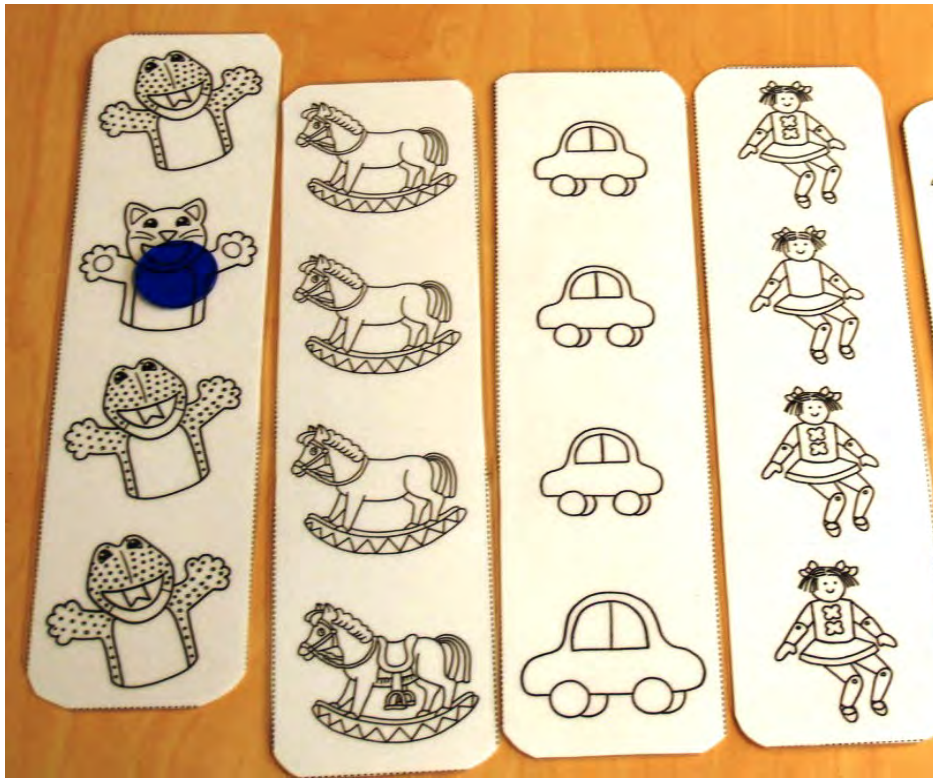
# For Young Learners, Spatial Perception Involves. . .

Visual discrimination – the ability to identify similarities and differences in an object's characteristics.



Del Grande, 1993

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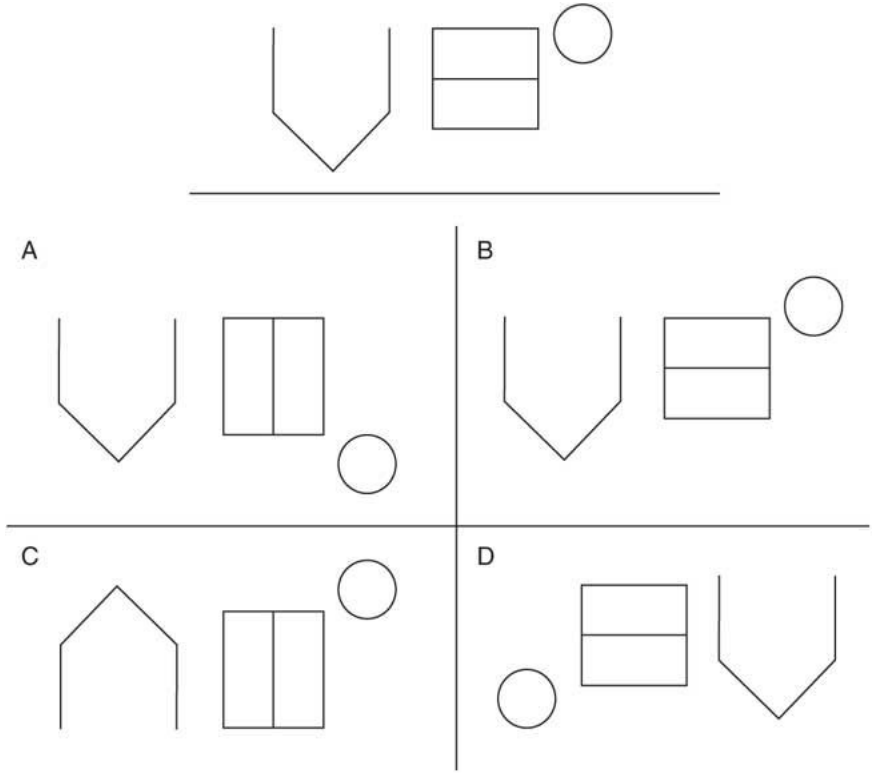
# For Young Learners, Spatial Perception Involves. . .

Visual memory – the ability to recall objects and the characteristics of objects that are no longer visible.




Benton visual retention test

Del Grande, 1993

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# 3-D Objects: Their Everyday World!

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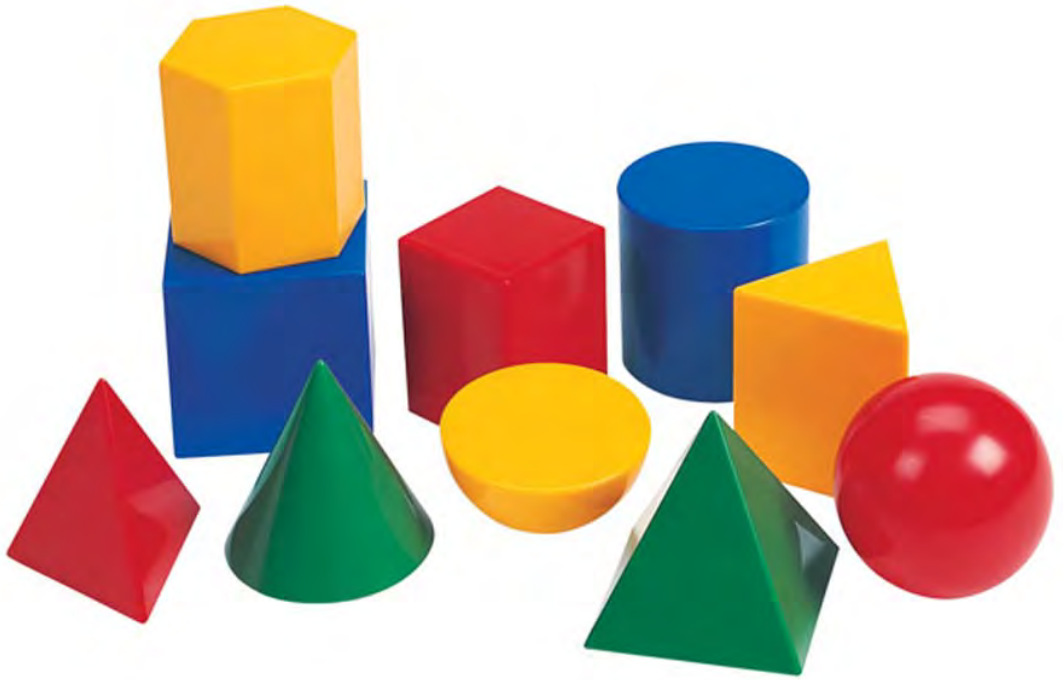
# 3D Objects for Young Learners

- Prism
- Pyramid
- Cone
- Cylinder
- Sphere
- Cube



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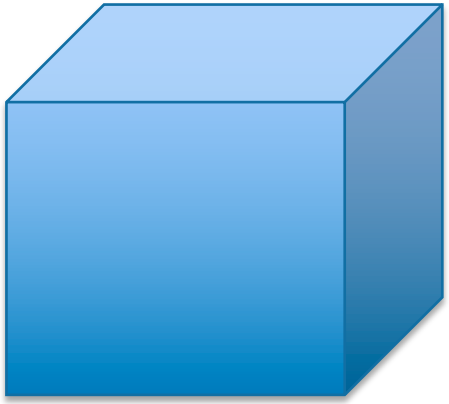
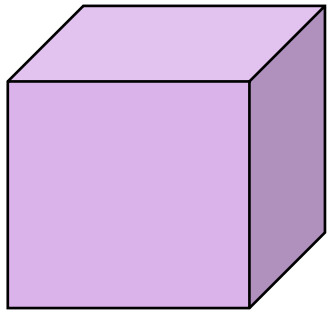
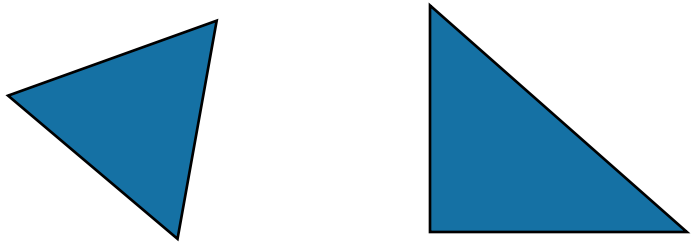
# Critical Attributes: 3D *and* 2D Shapes

An important aspect of geometry for early learners is that geometrical shapes possess critical attributes-must haves.





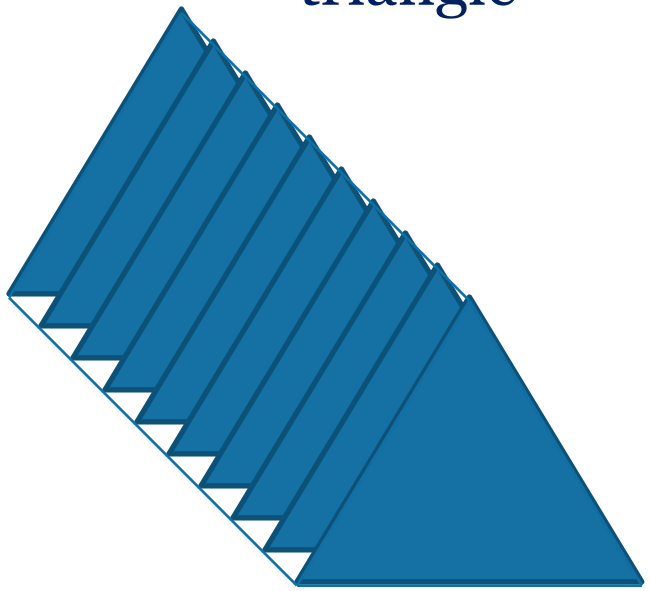
- A cube might be blue or purple, big or little, but it must have six faces.
- A triangle might have different orientations, but it must have three sides and three corners.



# Prisms

Prisms are made from congruent shapes.

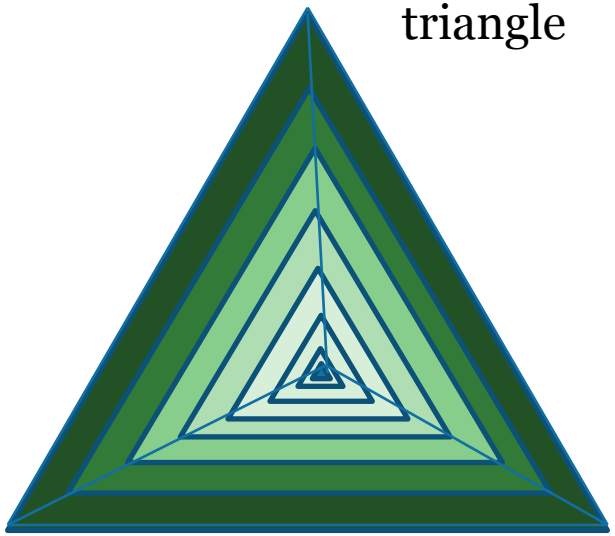
triangle



triangular prism

# Pyramids

Pyramids are similar shapes, getting smaller toward the vertex.

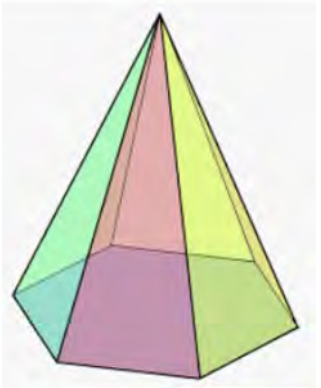


triangle

triangular-based pyramid

# Pyramids

- Only one base
- All other faces are triangular
- Common vertex (apex)
- Pyramids are named according to the shape of their base:
  - Triangular-based pyramid
  - Square-based pyramid
  - Rectangular-based pyramid
  - Hexagonal-based pyramid

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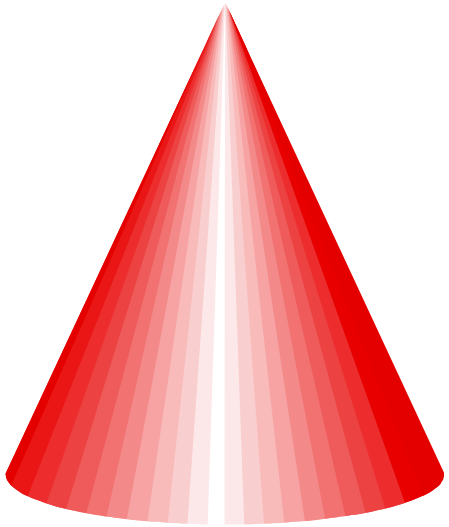
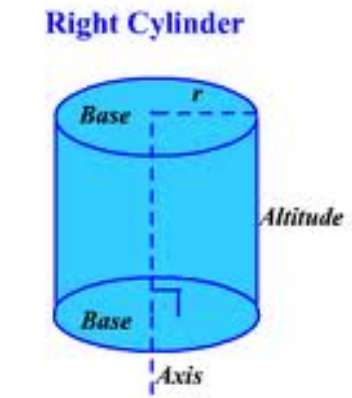
# Cones

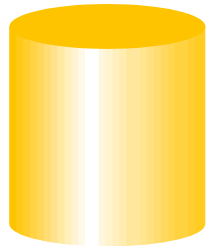
- Related to a pyramid
- Circular base
- A vertex (apex)
- A curved surface from circular base to vertex
- Height found by a perpendicular line from apex to the base plane

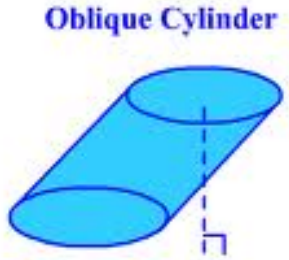


# Cylinders

- Related to a prism (like cone is to a pyramid)
- Has two congruent circular and parallel bases
- A curved surface linking the two bases
- Height found by drawing a perpendicular line from the top base plane to the bottom base plane

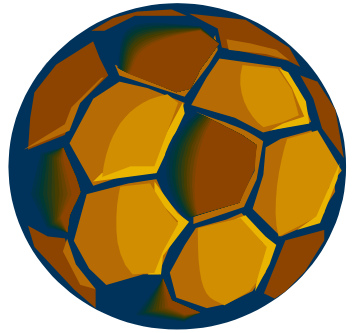


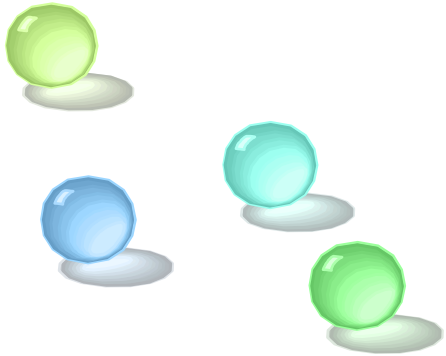






# Spheres

- Completely curved surface
- No edges
- No vertices
- Same distance from center to any point on its surface





# Cubes

- How would you want your students to describe a cube?
- What attributes would you want them to notice?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# Attributes of 3D Objects

The characteristics, attributes, or features are more important than the names of the objects and shapes.

- similarities and differences
- straight and curved surfaces or faces
- roll, stack, number of faces, corners, edges
- number of sides and angles

# Analytical Approach to 3D

Emphasizes the attributes of the object.

- Does it roll, stack, or both?
- Same number of faces, edges, corners?

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# Holistic Approach to 3D

Involves building families of objects with geometric similarity


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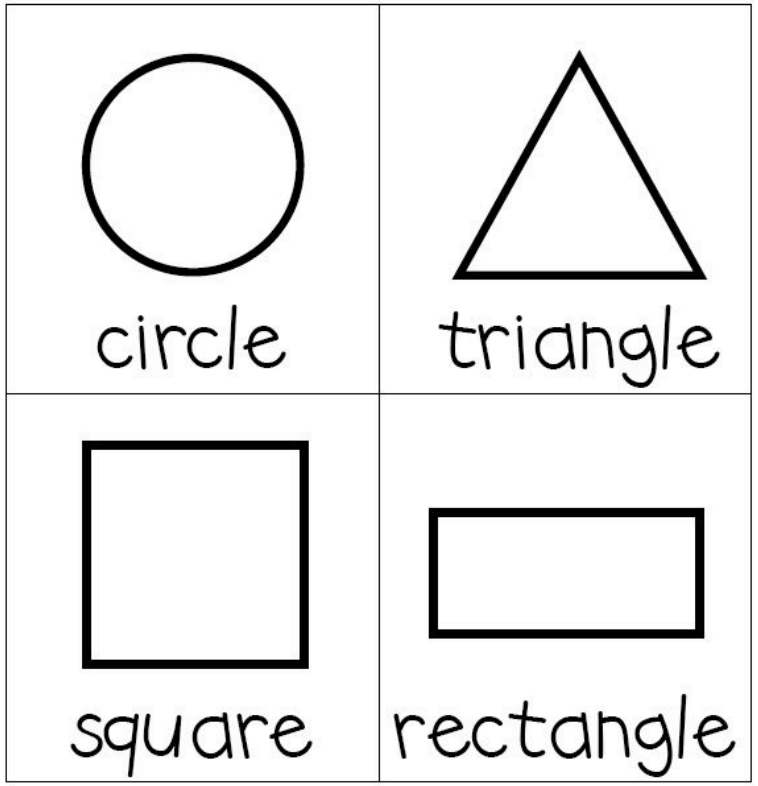
# 2D Shapes for Young Learners

Relating 2D shapes to 3D objects

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# 3D to 2D Understanding


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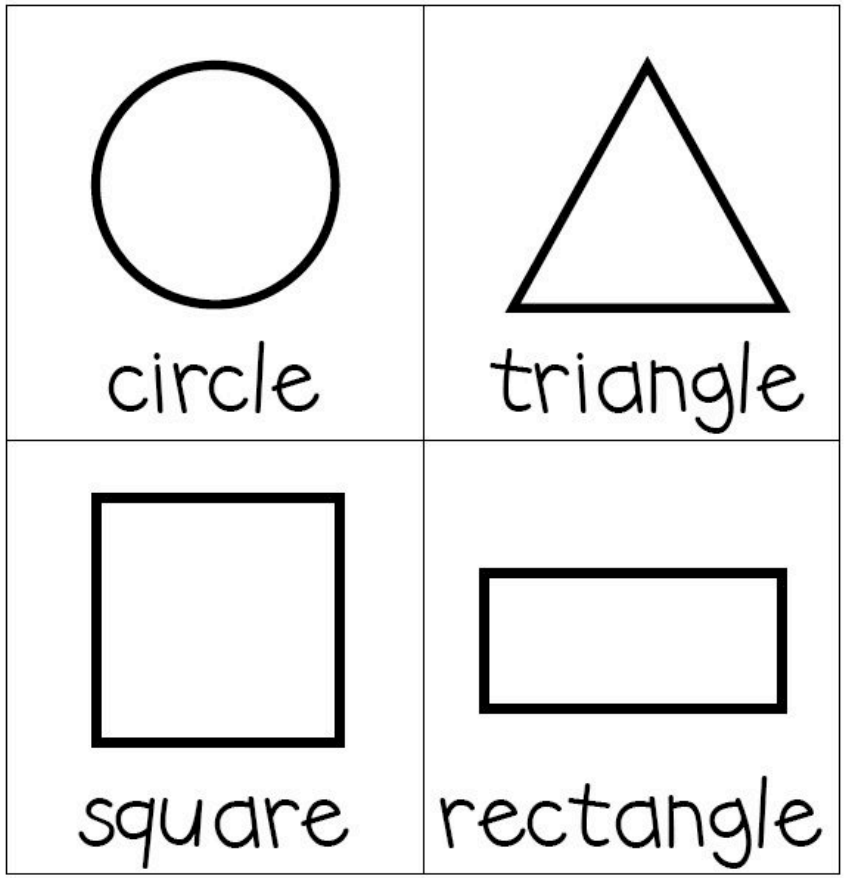
# 2D Shapes for Young Learners

Attributes:

- No thickness
- Are flat
- Corners
- Sides

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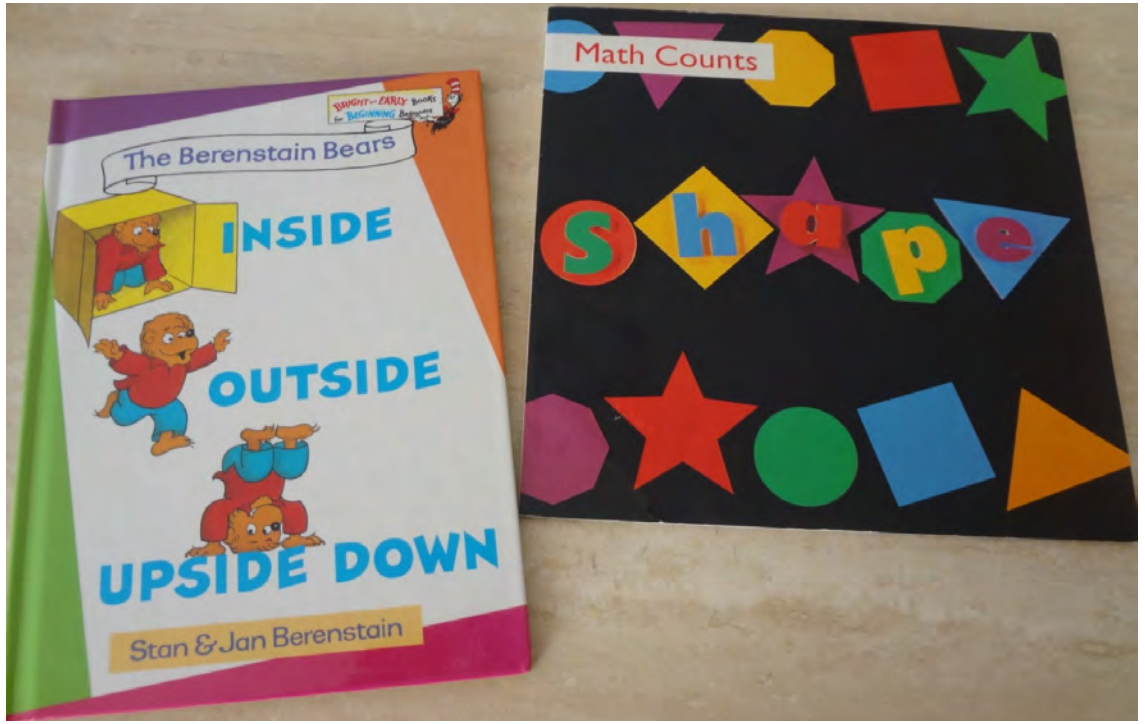
# Critical and Non-critical Properties

- Critical properties are the ones a shape must have
- Non-critical properties can confuse students
- Many students include non-critical attributes in their definitions
- Many students develop their own definitions through observation and deduction

# Beware of Misconceptions

More than 60 percent of commercial geometry books for children have incorrect representation and language for three-dimensional objects and two-dimensional shapes.



# Food for Thought

"Students do misunderstand, but it is seldom because they cannot understand, most often it is because they understand something else." (Tripp, D. 1993)

- Students can get the right answers for the wrong reasons and the wrong answers for the right reasons.
- In all cases asking students what they think is important.
- Good questions and thoughtfully chosen tasks can help the teacher to know which is which.

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# Thank you!!! Any questions?

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