

Geometry and Spatial Thinking for young children

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Geometry

Geometry is grasping space...that space in which the child lives, breathes and moves. The space that the child must learn to know, explore and conquer so as to live, breathe and move better in it.

(Freudenthal, NCTM,
1989:48)

Why do we study geometry?

*What is the point of learning geometry?
Is it to train logical thought by studying
deductive systems (making valid
conclusions)?*

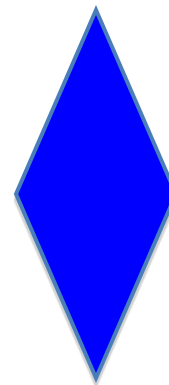
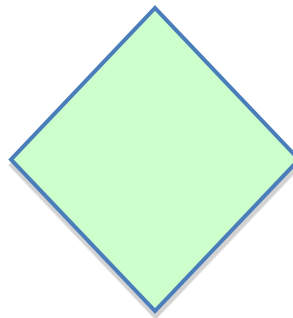
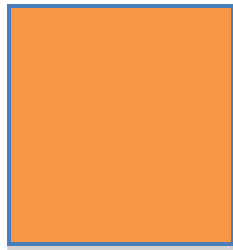
*Is it to develop spatial awareness and
ability by empirical study (test driven
development) of the environment?*

*Is it to learn a language rich in metaphor
(using analogies)? (Tahta, D., 1980:3)*

Goldenberg (1996)

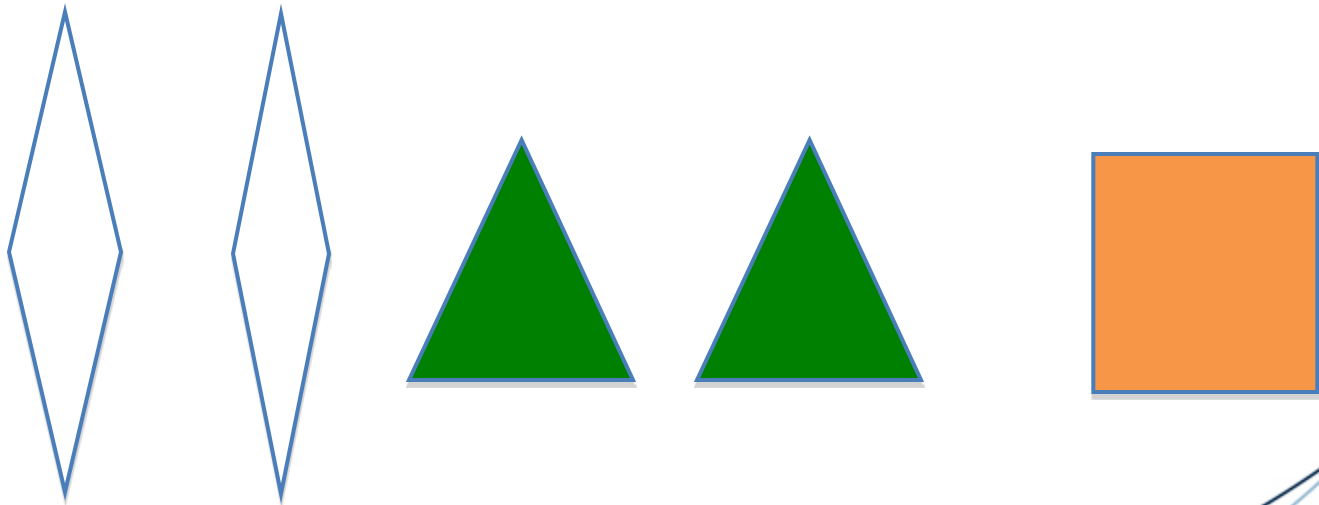
Geometry can help students connect with mathematics (serious reasoning and thought)

- Example: What is the same about all the shapes? What are the differences?



Geometry can be a way to build the habits of developing logic and proofs

Build two houses. What do you see? What can you say about the space covered by the houses? What if you take away the triangles? What can you say about the remaining shapes?



The van Hiele Theory of Geometric Thought

- How children learn geometry
- Gives information about the kinds of experiences we should provide for children to develop their spatial thinking

Expectations

Matches similar shapes 2D (0-2 years)

- Classifies and names similar shapes (3years/Grade R-3)
- Matches a wide variety of shapes (3-4 years/R-3)
- Classifies and names more shapes (4 years/R-3)
- Recognizes and classifies different orientations of rectangles (4-5 years/Grade R-3)
- Classifies and recognizes most familiar shapes (5 years/Grade R)
- Symmetry (R-3)

Clements and Sarama (2009); CAPS (2011)

CAPS expectation

- Grade R
- Grade 1
- Grade 2
- Grade 3

Where is the beginning?

Pre-school

Match and name shapes

Activity: Sit with children on a circle (group activity) Use two color shapes

- Take a shape from one color and give it to a child and take a similar shape from the color and ask children, “Who has a shape that is the same as mine? After their response ask them how do they know. Allow them to match the shapes if they want to. Give all children shapes from the two sets and ask them to find others who have similar shapes as theirs. Let them know that they can match more shapes during small group time.

Where is the end? Pre-shool

Classifying and recognizing most familiar shapes

- Activity (small group)
 - Make shapes on the geo-board with elastic bands (triangle, rhombus, square, rectangle)
 - Ask children how they know if the shape is correct.
- Activity (whole group)
 - Make shapes on the floor with sticky tapes. Ask children to step on to a rhombus, square, rectangle, triangle) Ask children to explain how they know each shape.

How

Mathematical goal

The path

Activity (purposeful game,
activity or play)

Geometry for young children

Spatial Orientation

Knowing your position around the world. Involves maps and coordinates. It involves young children's spatial location and spontaneous explorations. (Clements and Sarama, 2009)

1. Child's own position and movement
2. Landmarks in the environment (toys or a chair)

Cont.

Language of Space

First, spatial words “in”, “on”, and “under” along with vertical directionality such as “up” and “down”.

Second, words of proximity such as “beside” and “between”

Third, words referring to frames of reference such as “in front of,” “behind,” and “left,” “right” come later

Educator's role in learning of geometry by young children

- Provide children with stimulating materials to explore with a purpose in mind
- Provide a variety of materials in different stations
- Observe their actions and model learning experiences

Developing Spatial Orientation

- Landmark user (uses a distant landmark to locate an object)
- Insert activities that develop the spatial vocabulary “in,” “on,” and “under”
- Activities that develop “up” and “down”

Continue with spatial language developmental activities

- Develop activities or game that develop the use of words “beside” and “between” (e.g., treasure hunt games)
- Activities that develops use of “in front of” and “behind”.
- Games and activities that introduce “left and right” words.

Young children's developmental paths for shapes

- Pre-recognition
- Comparing
- Classifying
- Constructing
- Comparing attributes
- Angle recognition
- Shape Recognition

Pre-recognition

- Children give the shapes names that are familiar to them
- They sort colors instead of shapes

Developmental activities for shapes

- Show children a dollhouse
- Give them blocks to build the same dollhouse.

Use the blocks to build your house.

Let children hear the word “house” for vocabulary as they



Comparing

- After building their houses allow them to compare their houses
- Let children compare the same houses, then the different houses
- Compare your houses you have built
- Are they the same? If yes, in what way? If not, what is the difference?

Matching shapes

- Children find it easy to match one type of shape at a time
- Have a tub of shapes on the floor for children to explore

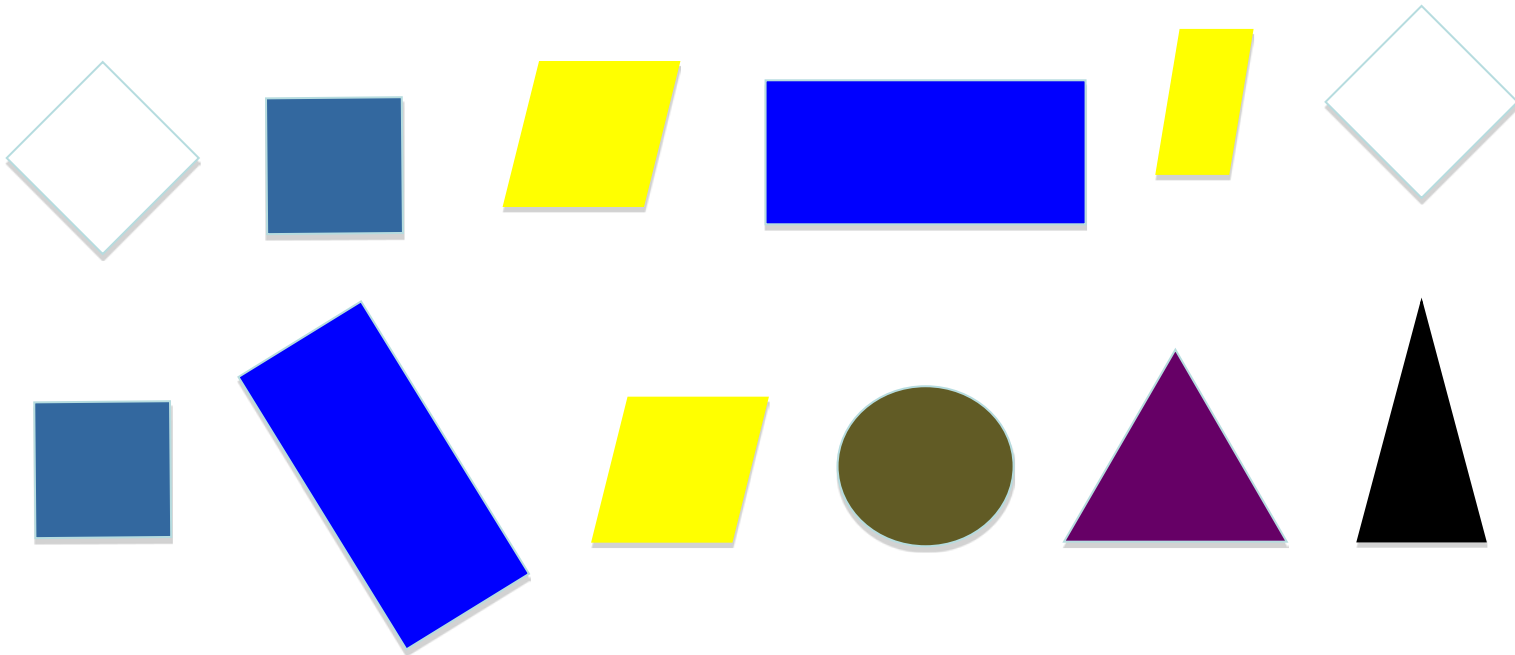


Sorting shapes

- Start by taking out a square and putting it on the floor
- Ask children to find more squares that look like the one on the floor (see if they bring same size and color or different sizes and different colors). That will indicate their developmental levels.
- Introduce the name square
- Challenge children now by changing orientation of the squares and asking them if they are still squares

Squares and non-squares

- Give children these shapes and ask them to pick all squares



Tile with squares

- Ask children to tile their kitchen floor with squares (give them plastic mats to tile)



Classifying (using names

- Make a family of squares (provide different colors of squares)
- Let children collect squares only into a sorting dish



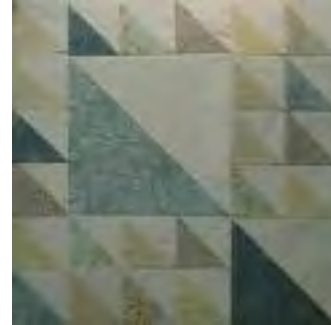
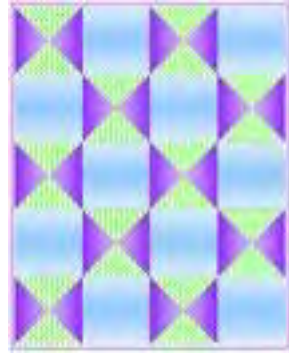
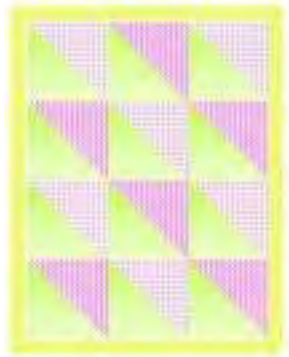
Triangles and non-triangles

- Select all triangles from this group of shapes



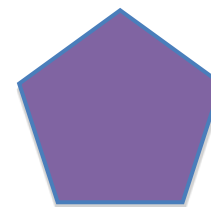
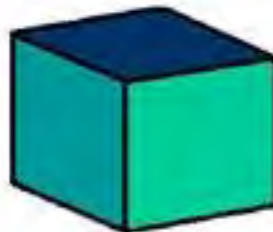
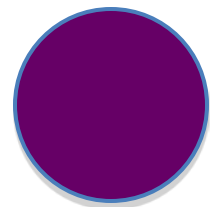
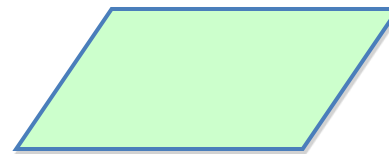
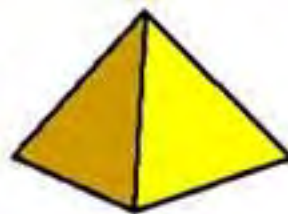
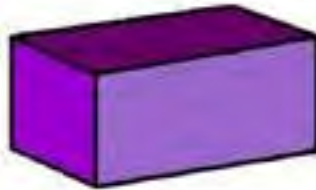
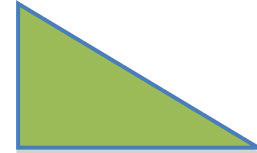
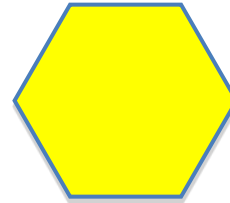
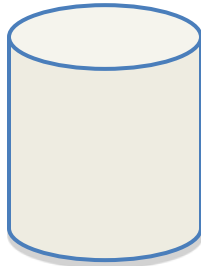
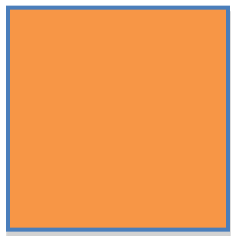
Quilt with triangles

- Make your own triangle quilt



Higher level sorting (work in pairs)

- Sort the shapes and objects alone and then let your partner guess your rule



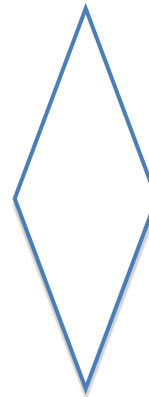
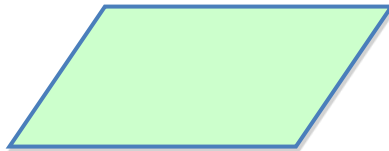
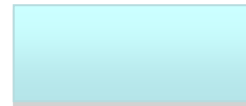
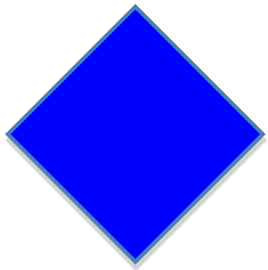
Possible rules for young children's sorting

- Sorting by color
- Sorting by shape and face
- Sorting by dimensions
- Sorting by polygons

At this stage children use names of shapes in their sorting. Make sure they explain their sorting rules.

Guessing rules

- Let children add more shapes in your group
- Can you guess my rule here?



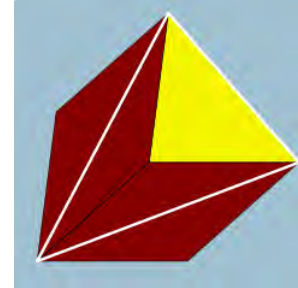
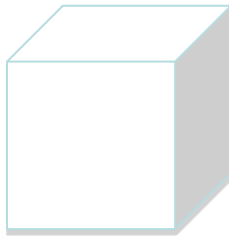
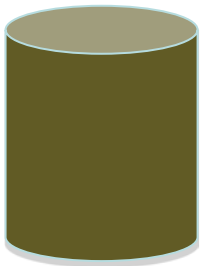
Polygons and non-polygons

- Pick up all shapes with closed straight sides.



Guessing the rule

- Guess my rule here.
- Add more of these objects.

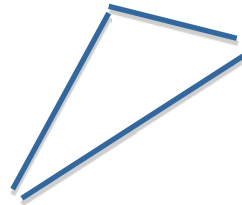
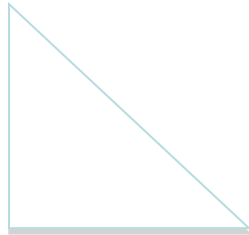
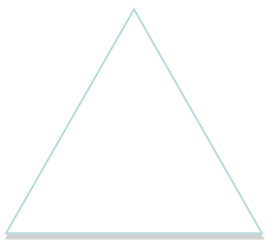


Constructing

- Composing and de-composing shapes
- Building and re-designing structures

Compose shapes for young children

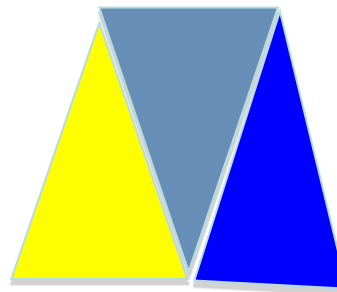
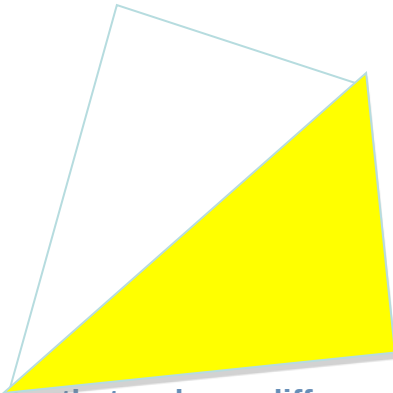
- Give children triangles of different kinds and let them explore



Modeling

Play with them and start composing shapes using triangles

- Make sure you have more triangles of the same kind for them to explore further
- Ask them to show and share the shapes they compose
- Assist with vocabulary, use correct mathematical vocabulary (e.g., rhombus instead of diamond)



Pattern block frames for young children

- First time should be more exploratory for them
- Start asking for different ways slowly
- Observe their strategies when they are selecting a block (for example, do they just pick up any or do they match the sides with the frame?). Observe closely

How

- Start with easy frames and let children enjoy them



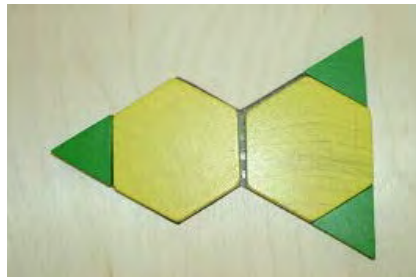
Stimulate children further

- Introduce the difficult ones bit by bit



Encourage

- Take pictures of their work



Pattern block frames

- Composing and decomposing shapes
- Exploring properties of shapes
- Keeping children's interests
- Challenging children's spatial thinking
- Introducing angle recognition and thinkin

Blocks construction and deconstruction

- Let children construct their own models



Big ideas reflection

- Shape recognition
- Sorting
- Analyzing
- Building
- Relations
- Mathematical vocabulary
- Composing and decomposing

The Role of Assessment

- Educators need to monitor each child's development on an on-going basis.
- 1. Identify the activities, interactions, and materials that will facilitate the next steps of development for *each child*.