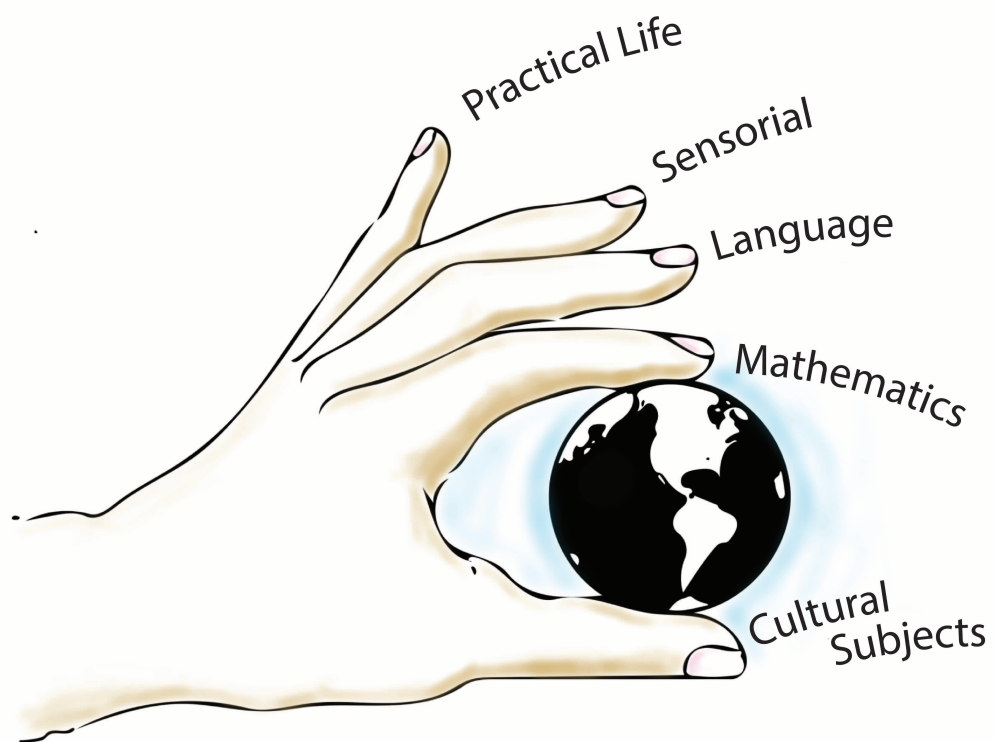


Montessori Educators International, Inc.



Sensorial
Early Childhood
Teacher Manual

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SENSORIAL MATERIALS FOR PERCEPTION OF DIMENSION

Purposes:

- To train the visual sense in perception of differences in dimension
- To improve keenness in observation
- To heighten attentiveness in carrying out systematic operations such as sequencing To stimulate reasoning power and application of intelligence
- To establish the habit of self-correction of error
- To develop motor control
- To develop muscular memory
- To stimulate appreciation of dimension
- To prepare for understanding of the science of numbers
- To develop appropriate vocabulary

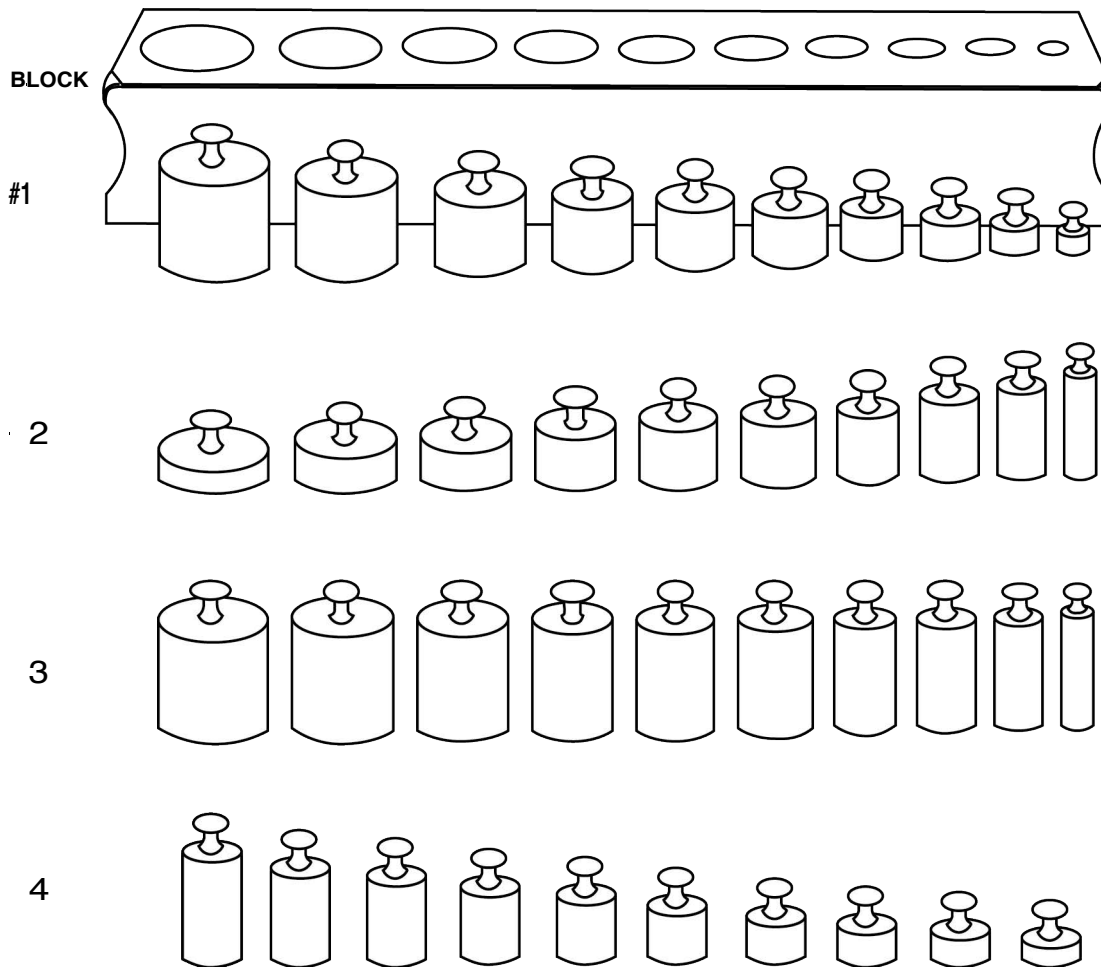
CYLINDER BLOCKS or SOLID INSETS

Preliminary Exercises:

- Practical life exercises including clothes pinning, manual transfer, use of tongs and tweezers, spooning, pouring, screwing nuts and bolts
- Handwork including bead stringing and beginning paper cutting

Materials:

- Four blocks each holding ten cylindrical insets of regular gradation:
 - (1) height and diameter are diminished by one half centimeter between successive cylinders with the largest diameter having the greatest height and the smallest diameter having the least height
 - (2) diameters are diminished by one half centimeter as height increases by a like amount
 - (3) height remains constant as diameter decreases by one half centimeter
 - (4) diameter remains constant as height decreases by one half centimeter



CYLINDER BLOCKS

Procedure:

1. Invite a child to the lesson.
2. Remove the first cylinder block from its place on the shelf by grasping at each end of the block, thumbs at front, fingers curled around the back.
3. Place the cylinder block on the table, largest cylinder at the left, so that the block is between you and the child with enough space in front to place the cylinders as they are removed. Be sure that the child is able to see down into the sockets when cylinders are removed. Have the child sit on your dominant side.
4. Using the thumb and first two fingers of the dominant hand, grasp the knob of the first cylinder at the left and lift it straight up. Place it quietly on the table in front of the block but not directly in front of the socket from which it was removed. Continue from left to right, removing cylinders and placing them at random in front with deliberate movements, but not so slowly that the child becomes bored and loses interest.
5. Look into the first socket on the left, then at the cylinders on the table. Select the largest cylinder and place it quietly into the socket. Look into the next socket, choose the appropriate cylinder and place it quietly into the socket. Continue working from left to right until all cylinders are replaced.

6. Stand up, replace chair, grasp solid inset block as before and return it to the proper place on the shelf.
7. Thank the child and say that this cylinder block may be chosen.
NOTE: It is not necessary to give a lesson with other than the first cylinder block, but as with many materials, more than one lesson may be needed. The same first set is used for repeated lessons.

Control of Error:

Visual recognition of incorrect fit of cylinders into sockets

Observations:

Holding and carrying the block of solid insets
Fingers used in handling cylinders
Handling of cylinders in placing on table or into sockets
Placement of cylinders in sockets
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

After child has worked successfully with the first cylinder block without difficulty, state that any of the other three sets may be chosen to be used individually.
Once each of the sets has been used successfully, invite the child to use two sets together and indicate that these are placed at an angle with the open part facing the child. The cylinders are placed between the two sets in random order.
After using two sets of cylinder blocks together successfully, invite the child to use three sets together and indicate that these are placed in the form of a triangle with the cylinders placed randomly in the space within the triangle.
Later the child is invited to use all four sets of cylinder blocks, placed in the form of a square with the cylinders placed randomly in the space within the square.

NOTE: Do not give demonstrations of the arrangement of cylinder blocks in an inverted V, triangular or square arrangements. Once the child has had lessons with the first cylinder block and has been observed to experience no difficulty in using the four sets separately, only then is the invitation given to combine the sets.

Vocabulary:

solid	inset	cylinder	knob	socket	identical
deep	deeper	deepest	short	shorter	shortest
thin	thinner	thinnest	thick	thicker	thickest
tall	taller	tallest	shallow	shallower	shallowest
large	larger	largest	small	smaller	smallest
big	bigger	biggest			

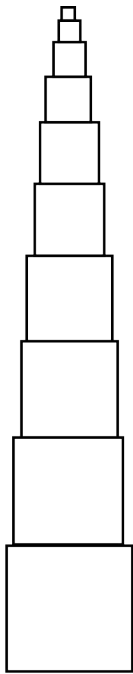
PINK TOWER or SYSTEM OF CUBES

Preliminary Exercises:

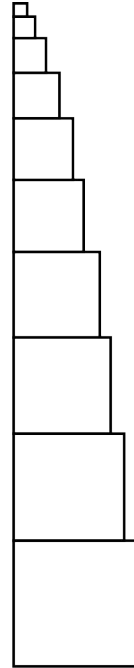
Practical life exercises such as unrolling and rolling mats, carrying objects such as

boxes Materials:

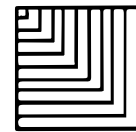
Ten pink wooden cubes varying from 1 cubic centimeter to 1000 cubic centimeters in size, representing variations in three dimensions and the cubes of numbers 1 through 10
Floor mat



Initial arrangement
Side View



Variation
Side View



Variation
Top View

PINK TOWER

Procedure:

1. Invite a child to the lesson. Have the child get a floor mat and unroll it near the storage space of the cubes.
2. Carry the cubes to the mat, one at a time in the dominant hand, by grasping each cube from above on all four sides, placing the thumb and two middle fingers on opposite faces of the cube with index finger and little finger on the other opposite faces. Place the cubes randomly on the mat. Have the child sit on your dominant side at the front of the mat.
3. Look carefully at the cubes, select the largest and place near the front of the mat by grasping on four sides as above.
4. Select the next largest cube and place it with one movement on top of the largest cube. Do not "adjust" the cubes to make alignment perfect since this distracts the child from the true purpose of the exercise which is perception of dimension.
5. Continue to select and place cubes of diminishing sizes until all ten cubes have formed a tower.
6. As the tower is disassembled one cube at a time, grasping from the top as before, the cubes are placed on the mat in random order.

7. Return the cubes one at a time to their storage place, beginning with the largest, grasping from the top as before, building the tower in proper sequence when replacing the cubes.
8. Have the child roll and replace the floor mat.
9. Thank the child and say that the pink tower may be chosen.

Note: If the child cannot grasp the large cubes with one hand, it will be natural to use two hands. Control of Error:

Visual recognition of ordered sequence of cubes
 Toppling of cubes if badly misplaced
 Muscular impression of increasing size and weight of cubes

Observations:

Grasping of cubes for carrying and placement
 Arrangement of cubes on the mat and upon return to their storage place
 Handling of floor mat
 Handling of materials
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Variations:

(To be introduced ONLY after the child has worked successfully with the material according to the first presentation)
 Demonstrate arrangement of cubes with two sides even so that ledges are formed on the remaining sides, ledges facing the child.
 Demonstrate movement of the smallest cube along the ledge of each cube in the variation arrangement, starting at the top. Return the cube to its original position after completing the exercise.
 Suggest that cubes be arranged horizontally.

Vocabulary:

cube	small	smaller	smallest
	large	larger	largest
	big	bigger	biggest
tower			

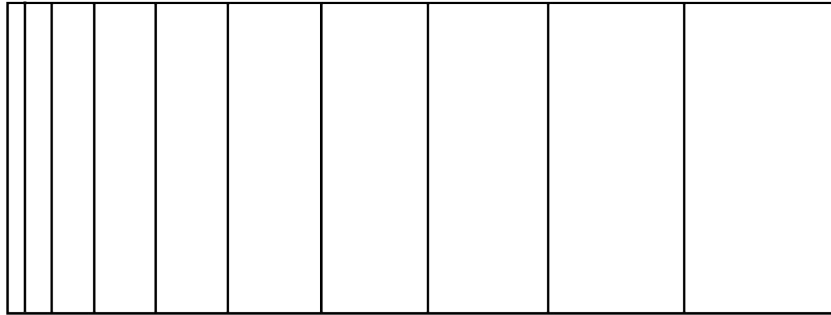
BROAD STAIR or SYSTEM OF PRISMS

Preliminary Exercises:

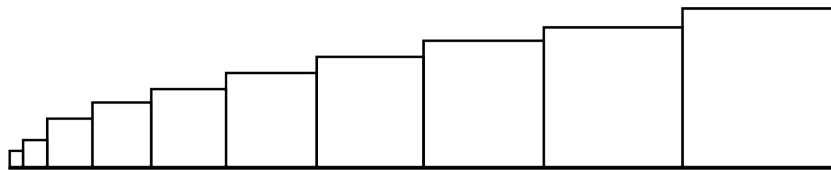
Practical life exercises including unrolling and rolling floor mats, carrying objects

Materials:

Ten brown wooden rectangular prisms 20 cm long with width and height varying from 1 square cm to 10 square cm, representing variations in two dimensions and the squares of the numbers 1 through 10
Floor mat



Top view



Side View

BROAD STAIR

Procedure:

1. Invite a child to the lesson. Have the child get a floor mat and unroll it near the shelf containing the prisms.
2. Start with the largest prism. Carry the prisms one at a time in the dominant hand.
3. Grasp the prisms across the width with thumb on one face and the four fingers on the opposite face.
4. Place them in random arrangement on the mat toward the back of the mat but parallel to the side.
5. Have the child sit on your dominant side in front of the mat.
6. Select the smallest prism and place with the dominant hand near the front of the mat to the left. The long side of the prism is parallel to the left end of the mat but is not placed on the edge of the mat. By starting with the smallest prism, there is space for the thumb when placing subsequently larger prisms. Prisms are handled with one hand only, not both. The child may require two hands for the largest prism.
7. Select the smallest remaining prism and place it to the right of the smallest prism with both ends even, using one hand for placement. Do not "adjust" prisms to make ends even but place so carefully that the ends will be even with one movement.
8. Continue selecting and placing prisms from left to right, using the dominant hand.

9. Once all prisms are sequenced, disassemble on mat. Replace on the shelf, beginning with the smallest and building left to right.
10. Have the child roll and replace the floor mat.
11. Thank the child and say that the prisms may be chosen.

Control of Error:

Muscular impression of increasing width and weight of prisms
 Visual recognition of ordered sequence of prisms

Observations:

Grasping of prisms
 Random placement on mat
 Placement of smallest prism
 Directionality of work
 Sequence of prisms on mat and upon return to shelf
 Position of ends of sequenced prisms
 Return of rolled mat
 Handling of material
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Variations:

(To be introduced ONLY after the child has worked successfully with the material according to the first presentation)
 Demonstrate the movement of the smallest prism up the "stairs" formed by the properly sequenced prisms. Holding the smallest prism at each end, move across the surface of each prism on the way up to the intersection of the next largest. Return the smallest prism to its original place in the sequence after reaching the largest one.
 Suggest that the cubes and prisms be arranged

together. Vocabulary:

prism					
small	smaller	smallest	large	larger	largest
big	bigger	biggest	thick	thicker	thickest
wide	wider	widest	thin	thinner	thinnest
narrow	narrower	narrowest			

RED RODS or SYSTEM OF RODS

Preliminary Exercises:

Practical life exercises including unrolling and rolling floor mats, carrying objects

Materials:

Ten red wooden rods with identical cross sections of 2 cm square, varying from 10 cm to 100 cm in length, with graduated differences of 10 cm, representing variation in one dimension and the series of numbers 1 through 10

Floor mat large enough to accommodate the rods, about two by three and a half feet.



Top View
RED RODS

Procedure:

1. Invite a child to the lesson. Have child get a floor mat and unroll it in an area near the shelf containing the red rods.
2. Beginning with the shortest rod, remove from shelf and place at random toward the back of the mat but parallel to the long side. Carry the rods one at a time, using both hands and holding in a vertical position parallel to the center front of the body so that interference with others does not occur. Have the child sit on your dominant side in front of the mat.
3. Select the shortest rod, move it to the front of the mat and place parallel to the front edge.
4. Draw the first two fingers of the dominant hand from left to right along the rod, then place at the left front of the mat, but not on the edges of the mat.
5. Select the next shortest rod, move to the front, feel from left to right with the first two fingers of the dominant hand as before, and place above the shortest rod so that they touch with the left ends aligned. Do not "adjust" the rods to make ends even, but make careful placement with one movement to ensure even ends.
6. Continue to select successively longer rods, moving each so that it is convenient for feeling as before and place above the previous rod with left ends in alignment.
7. After all rods have been arranged, return the rods to the shelf, arranging in the proper order but without feeling. It may be easier to start with the longest rod rather than starting with the shortest.
8. Have the child roll and replace the floor mat.
9. Thank the child and say that the rods may be chosen.

Control of Error:

Feeling the length of each rod before placement
Visual recognition of ordered sequence of rods

Observations:

Carrying of rods
Placement of rods in random order
Feeling length of each rod
Directionality of feeling
Sequence of rods on mat and upon return to shelf
Position of left ends of rods
Return of rolled mat
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

(To be introduced ONLY after the child has worked successfully with the material according to the first presentation)
Demonstrate the movement of the shortest rod along the right side of the sequenced rods from front to back by sliding on the mat to each position. Return shortest rod to its original position in the sequence.
Suggest that the child arrange the rods with the cubes and prisms.

Vocabulary:

short shorter shortest long longer longest sequence rod

KNOBLESS CYLINDERS

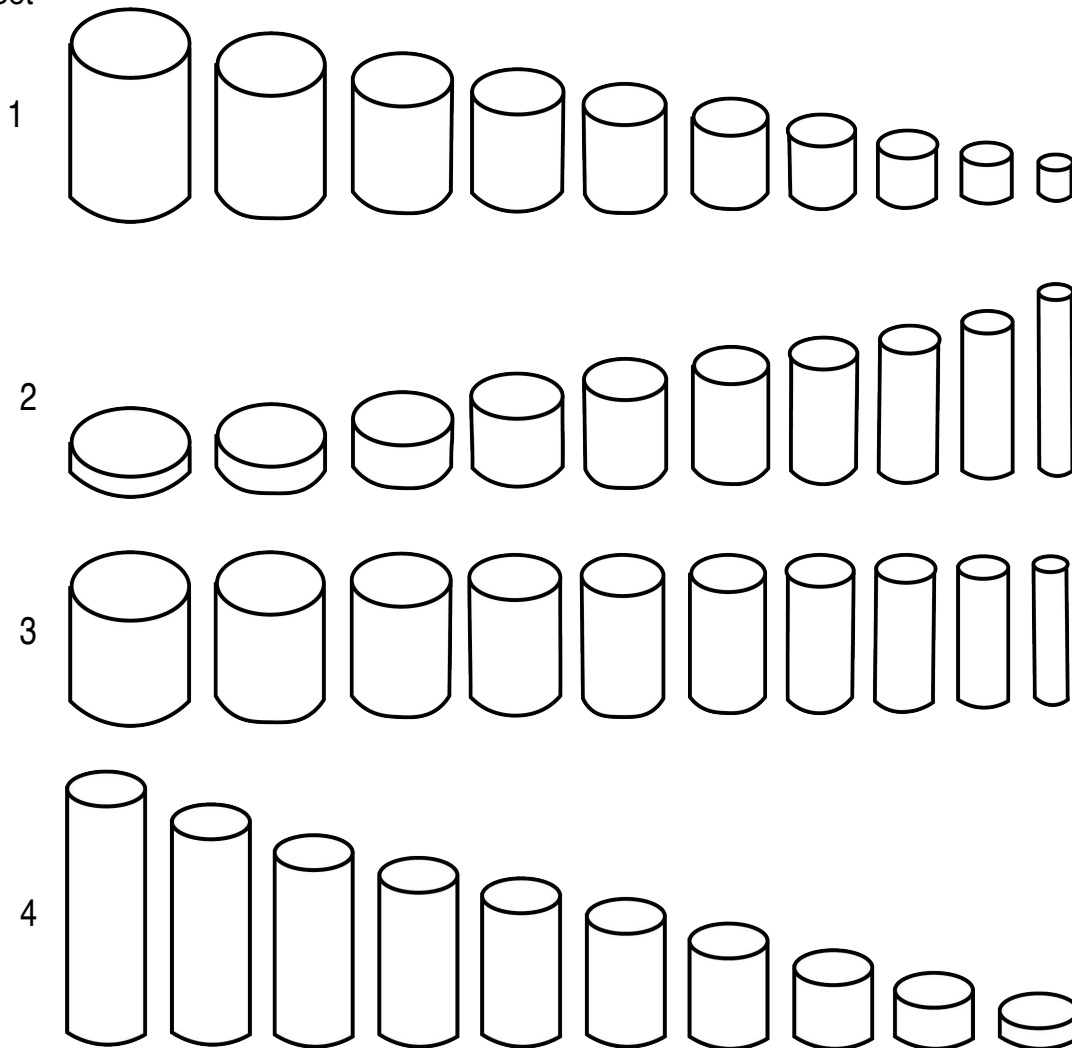
Preliminary Exercise:

Practical life exercises such as unrolling and rolling floor mats, carrying objects Exercises with the pink tower and knobbed cylinders

Materials:

Four sets of knobless cylinders identical in dimensions to those in the cylinder blocks, each set a different color contained in a separate box with lid color to match cylinders within
Floor mat
Strip of wood or plastic, 19 inches long and 3 inches wide

Set



KNOBLESS CYLINDERS

Procedure:

1. Invite a child to the lesson. Have the child get a floor mat and unroll it near the shelf containing the knobless cylinders.
2. Choose the box which contains set one and its accompanying strip. Have the child sit on your dominant side. Place the box between you and the child. Place the strip in front of the box.
3. Remove the lid, place to your non-dominant side, top down. Place the box on the lid.
4. Remove the cylinders from the box, grasping from above with all five fingers of the dominant hand, placing in random order on the mat.
5. Select the largest cylinder, grasping from above as before, and place on the left of the strip.
6. Select the next largest cylinder and place with one movement at the right of the largest without allowing them to touch.
7. Continue selecting and placing cylinders of diminishing size until all ten have been placed in sequence.
8. Remove the cylinders from the strip onto the mat. Replace the cylinders in the box one at a time starting with the largest and placing the base on the bottom of the box so that each cylinder stands upright.
9. Replace lid, return the box and the strip to the shelf.
10. Have the child roll and replace the mat.
11. Thank the child and say that any of the boxes of knobless cylinders may be chosen.

Control of Error:

- Visual recognition of ordered sequence of cylinders
- Muscular impression of decreasing size and weight of cylinders

Observations:

- Grasping of cylinders
- Placement on mat
- Arrangement of cylinders on strip
- Removal and replacement of cylinders in box
- Handling of floor mat
- Handling of material
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

- (To be introduced ONLY after the child has worked successfully with the material according to the first presentation)
- Suggest that two sets of cylinders be used together, then three sets and finally all four sets be arranged in an orderly manner so that relationships may be seen.
- Suggest that cylinders be arranged vertically to form a tower with cylinders placed concentrically

Vocabulary:

- knobless cylinder
- vertical
- horizontal

SENSORIAL MATERIALS FOR TACTILE EXERCISES

Purposes:

- To initiate the child into perception of contrasts, identities and gradations thus stimulating reasoning power and application of intelligence
- To teach the child how to make systematic distinctions
- To refine the tactile sense
- To develop a light touch
- To heighten awareness and appreciation of surface texture
- To prepare for feeling sandpaper letters and numerals which leads to writing
- To aid control of movement
- To develop appropriate vocabulary

TOUCH BOARDS

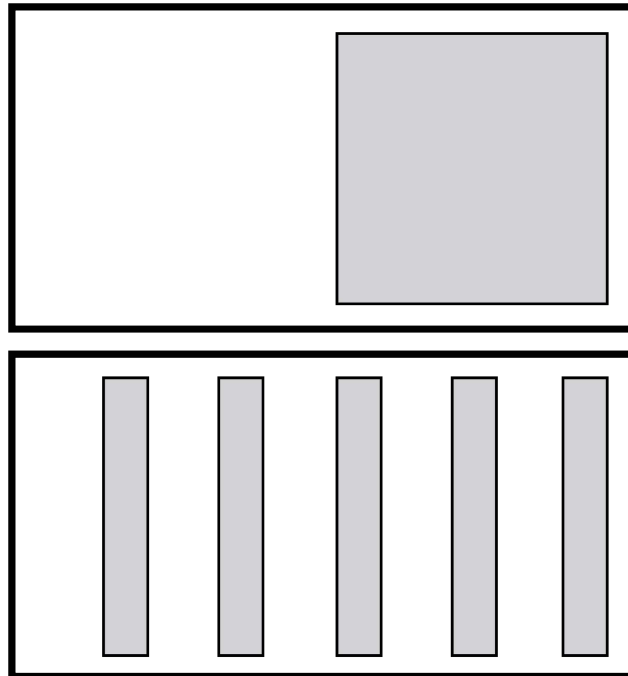
Preliminary Exercises:

Practical life exercises including holding objects, carrying objects, folding, hand washing

Materials:

Rectangular boards of the same size with textures to be touched in fixed position:

- (1) divided into two equal rectangles: one smooth, one rough
- (2) with alternating strips of smooth and rough textures
- (3) with strips of decreasing grades of roughness
- (4) with strips of decreasing grades of smoothness Blindfold



TOUCH BOARDS

Procedure:

1. Invite a child to the lesson.
2. Remove the first touch board from its place on the shelf by grasping at each end, and place on a table with the longest sides parallel to the front edge of the table. Have the child wash hands with soap, rinse in tepid water, dry and rub finger tips together to sensitize.
3. Have the child sit on your dominant side.
4. Show how to hold the first two fingers of the dominant hand together with the other fingers bent toward the palm, held by the thumb. Turn the hand over so that the position of the thumb and fingers can be observed easily, then turn palm downward.
5. Using the first two fingers of the dominant hand, draw the fingers lightly over the surface, starting at the top and moving downward. Begin with the left side, then feel the right side. Rough may be on left or right. Close eyes when feeling the board. Invite the child to feel the touch board.
6. Because this presentation is so simple, the three period lesson to teach rough and smooth may be given with the first presentation rather than waiting until the child has used the material. Encourage the closing of the eyes or the wearing of a blindfold.
7. Stand, replace chair and return the touch board to the proper place on the shelf.
8. Thank the child and say that the first touch board may be chosen.

Control of Error:

Visual recognition of different textures
Tactile awareness of textures

Observations:

Preparation of hands before choosing the material
Fingers used for feeling
Pressure of touch
Direction in which feeling is done
Use of blindfold or closed eyes
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Invite the child to use any of the other touch boards once a light touch and proper finger position have been

established. Vocabulary:

rough rougher smooth smoother smoothest
roughest tepid tactile
texture

TOUCH TABLETS

Matching Exercises

Practice with touch boards

Preliminary Exercises:

Materials:

Matching pairs of tablets, one of each pair marked or mounted on a different color, each of the two colors in separate container, minimum of four pairs with gradations of roughness

Matching pairs of tablets as above except the four pairs have gradations of smoothness
Blindfold

Procedure:

1. Invite a child to the lesson.
2. Remove one container of rough tablets from the shelf, place on table, return for second container of rough tablets.
3. Prepare hands as for use of touch boards.
4. Have the child sit on your dominant side.
5. Place containers side by side in front of the child.
6. Remove tablets from the left container one at a time. With the long side of the tablet parallel to the front edge of the table, place the tablets in a column at left of the box, starting at the top of the table. Place tablets from the other container in a column to the right. Move the containers to the outside of the columns so that there is space between the columns in which to place the pairs of touch tablets.
7. Select the top left tablet, move it to the front of the table between the two columns.
8. Show the child how to draw the first two fingers of the dominant hand from top to bottom of the selected tablet, then the repeat the process by feeling the tablets in the right column until a matching texture is located. It may be necessary to feel the selected tablet from time to time during the process.
9. Move the matching tablet to the right of the selected tablet, feel both again and say, "These feel the same." Invite the child to feel the matching tablets. Place the pair of tablets at the top between the two columns.
10. Select the next tablet at the top of the left column, move to the front of the table between the two columns and repeat the matching process, always saying "These feel the same," and inviting the child to feel the tablets when a match is made. Note: The first time the exercise is done, the eyes are open, but with subsequent use, suggest that the eyes should be closed or covered with a blindfold.
11. Once all have been paired, replace tablets in the left column in one container, those in the right column in the other container.
12. Stand, replace chair and return container one at a time to proper place on shelf.
13. Thank the child and say that tablets may be chosen.

Control of Error:

Visual recognition of different appearances of textures of each pair

Tactile awareness of different textures

Visual recognition of different color mounting or marking for each tablet of the pair

Observations:

- Preparation of the hands before choosing the material
- Positioning of tablets
- Fingers used for feeling
- Use of blindfold or closed eyes
- Direction in which tablets are felt
- Placement of matched pairs
- Return of tablets to containers
- Handling of material
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

Invite the child to match pairs of smooth tablets, using the same procedure as for rough ones.

Vocabulary:

column pair pairing

Grading Exercises:

Preliminary Exercises:

Practice matching touch tablets

Procedure:

1. Invite a child to the lesson.
2. Remove one container of touch tablets from the shelf and place on the table to the left of the child.
3. Prepare hands as for previous touching exercises. Have the child sit on your dominant side.
4. Remove the tablets from the container and place in a row midway of the table with the longest side perpendicular to the front edge of the table.
5. Feel the tablets from top to bottom as before. When the roughest is located say, "This is the roughest," and place it at the left front under the top row.
6. Feel the remaining tablets to find the roughest of those remaining. Place the selected tablet to the right of the previously placed tablet. Eyes should be blindfolded or closed.
7. Continue feeling the remaining tablets to find the roughest one, placing each selected tablet to the right of the previously placed tablet.
8. Continue until only two tablets remain. When the rougher tablet is selected say, "This is rougher," before placing it to the right of the previously placed tablets.
9. Move the last tablet to the right of the previously placed tablet. Say, "This is the least rough." Be sure to use the term "rougher" when there are only two tablets remaining.
10. Once the tablets have been felt and placed in a row, have the child begin at the left and feel each tablet to verify that the textures have been arranged from roughest to least rough.
11. Ask the child to replace tablets in the container.
12. Stand, replace chair and have the child return the material to the shelf.
13. Thank the child and say that grading may be chosen.

Control of Error:
Verification as in step 11

Observations:
Preparation of hands
Fingers used for feeling
Use of blindfold or closed eyes
Direction in which tablets are felt Placement
of tablets
Handling of material
Child's reaction to error
Length of work time and number of
repetitions Length of period of contemplation
Degree of interest and concentration

Variations:
Invite the child to grade the smooth tablets using the same procedure as for the rough
ones.

Vocabulary:
row least rough grading least smooth

FABRICS

Preliminary Exercises:
Practice matching touch tablets

Materials:
Set 1 Pairs of fabrics representing the principal fibers: silk, wool, cotton, linen, polyester,
rayon
Set 2 Pairs of fabrics with different types of weaves: pile, twill, basket, plain, satin, etc.
(All are five and one half inches square, and each pair is a different color.)
Blindfold

Procedure:

1. Remove three pairs from either set which have a distinctively different "hand" or feeling and place in a separate flat basket or on a tray.
2. Invite a child to the lesson.
3. Remove the container with three pairs of fabrics from the shelf, place on table.
4. Wash hands and have the child sit on your dominant side.
5. Show the proper manner for feeling fabric, placing it on the open hand with palm upward. Feel by rubbing the thumb over the fabric as it rests on the fingers.
6. After the child can feel the fabric as demonstrated, place one of each pair in columns with space enough between to lay the matched pairs.
7. Choose a piece of fabric from the left column with the left hand, to feel it with eyes closed or with a blindfold, then feel the fabrics in the right column with the right hand until a match is found. Say, "These feel the same," and invite the child to feel them. The matching fabrics are placed together one on top of the other at top center between the two columns.
8. Continues to feel and match the remaining fabrics, placing them in the center so that a single column of three pairs results, each pair a matching color.
9. Replace fabrics in mixed order in container.
10. Stand up, replace chair and return fabrics to shelf, placing in them the original container.
11. Thank the child and say that the fabrics may be chosen.

Control of Error:

Colors of pairs of fabrics

Observations:

Use of blindfold or closed eyes
Technique used in feeling fabrics
Pairing procedure
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Introduce additional pairs from either set. It may be necessary to place five or more pairs the length of the table which necessitates having the child stand to do the exercise. Introduce simple weaving to produce the different kinds of weaves. (Refer to "Handwork" section for details.)
Provide simple experiments to demonstrate properties of various fibers of fabrics. (Refer to "Experimental Science" section)

Vocabulary:

"hand" fabric fiber weave silk wool cotton linen polyester
satin weave plain weave pile weave twill weave basket weave

SENSORIAL MATERIALS FOR EDUCATION OF THE STEREOGNOSTIC SENSE

Purposes:

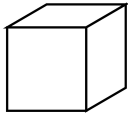
- To educate the stereognostic sense
- To develop recognition of shape through muscular memory and tactile sensation
- To allow for greater exactness of perception through integration with visual experience
- To heighten appreciation of shapes and sizes of objects
- To provide a sensorial basis for the future study of geometry
- To develop appropriate vocabulary

Preliminary Exercises:

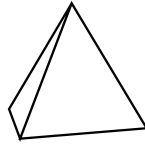
- Practical life exercises such as lifting and carrying objects, manual transfer of objects
- Practice touch boards

Materials:

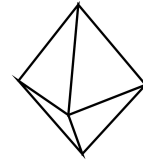
- Tray with two containers with six pairs of small geometric solids of a size to fit comfortably in child's hand, one of each pair in each container; strip of felt on which to place paired solids
- Tray with container of objects which differ in size, shape and color such as grains or dried beans; smaller containers in which to place sorted objects, number of containers to correspond to different types of objects. (Containers should be stable, shallow and large enough to allow materials to spread out in one layer.)
- Tray with container of objects which are the same shape, but differ in size and color, such as buttons, with different quantities of each type identical in size and color; smaller containers in which to place the sorted objects, number of containers to correspond to number of different types of objects
- "Secret" bag with about six familiar objects
- Blindfold



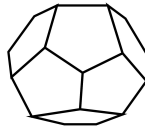
hexahedron



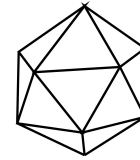
tetrahedron



octahedron



dodecahedron



icosahedron



triangular pyramid



square-based pyramid



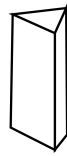
hexagonal pyramid



octagonal pyramid



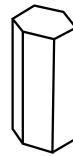
base views



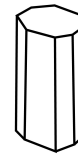
triangular prism



square-based prism



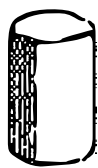
hexagonal prism



octagonal prism



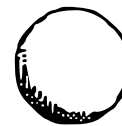
cone



cylinder



hemisphere



sphere



ellipsoid



ovoid



oblate spheroid



torus

Pairing solids

Procedure:

1. Invite a child to the lesson. Take tray of geometric solids and a felt mat to a table, and place near the back of the table but in front of child who is seated on your dominant side.
2. Place one container to the left and one to the right in front of the tray. Spread the felt mat in front of and between the two containers.
3. Remove a solid from the left container in the left hand and with the right hand, grasp the solids in the right container until a match is found. Say, "These are the same."
4. Place the pair of solids at the top of the felt mat, then continue feeling the solids as in step 3 until all are matched.
5. Observe the pairs of solids and state, "These match," pointing to each pair.
Note: The first time the exercise is done, the eyes are open but with subsequent use, suggest that the eyes should be closed or covered with a blindfold.
6. Replace one of each pair of solids in each container and replace them on the tray with the felt mat.
7. Stand, replace chair and return tray to shelf.
8. Thank the child and say that the solids may be chosen or say, "We will have another lesson."

Control of Error:

Visual recognition of identical shapes in the pairs on the felt mat

Observations:

Placement of material
Pairing of solids on felt mat
Use of blindfold or closed eyes
Replacement of solids in containers
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Add other small geometric solids pairs to the containers but no more than fifteen. Teach names of solids by three period lesson.

Vocabulary:

stereognostic
Regular solids: tetrahedron, hexahedron, octahedron, dodecahedron, icosahedron
Straight-edged semi-regular solids: pyramids and prisms (named by shape of base)
Flat-based, curved-surface semi-regular solids: cone, cylinder, hemisphere
Curved-surface solids: sphere, ellipsoid, ovoid, oblate spheroid, torus,

Sorting objects of different sizes, shapes and colors

Procedure:

1. Invite a child to the lesson. Take tray of material to be sorted, for example, dried beans, to a table and place in front of the child who is seated on your dominant side.
2. The large container of mixed objects is at the back center of the tray with the small empty containers in front of it. Begin with three different kinds of objects, five of each kind.
3. Demonstrate to the child how to feel each object with the thumb and first two fingers of the dominant hand.
4. With the non-dominant hand, touch the front of the small container on the far left. Select one kind of object and place in this container, then continue to feel objects until all of that kind are located and placed in the left container. Conduct step four with a blindfold or closed eyes.
5. Continue sorting the remaining objects as in step 4 into their separate containers.
6. After all objects are sorted, remove blindfold or open eyes and examine each small container to determine if objects have been sorted properly by observing size, shape and color.
7. Return objects to large container, one at a time.
8. Stand, replace chair and return tray of objects to shelf.
9. Thank the child and say that this sorting may be chosen .

Control of Error:

Different color, size and shape of objects in each small container
Maintaining contact with container being used

Observations:

Placement of objects in containers
Replacement of sorted objects into large container
Use of blindfold or closed eyes
Child's reaction to error
Handling of material
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Addition of more than three sizes of objects
Introduction of other objects with different shapes, sizes and colors such as dried grains

Vocabulary:

sorting names of objects used for sorting
Sorting objects with similar shapes, different sizes and colors

Sorting objects with similar shapes, different sizes and colors

Procedure:

1. Invite the child to sort these objects if previous sorting has been successful.
2. The large container of mixed objects is at rear center of the tray with the small empty containers in front of it. Begin with three sets of objects.
3. Tell the child that these objects may be sorted the same way as the dried beans.

Control of Error:

Different colors and sizes of objects in each small container

Observations:

Placement of objects in small containers
Replacement of sorted objects into large container
Use of blindfold or closed eyes
Child's reaction to error
Handling of material
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Addition of more than three sets of objects
Introduction of other objects with similar shapes, different sizes and colors such as seashells

Vocabulary:

similar

"Secret" bag

Procedure:

1. Invite two or three children to the lesson. Take the "secret" bag to a table around which children are seated.
2. Remove objects from bag for children to examine and name. Although objects should be familiar, use the three period lesson to teach names of objects for which any child lacks vocabulary.
3. Replace objects in bag.
4. Invite each child to take a turn reaching into the bag to feel an object, name it and then remove it. The child places the object in the center of the table.
5. After all objects have been identified and placed on the table, they are returned to the bag.
6. Stand, replace chair and return "secret" bag to shelf.
7. Thank the children and say that the "secret" bag may be chosen.

Control of Error:

Familiarity with objects and their names
Child's stereognostic sense

Observations:

Identification of objects
Replacement of objects in bag after all are identified
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Add more than six objects.
Replace with other familiar objects.
Ask the child to find a certain object in the bag. Use familiar objects without previously showing them

Vocabulary:

names of objects secret

MATERIALS FOR EDUCATING THE CHROMATIC SENSE

Purposes:

- To assist in the recognition and naming of colors
- To refine color perception
- To acquire sensitivity to intensity of colors
- To develop color memory
- To increase awareness of and appreciation for color
- To educate the chromatic sense
- To prepare for art activities
- To develop appropriate vocabulary

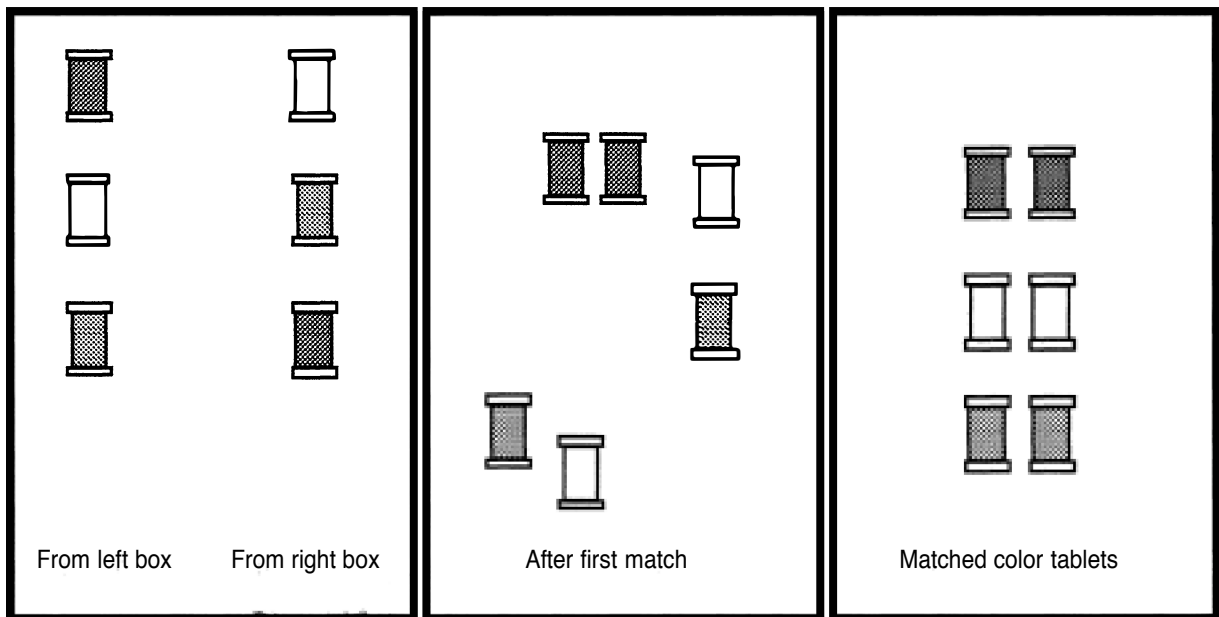
Preliminary Exercises:

Practical life exercises such as carrying boxes, removing, replacing lids, manual transfer
Sensorial activities such as the knobbed cylinders

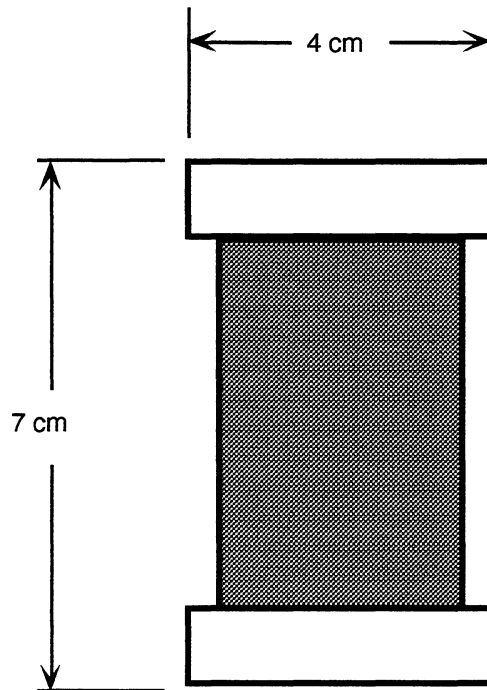
Matching exercise:

Materials:

- Two boxes each containing a red, a blue and a yellow color tablet
- Two boxes each containing one of the primary and secondary colors plus gray, white, black, brown, pink



Matching with the First Color Tablets



Color Tablet

Procedure:

1. Invite a child to the lesson. Take the two boxes of color tablets which contain the three primary colors and place on a neutral colored table in front of the child who is seated on your dominant side.
2. Place boxes side by side, remove lids and place under boxes.
3. Grasping the uncolored ends, place tablets from left box to the left of it in a column. Place tablets from right box to the right of it in a column. Remove boxes and lids to the outside of the columns so that there is space between the columns in which to place the pairs of color tablets.
4. Show the child how to hold the color tablets so that the fingers do not touch the colored part and invite the child to practice picking up the tablets.
5. Select a color tablet from the top of the left column and move it to the front of the table between the two columns.
6. Ask the child to find the one that looks the same from the right column and indicate its placement next to the previously placed tablet with the colored areas side by side. Have the child move the matched pair to the top of the space between the columns.
7. Select another color tablet from the left, move it to the front and have the child find the matching tablet as before, moving the pair under the previously placed pair.
8. Move the third tablet to the front and have the child place its match next to it.
9. Show the child how to replace the tablets from the left side of the pairs into the box at the left and repeat the procedure with the tablets on the right.
10. Place the lids back on the boxes, stand, replace chair and return boxes to shelf.
11. Thank the child and say that these color tablets may be chosen but only if the matching of colors was successful. Otherwise, state, "We will have another lesson with the color tablets later."
12. Once the child has worked with the primary color tablets many times, invite the child to use the second box of eleven tablets for matching. A lesson with the second box is not needed.

Control of Error:

Visual discrimination of matching color in the pairs

Observations:

- Carrying of boxes
- Position of fingers in handling color tablets
- Placement of tablets before pairing
- Pairing procedure
- Return of tablets to boxes
- Handling of materials
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

- Teach color names by the three period lesson.
- Introduce color memory game by placing one of each pair of the second color box on separate widely located tables. Show a color tablet to a child, ask the child to remember it and get the matching color from the other table.

Vocabulary:

- Names of colors

Grading Exercise:

Preliminary Exercises:

- Matching exercises with color tablets

Materials:

- Box with separate compartments for each of seven color gradations, minimum of primary and secondary colors (red, yellow, blue, green, purple, orange)

Procedure:

1. Invite a child to the lesson. Take the box of graded color tablets to the table and place in front of the child who is seated on your dominant side. Place the lid under the box.
2. Remove the lightest color and darkest color from one compartment of colors. Do not use red or purple because light red is pink and light purple is lavender which are words the child will learn later or may already know.
3. By the three period lesson, teach the terms light and dark.
4. If the three period lesson has been successful, take the medium color from the same compartment and place the three color tablets in a row in front of the child.
5. Ask the child to find the darkest color and indicate placement at the left near the front of the table, then to find the lighter color, indicating placement at the right. Have the child place the remaining tablet between those two so that they are touching. The uncolored ends are at top and bottom of the row.
6. If continued interest is shown, invite the child to remove the remaining four gradations of color from the same set, rearrange all seven tablets in a row in random order and then grade with the darkest at the left, the lightest at the right. The invitation to use all seven tablets is made only if you observe no difficulties in grading the three tablets. Leave the table and observe unobtrusively. The child is free to choose any of the colors to grade, using only one set at a time at first, then later grading several sets.
7. If the child does not appear to be interested in continuing, the remaining tablets are introduced at another lesson.
8. Upon completion of the work, the child replaces the color tablets in the box, not necessarily in order, and returns it to the shelf. You do not need to be there because this practice should have been established before this stage.

Control of Error:

Visual discrimination of color gradations

Observations:

Carrying of boxes
Position of fingers when handling tablets
Placement of tablets on the table
Grading procedure
Return of tablets to compartments
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Teach other color names such as pink, lavender, etc.
Mix all seven gradations of two widely contrasting colors such as red and blue to be separated, then graded in the series.
Introduce the color memory game by placing on a table as many series of graded colors as there are children participating. Have each child select one color to remember.
Mix the tablets in random order and then invite each child to find the color originally selected to grade.
Mix the entire box of colors on a table to be arranged in gradations of each color by one child or several children.
If there are two boxes of graded color tablets available, the child chooses any tablet from one boxed set, places it on that table, then selects the matching color by memory from all sets laid out in gradation on a distant table.
Suggest that the child use a color wheel control against which to place the color tablets, starting with the darkest color tablet placed on the edge of the control, then grading outward. To prepare a control, make a hexagon from white heavy weight paper, each side of the hexagon being the width of the color tablet. Color a strip on each side in this order, going clock-wise: yellow, orange, red, purple, blue, green.
Note: If the table size is not adequate, use a mat on the floor.

Vocabulary:

dark darker darkest light lighter lightest gradation aqua turquoise maroon
pink lavender peach maize azure cerulean violet rose crimson scarlet vermilion

EXERCISES FOR DISTINGUISHING SOUNDS

SOUND BOXES

Purposes:

- To introduce the first category of sound which is noise
- To provide training in listening
- To develop the ability to distinguish intensity of noises
- To arouse interest in variations in sound
- To aid the development of hearing ability through perception of minimal sound
- To give indirect preparation for learning phonetic sounds
- To develop appropriate vocabulary

Preliminary Exercises:

Practical life exercises such as carrying objects

Materials:

- A box containing six cylinders with red tops, each making a different intensity of noise
- A box containing six cylinders with blue tops, identical in sound to those with red tops
- A box containing two cylinders with red tops, one making the loudest noise, one making softest
- A box containing two cylinders with blue tops, one making the loudest noise, one making softest

Introductory Procedure:

1. Invite a child to the lesson. Take either box containing six cylinders and place on a table in front of the child who is seated on your dominant side.
2. Remove the box lid and place the box on top of it.
3. Remove the cylinders and place in a row in front of the box.
4. Demonstrate how to hold the cylinder from the left in the dominant hand with fingers around the circumference of cylinder, being careful that fingers don't touch ends.
5. Hold the cylinder next to the ear on the dominant side and shake with one downward motion, then replace in the row.
6. Repeat with the other cylinders in turn.
7. Place the cylinders in the box, replace the lid.
8. Stand, replace chair, return box to the shelf.
9. Thank the child and say that either of the boxes of sound cylinders may be chosen.

Matching Procedure:

1. Invite a child who has done the introductory work to a lesson. Take the boxes containing two cylinders, one at a time. Place near each other toward the rear of a table in front of the child who is seated on your dominant side.
2. Remove the lids, place under the boxes and remove the cylinders, placing the two with red tops in a column on one side of the boxes and those with blue tops in a column on the other side. Move boxes and lids to the rear outside of the columns.
3. Take the first cylinder from the top of left column in the dominant hand, shake and place it at the front between the two columns.
4. Shake each cylinder from the right column, using dominant hand until a match is found for the first cylinder chosen. Shake each again to verify that the sounds are the same. Say, "These sound the same.", Place the matched pair together in the center.
5. Shake the remaining cylinders to verify that they sound the same. State so and place them together in front of the first pair.
6. Replace the cylinders in the boxes.
7. Stand, replace chair and return boxes, one at a time, to shelf.
8. Tell the child that this set of cylinders may be chosen.

Control of Error:

One red and one blue top in each pair
Auditory discrimination of intensity of sound

Variations:

Once the two pairs of sound cylinders have been matched without difficulty, tell the child that both boxes of sound cylinders may be matched.

Grading Procedure:

Preliminary Exercises:

Matching all six pairs of sound cylinders

Materials

A box containing six sound cylinders with either red or blue

Procedure:

1. Invite a child to the lesson. Take either box containing six sound cylinders, place in the middle of the table in front of the child who is seated on your dominant side.
2. Remove the lid, place under the box and remove the cylinders, placing them in a row in front of the box.
3. Shake each cylinder in turn, left to right, to find the loudest sound, then place it at the left in front of the row of remaining cylinders.
4. Ask the child to shake the other cylinders, find the softest sound and place it at the right in front of the row of remaining cylinders.
5. Continue the procedure until all cylinders are graded.
6. Verify the grading by shaking each cylinder in turn, starting at left.
7. Replace the cylinders in the box.
8. Stand, replace chair and return box to the shelf.
9. Thank the child and say that the sound cylinders may be chosen for grading.

Control of Error:

Auditory discrimination of differences in intensity of noise

Observations:

Carrying of boxes
Placement of cylinders
Grading or matching procedure
Return of cylinders to box
Handling of materials
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Vocabulary:

loud louder loudest soft softer softest intensity

BELLS

Purposes:

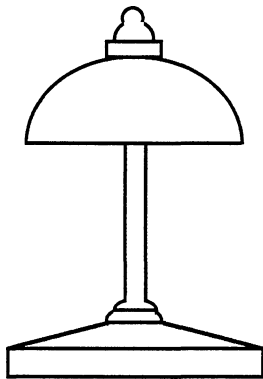
- To introduce the second category of sound which is musical tones
- To provide further training of the auditory sense
- To develop the ability to distinguish musical tones
- To train the musical sense
- To establish a foundation for musical education
- To develop a basis for music appreciation
- To develop appropriate vocabulary

Preliminary Exercises:

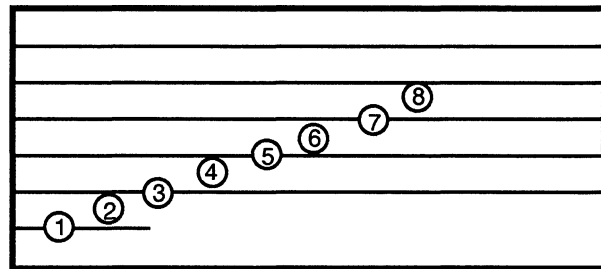
- Matching and grading the sound cylinders

Materials:

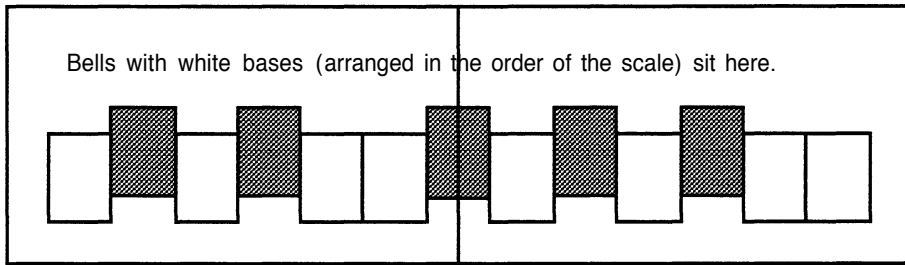
- Eight bells mounted on natural wooden bases representing an octave starting at middle C
 - Eight bells mounted on white wooden bases whose tones match the other eight bells
 - Felt tipped damper
 - Striker
 - Cabinet or low table to contain the bells at a height convenient for striking while standing
 - Two boards painted black and white to simulate one octave on the piano keyboard and to be used for placement of bells with natural wooden bases
 - Staff board with container of eight movable notes starting with middle C, and control staff board
 - Container of cut-out bass and treble clef symbols
- Note: The white based bells are always kept in the proper arrangement to form the scale and are placed on the green spaces at the rear of the board.



BELL



STAFF BOARD



Bells with natural finished wood bases sit on the white rectangles.

THE BELL BOARD

Introductory Procedure:

1. Invite a child to the lesson. Stand in front of bell cabinet or table on which the set of bells with natural wood bases is mixed randomly in a row at the front but not on the bell boards.
2. Show the child how to pick up, hold and carry the bells by grasping around the stem, palm downward, so that no part of the hand ever touches the metal bell.
3. Demonstrate how to hold the striker near the top end of the handle in the dominant hand and how to swing it freely through action of the wrist to strike the bell rim. Hum the tone.
4. Touch the felt part of the damper, held in the non-dominant hand, under the rim to stop the sound after striking each bell and before striking the next bell. Always hum the tone before damping.
5. Thank the child and say that the bells may be chosen.

Matching Tones:

Preliminary Exercise:
Introductory exercise

Procedure:

1. Choose the pair of bells for E and the pair for G, these tones representing the natural pitches of the child according to some theorists. Arrange with the natural wood based bells at the front, keeping the white bells in their places on the green part of the board. Remove the remaining natural wood based bells from the surface where matching will take place. Note: Place small pieces of tape on the bases of the pairs of E and G bells so that the child will be able to choose the proper ones from the entire set without having to depend on the teacher to find them.
2. Invite a child to the lesson, stand in front of the bells.
3. Strike the natural wood based bell at the left and hum the tone. It does not matter which tone is left or right. Damp the bell, then strike each of the white based bells, damping between strikes. Always hum the tone before damping.
4. When the tone is found which matches that of the first bell, restrike both matching bells, hum, damping between, move the natural wood based bell in front of its match, and say, "These sound the same."
5. Repeat the procedure with the other pair.
6. Thank the child and say that the bells may be matched, first the two pairs, then all eight.

Control of Error:

Auditory discrimination of matching tones
One white and one natural wood based bell in each pair
Small pieces of tape on the E and G bells

Controlled Grading:

Preliminary Exercises:
Matching all eight pairs of bells

Procedure:

1. The natural wood based bells are in random order in front of the white based bells.
2. Invite a child to the lesson, stand in front of the bells.
3. Tell the child to match the natural wood based bells to those with white bases which are arranged in the scale, humming each tone.
4. Do not stay with the child, but observe unobtrusively.

Control of Error:

White based bells graded in scale

Independent Grading:

Preliminary Exercises:

Controlled grading

Procedure:

1. After the child has had practice with controlled grading, suggest that the natural wood based bells be placed in random order in front of the bell boards.
2. Invite the child to grade the bells, humming each tone, and placing them in order on the bell boards without striking the white based bells.
3. Tell the child to strike each bell in turn to verify the arrangement, humming each tone.
4. Bells should be rearranged in random order at the conclusion of the exercise.

Control of Error:

Auditory discrimination of graded tones of scale
White bells

Observations:

Handling of bells
Use of striker and damper
Humming of tones
Arrangement of bells in pairing and in grading
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Teach parts of the bell: bass, stem, bell, top
After successful use of the bells introduced initially, add the black based bells and matching natural wood based bells for matching and grading.
Introduce the singing of the names of the notes as soon as the child has learned how to distinguish sounds accurately.

Memory Game 1:

(For children who have worked successfully at matching the bells)

Place the natural wood based bells at random in a row on a table away from the bell cabinet. Have a child strike any natural wood based bell, hum the tone and remember it. The child strikes the white wood based bells, hums the tones and finds the one which matches the natural wood based bell. The natural wood based bell is taken to the bell cabinet and placed in front of its matching white based bell. Once the child becomes proficient, suggest that two bells be remembered and matched. Suggest that the child wait a longer time between striking the white based bell and finding its matching tone, perhaps doing another activity in the interim.

Memory Game 2:

(For those who have done the first matching game)

Move natural based wood bells to a table from a randomly arranged set. Invite children who have matched and graded the bells each to strike a natural wood based bell, hum and remember the tone. Strike a white based bell and ask the child who has the matching tone to bring that bell from the cabinet to the table. The child verifies that the tones match by striking both bells and humming the tones. The natural wood based bell is placed in front of its matching white based bell. Repeat the exercise with another white based bell.

Grading Game:

(For those who have successfully graded the bells as an individual exercise)

Eight children each choose a natural wood based bell to hold, then arrange themselves in a row. Another child strikes and damps each bell. The child holding the bell hums the tone. The children move up or down the row according to their pitch to form the scale. The child who does the striking repeats striking the bells until all are in order. Once the black based bells have been introduced, these may be included in the grading game by increasing the number of children.

Note Matching

(For those who have learned to sing the note names)

Invite the child to strike each note on the white based bells, starting at the left with middle C. The child sings the tone and places the appropriate movable note at the front of the bell base.

(Note: It may be necessary to give a three period lesson on the letters shown on the movable notes.)

Invite those who have done all of the previous exercises to participate. The teacher plays a simple tune on the bells without damping between the notes. After repeating the same tune many times, invite a child to reproduce the tune.

Provide a tape with simple tunes played on the bells to be used on a tape player with earphones by children. Examples of simple tunes are Three Blind Mice, Jingle Bells, Twinkle Little Star, Hot Cross Buns, Row Your Boat.

Staff Board

(For those who have mastered note matching)

Place the staff board on a table near the bell cabinet with the control staff board at the left.

Place the box of notes behind the mute board. Notes have letter designating name on the face and numeral designating sequence on reverse. Place the notes on the control board by matching numerals, then move the notes to the same position on the mute board.

Note may be placed at random on the mute board, then played on the bells.

By the three period lesson, teach the following terms with the corresponding material: staff, treble clef, bass

clef. Vocabulary:

base stem bell striker damper names of notes damp
octave staff treble clef bass clef

SILENCE

Purpose:

To introduce the third category of sound which is silence
To exercise the will in the suspension of movement
To isolate oneself from the ordinary sounds of life
To induce collective action for the production of silence
To improve hearing ability through perception of minimal sounds
To develop awareness of minimal sounds in the environment

Preliminary Exercises:

Practical life exercises for control of movement such as carrying chairs, walking on the line, handling objects, etc.

Materials:

Card with "Silence" written on it

Procedure:

1. Stand or sit quietly, inviting children to act in the same way. Mention sounds that you hear such as breathing, feet moving, etc.
2. When silence is achieved, tell the children to come to you when they hear their names being called.
3. Leave the room and stand in an open door or stand in an area of the room away from the children. Quietly call the name of each child, who moves silently to stand behind or beside you.
4. Once all the children have been called, quietly move back into the room without saying anything, gesture to the children to follow and return to their activities without breaking the spell of silence.

Control of Error:

Auditory awareness of sounds resulting from movement

Observations:

Suspension of movement
Attentiveness
Child's reaction to error
Degree of interest and concentration

Variations:

The teacher may use a "silence" sign to begin the process of making silence. The children do not use the sign.

Note: The "silence game" should be introduced at the end of the work cycle. It is never used as an attempt to regain order in the class.

The fourth category of sound is the human voice. The learning of the phonetic sounds of letters is classified in this category.

SENSORIAL MATERIALS FOR EDUCATION OF THE SENSE OF SMELL

Preparation of odor bottles with dried materials

Materials:

Ten opaque containers about two inches tall, one and one fourth inches in diameter with *five* screw-type lids painted red and *five* blue, or *five* red and *five* blue containers. (Film containers, glass ointment jars from the pharmacy or any small non-transparent container with a screw-type lid may be used.) Cloth for making four inch squares, thread

Five different dried materials such as herbs, flowers, grated fruit peels, ground spices, etc. Five transparent jars with screw-type lids, large enough to hold a quantity of ground dried material.

Five teaspoons

Transparent self-adhesive laminating material such as Contact

Five different colors of adhesive tape or adhesive dots

Mortar and pestle

Container large enough to accommodate the *five* pairs of odor bottles

Note: Red and blue plastic squeeze bottles may be used with cotton balls to keep odor materials from escaping as the bottle is squeezed.

Procedure:

1. If plants with distinctive odors are available in the children's garden or from other sources, gather the plants and hang or spread to dry with the help of the children, if possible.
2. Once the plants have dried, show how to grind the material with a mortar and pestle and place in labeled transparent jars with a whole piece of the dried plant affixed to the lid with transparent self-adhesive laminating material such as Contact. Clean the mortar and pestle between grindings of each different material.
3. Tear ten four inch squares of fabric with the help of children who are interested.
4. Check ten opaque containers for residual odors. Children may wash those until no odor remains. Be sure the containers are perfectly dry.
5. Lay out *five* pairs of fabric squares in two columns and place at their left *five* teaspoons. To the left of the spoons, place the large jars of dried, ground materials chosen to make up odor bottles.
6. Have a child open the first large jar, measure one heaping teaspoon of dried material into each of the two fabric squares next to that jar, replace lid and spoon.
7. Gather together the four corners of the first pair of fabric squares and secure the materials within by wrapping thread around the cloth above the enclosed material, then tying in a square knot.
8. Place pairs of fabric wrapped odor materials into two of the opaque containers, tied side downward.
9. Choose one color of adhesive tape and cut four small rectangles or use four of the same colored dots. Place two on the bottoms of these two prepared containers, one inside a red lid, one inside a blue lid so that the odors will not mingle among lids and containers. Place lids on containers. Plastic squeeze bottles need no lid markings since the lids are not removed.
10. Continue to prepare the material as in steps 6 through 9, one pair at a time, marking each pair with a different color of tape or dots.
11. Place the *five* pairs of odor bottles in their container and put on the assigned place on the shelf.

Preparation of odor bottles with liquids

Materials:

- Ten opaque containers about two inches tall, one and one fourth inches in diameter with five screw-on lids painted red and five blue, or five red and five blue plastic squeeze bottles
- Absorbent cotton
- Five nontoxic liquids having distinctive odors such as vanilla extract, oil of peppermint, etc. Five teaspoons
- Five different colors of adhesive tape or colored dots
- Container large enough to hold five pairs of odor bottles

Procedure:

1. Select ten odor-free containers like those used for dried materials.
2. Fill each of the ten containers with absorbent cotton.
3. Make two columns with the small containers or plastic bottles, place a teaspoon left of each pair and place a different liquid to be used for odors at the left of each spoon.
4. Remove the lid from the top left liquid, pour one teaspoon in each of the two cotton filled containers to the right of it and replace the lid on the liquid.
5. Choose a color of adhesive tape and cut four small rectangles or use four dots of one color. Place two on the bottoms of the first pair of containers, one inside a red lid and one inside a blue lid. Put the lids on these containers. Plastic squeeze bottles need no lid markings since the lids are not removed.
6. Repeat for each of the other liquids, using different colors for each pair.
7. Place the five pairs of prepared containers into their container and put in the assigned place.

Matching Exercise with Odor Bottles

Purposes:

- To develop a keen sense of smell as a means of exploring the environment
- To discriminate odors
- To demonstrate the correct procedure for smelling any substance
- To develop appropriate vocabulary

Preliminary Exercises:

- Practical life exercises such as carrying trays and boxes; removing lids

Materials:

- Odor bottles containing dried materials
- Odor bottles containing liquid materials

Procedure:

1. Invite a child to the lesson. Take either container of odor bottles to a table and place in front of the child who is seated on your dominant side.
2. Place the red bottles or those with red tops on one side of the container in a column and the blue bottles or those with blue tops in a column on the other side. It does not matter on which side the red or blue placement is made, but the bottles must be within easy reach of the child.
3. Remove the empty container from the center so that there will be space to place the matched pairs. Place the container out of the way on your non-dominant side.
4. Remove lids from each container and place to the left of the left column and to the right of the right column. Lid top faces upward so that the colored tape on the inside of the lid is not visible. Child assists with removal of lids. With plastic bottles, place red in one column, blue in other, keeping the lids on.

5. Select the top left container and move it near the front edge of the table between the two columns.
6. Demonstrate how to hold the container and to pass it slowly under the nostrils from left to right, breathing normally. Replace the container on the table and invite the child to smell it. With plastic bottles, gently squeeze bottle as it is passed under the nostrils.
7. Smell the containers in the right column until an odor is found that matches, letting the child smell each. It may be necessary to smell the container from the left column several times during the process. Once a match is located, verify by smelling both containers.
8. Place the matched pair of odor containers at top center between the two columns.
9. Choose the next container from the left column and repeat steps 7 and 8.
10. After all odors have been matched, check the bottom of each pair of containers to see if the colored tape matches.
11. Return the appropriate lid to each container by looking at the color of tape on the underside of the lid and matching it to the color on the bottom of the container.
12. Replace in the large container.
13. Stand, replace chair and return the materials to the shelf.
14. Thank the child and say that the odor bottles may be chosen.

Control of Error:

Color of tape or dots on bottoms and inside lids of containers

Observations:

Placement of odor bottles
 Checking of colored tape on bottoms of pairs after matching odors
 Replacement of lids by matching colors on undersides of lids to those on bottoms of containers
 Handling of materials
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Variations:

Use different dried and liquid materials for odor containers. Identify plants by odor.
 Make sachets with dried materials.
 Three period lesson to learn the names of the odors.

Vocabulary:

odor nostril names of materials used to prepare odor containers

SENSORIAL MATERIALS FOR EDUCATION OF THE SENSE OF TASTE

Preparation of tasting materials

Materials:

Salt, sugar, vinegar, alum
Cup, four teaspoons
Four containers with screw lids to hold one cup of each liquid and labeled according to contents
Four non-transparent dropper bottles
Funnel

Procedure:

1. Add one teaspoon of salt to one cup of warm water and place in labeled container.
2. Add one teaspoon of sugar to one cup of warm water and place in labeled container.
3. Add one teaspoon of alum to one cup of warm water and place in labeled container.
4. Add four teaspoons of vinegar to one cup of water and place in labeled container.
(Older children may be instructed to prepare solutions.)

Note: The strength of vinegar may vary. Larger amounts may be needed to produce the sour taste.

5. Using a funnel, add a different solution to each unlabeled dropper bottle and place dropper bottles in a row on a tray with the small pitcher behind the bottles. Clean the funnel after each use. (Older children may fill the bottles.)

Lesson with tasting bottles

Purposes:

To develop recognition of the four basic tastes (sweet, sour, salty, bitter)
To arouse interest in distinguishing mixed sensations of taste, smell and tactile sensations of the tongue as an exploration of oneself and one's environment
To develop appropriate vocabulary

Preliminary Exercises:

Practical life exercises such as use of dropper bottle, removing lids, use of funnel, carrying a tray, pouring water.

Materials:

Large containers (with lids) of concentrated solutions of sugar, salt, alum
Large container (with lid) of vinegar solution
Four non-transparent dropper bottles, containing solutions as prepared, on a tray
Closed container with a supply of small disposable cups
Closed container with a supply of mini paper petit four cups
Tray to hold four dropper bottles, two cups.eight petit four cups

Procedure:

1. Invite a child to the lesson.
2. Wash hands and have the child wash hands.
3. Place eight petit four cups and two disposable cups on the tray of tasting bottles and take to a table. Seat the child on your dominant side.
4. Place two petit four cups in front of each tasting bottle.
5. Have the child get water in one disposable cup while the teacher gets water in the other from the sink or drinking fountain. Cups of water are placed on the table before each person.

6. Unscrew the lid of the first dropper bottle on the left, collect liquid in the dropper, and place one or two drops in the petit four cup. Replace dropper in bottle, but do not screw in place until the exercise is completed and materials are ready to be replaced on shelf.
7. Carefully raise the petit four cup to your mouth and lick the drops. Return the petit four cup to the tray, placing it behind the tasting bottle to keep your paper separate from the child's. Take a sip of water from your cup.
8. Invite the child to repeat the procedure and say the name of the taste, either sweet, salty, sour, bitter. (This is the first period of the three period lesson.) The child's petit four cup is placed in front of the bottle just sampled and the water cup is returned to its place on the table.
9. Repeat the procedure for the other tasting bottles, giving the name of the taste and taking a sip of water between tastes.
10. After the child tastes the liquids several times, ask if a taste is salty or sweet, bitter or sour. (This is the second period of the three period lesson, which may be repeated if necessary.)
11. If interest is sustained, move to the third period of the lesson by asking the child to name the taste as tasting is being done. It may be necessary to delay the third period or even the second period until another time the child chooses the material.
12. Take all used cups to the waste basket, first emptying any remaining liquid into the sink. Tighten the tops of the tasting bottles.
13. Check table and tray for any spills which are then cleaned up appropriately.
14. Stand, replace chair and return tray of tasting bottles to shelf.
15. Thank the child and say that tasting may be chosen.

Control of Error:

Child's sense of taste

Observations:

Placement of drops in petit four cups
 Transfer of liquid to mouth
 Sipping water between tastings
 Clean up procedure
 Handling of materials
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Variations:

Provide foods which have distinctive sweet, salty, sour and bitter tastes.
 Teach the areas of tongue which receive each of the four tastes by means of cards with diagrams and controls.
 Provide substances which offer tactile sensations to the tongue in addition to taste such as fish oil, thick syrup, etc.

Vocabulary:

sweet sour salty bitter oily sticky parts of the tongue

SENSORIAL MATERIALS FOR IMPRESSION OF TEMPERATURE

Purposes:

To heighten awareness of differences in temperature
To teach the child how to make systematic distinctions
To develop appropriate vocabulary

THERMIC BOTTLES

Preliminary Exercises:

Practical life exercises such as carrying boxes, removing lids
Exercise with packet for parts of the hand, using the three period lesson

Materials:

Container with eight metal, plastic or heavy glass cylindrical or elliptical containers, small enough to be held comfortably in a child's grip and about four inches tall, with four water-tight tops colored red and four blue. (Plastic spice or seasonings containers of identical size, color and shape may be used by painting the tops. Containers may be transparent.)

Matching Exercise:

Procedure:

1. Prepare the thermic bottles by placing very cold water in one pair (that is, one container with a red top and one with a blue top); hot water from a hot water tap in another pair. (Be certain that the temperature will not be uncomfortably hot.) Prepare a warm pair by adding hot water to 3/4 the volume of the container and filling the 1/4 with cold water. Prepare a cool pair by adding cold water to 3/4 the volume of the container and filling the 1/4 with hot water. Children may watch the procedure and eventually, older ones may want to do the preparation.
2. Invite a child to the lesson. Take the container of thermic bottles to a table and place in front of the child who is seated on your dominant side.
3. Place the bottles with red tops on one side of the container in a column and those with blue tops on the other side in a column in front of the child. It does not matter on which side red or blue placement is made, but tubes should be within easy reach of the child.
4. Remove the empty container from the center so that there will be space to place the matched pairs. Place the container out of the way on your non-dominant side.
5. Select the top left bottle and move it near the front edge of the table between the two columns. Show the child how to feel the bottle by grasping it to make contact with the palm, fingers wrapped around the tube.

6. Grasp the tube in the left hand, then grasp each of the bottles in the right column with the right hand until a match is located. Place it beside the first bottle which has been moved to the front of the table between the two columns. Invite the child to feel the two bottles and say, "These have the same temperature."
7. Move the matched pair to the top center between the two columns.
8. Continue to match the thermic bottles as in step six, placing subsequent pairs in front of previously paired bottles.
9. Replace the bottles in their container once all have been paired.
10. Stand, replace chair and return container of thermic tubes to the proper place on the shelf.
11. Thank the child and say that you must prepare the thermic tubes before they can be chosen, unless chosen immediately following the lesson when temperatures have not changed appreciably. You may say, "We will have another lesson later." Remove bottles from shelf once temperatures are the same.

Control of Error:

One red and one blue top in each pair
Child's sensitivity to temperature

Observations:

Placement of thermic bottles on table
Grasping of bottles
Placement of paired bottles
Child's reaction to error
Handling of material
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Teach the terms warm, hot, cold and cool by the three period lesson if not known.

Vocabulary:

hot cold Grading warm cool temperature thermic

Exercise:

Preliminary Exercises:

Pairing exercise with thermic

bottles Procedure:

1. Invite a child to the lesson after preparing thermic bottles as described in the previous exercise. Take the thermic bottles to a table and place in front of the child who is seated on your dominant side.
2. Remove one set of thermic bottles (with either the red or blue tops) from the container and mix in a row midway of the table.
3. With the dominant hand grasp each thermic bottle and find the warmest one. Placed at the left and in front of the other thermic bottles and say, "This is the warmest temperature."

4. Repeat the process to find the warmest of the remaining bottles. Place it to the right of the previously placed bottle. Say, "Of those which remained, this is the warmest."
5. Feel the remaining two bottles until the warmer one is found. Move it to the right of the previously placed bottle and say, "Of the two bottles this is the warmer one."
6. Place the remaining bottle to the right of the previously placed bottles.
7. Grasp each bottle in turn, starting at the left, saying, "This is hot, this is warm, this is cool, this is cold." Invite the child to grasp each of the bottles as just demonstrated to verify grading of temperatures.
8. Replace bottles in container.
9. Stand, replace chair and return container of thermic bottles to the shelf.
10. Thank the child and say that grading as well as matching thermic bottles may be chosen or say, "We will have another lesson."

Control of Error:

Verification of gradation of temperature in step 7

Observations:

Choice of bottles with same color top
 Arrangement of bottles before grading
 Grasping of bottles
 Handling of material
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Vocabulary:

row grading warmer warmest cooler coolest hotter hottest colder coldest

THERMIC TABLETS

Preliminary Exercises:

Matching and grading temperatures with thermic bottles

Materials:

Two containers each with one of a pair of tablets made of materials having different thermal properties such as felt, marble, wood, steel, glass, each tablet being the same size and thickness
 Blindfold

Matching Exercise:

Procedure:

1. Invite a child to the lesson. Take one container of thermic tablets to a table, return for the second and place in front of the child who is seated on your dominant side. Remove lids and place under boxes.
2. Place one of each pair on either side of the containers in columns.
3. Remove the empty containers and lids from the center so there will be space to place matched pairs. Place containers and lids out of the way to the left and right of the columns.
4. Move the top left tablet to the front center between the two columns. Lightly place the underside of the left wrist on the tablet, then remove the wrist. Lightly touch the tablets in the right column with the underside of the right wrist until one is found that matches the temperature of the first tablet. It may be necessary to touch the first tablet with the left wrist from time to time. Place the matched tablets side by side at the front, retouch and say, "These have the same temperature. Invite the child to touch the left wrist to the left tablet and the right wrist to the right tablet.
5. Place the matched pair at the top center between the two columns.
6. Continue to match the tablets as in step 4, placing subsequent pairs in front of those previously paired.
7. Once all have been paired, place one of each pair in a separate container.
8. Stand, replace chair and return container of thermic tablets to the proper place on the shelf.
9. Thank the child, say that thermic tablets may be chosen for matching or say, "We will have another lesson."

Control of Error:

Visual recognition of identical appearance of properly matched pairs

Observations:

Placement of tablets before matching
Touching of tablets
Placement of pairs
Use of blindfold or closed eyes
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Teach the names of the materials used in the tablets by the three period lesson. Invite the child to do the matching lesson with eyes closed or with a blindfold.

Vocabulary:

steel marble felt wood glass (any names of materials used for thermic tablets)

Grading Exercise:

Preliminary Exercises:

Grading thermic bottles
Matching thermic tablets

Procedure:

1. Invite a child to the lesson. Take one box of thermic tablets to a table and place in front of the child who is seated on your dominant side.
2. Remove the tablets from the container and place in a row midway of the table.
3. Touch each tablet with the underside of the wrist to find the warmest one, then place at the left front below the row of other tablets. Invite the child to touch it with the wrist and say, "This has the warmest temperature."
4. Continue touching and placing the tablets in a row according to temperature.
5. Touch each tablet in turn, beginning at the left, to verify grading from warmest to coolest. Invite the child to feel the row of graded tablets.
6. Replace the tablets in the container, stand, replace chair and return material to the shelf.
7. Thank the child and say that the thermic tablets may be chosen for matching or grading or say, "We will have another lesson."

Control of Error:

Child's sensitivity to differences in temperature

Observations:

Placement of tablets
Touching technique
Use of blindfold or closed eyes
Child's reaction to error
Handling of material
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Older children may use thermometers to determine actual temperature of thermic materials.

Use thermometers to measure body temperature and air temperature. Introduce structure and function of various types of thermometers.

Invite the child to do the grading exercise with eyes closed or with a blindfold.

Vocabulary:

cool cooler coolest warm warmer warmest

SENSORIAL MATERIAL FOR IMPRESSION OF WEIGHT (BARIC TABLETS)

Purposes:

To educate the baric sense
To develop perception of small differences in weight
To stimulate awareness of weight
To develop appropriate vocabulary

Preliminary Exercises:

Practical life exercises such as carrying boxes, removing lids
Practice with stereognostic exercises

Materials:

Three boxes, each containing ten wooden baric tablets of uniform size, made from three kinds of wood to give three different weights as well three different natural wood colors. (The light weight is the lightest color, the heavy weight is the darkest color, the medium weight is between the other two in color.) Note: There is approximately a five gram difference between each set.

Blindfold

Procedure:

1. Invite a child to the lesson. Take the box of baric tablets with the heaviest weight to a table, then take the box with the lightest weight to the table. Turn two chairs so that you and the child can sit facing each other beside the table.
2. Show the child how to place both hands with palms upward and fingers extended, arms away from body and elbows bent so that hands are in a comfortable position about waist height.
3. Place a heavy tablet on the outstretched fingers of one hand and a light tablet on the other and by the three period lesson, teach the terms "heavy" and "light", moving the tablets so that the same weight is not always on the same hand. It may be instinctive for the child to move the hands up and down, but too much movement interferes with exact estimation of weight. Do not proceed with step 4 until the child understands the terms.
4. Present the remaining light and heavy baric tablets, being sure that the same weight is not always placed on the same hand. Ask the child to indicate either the heavy or light weight. Place those designated "light" in one stack, those designated heavy in another. Encourage the use of a blindfold or closed eyes. Continue the procedure until all tablets have been "weighed".
5. Upon completion of the exercise, have the child examine the stacks of baric tablets to determine if each stack contains the same color.
6. Return the tablets to the boxes.
7. Stand, replace chair and return the boxes, one at a time, to the shelf.
8. Thank the child and say that the heavy and light baric tablets may be chosen or say, "We will have another lesson."

Control of Error:

Color of the wood

Observations:

Position of hands and fingers
Placement of tablets into stacks
Color of tablets in each stack
Use of blindfold or closed eyes
Child's reaction to error
Handling of materials
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

After successful use of light and heavy sets, invite child to use medium weight and heavy weight sets, then invite child to use medium weight set with light weight set. Once these have been used successfully, invite child to use all three sets together. Introduce various types of scales to weigh objects in environment.

Vocabulary:

light lighter lightest heavy heavier heaviest
medium weight basic tablet names of wood used in tablets
names of scales used in weighing

SENSORIAL KNOWLEDGE OF GEOMETRY

Purposes:

- To assist visual perception through association with the kinesthetic sense
- To stimulate awareness and observation of geometric forms in the environment
- To develop coordination of movement
- To give indirect preparation for writing
- To provide a sensorial basis for the future study of geometry
- To heighten attentiveness in carrying out systematic operations
- To establish the habit of self-correction
- To develop visual memory
- To stimulate reasoning power and application of intelligence
- To assist the development of appreciation of geometric forms
- To associate abstract representation with concrete objects
- To develop appropriate vocabulary

GEOMETRIC PRESENTATION TRAY

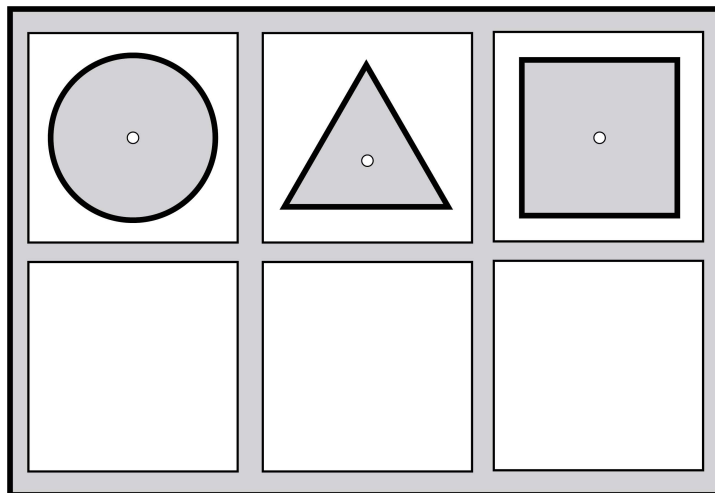
Preliminary Exercises:

- Practical life exercises
- Use of dimensional materials
- Practice with stereognostic exercises
- Handwork activities

Materials:

Presentation tray with three blank 14 cm squares across the bottom, 14 cm square frames containing insets: a circle 10 cm in diameter, a square with 10 cm sides and an equilateral triangle with 10 cm sides (Insets and bottom of tray must be the same color.)

A second presentation tray with three blank 14 cm squares and three different insets
Note: A second set of geometric cabinet contents makes it easier to prepare presentation trays.



GEOMETRIC CABINET PRESENTATION TRAY

Procedure:

1. Invite a child to the lesson. Take the presentation tray to a table and place between you and the child who is seated on your dominant side.
2. Using the thumb and first two fingers of the dominant hand to grasp the knob, remove each inset, starting at the left, and place on the blank square..
3. Begin with the figure on the left. Grasp the knob firmly with the non-dominant hand, lift the inset, hold in a horizontal position with the knob downward and the bottom of the inset shape upward in full view. Using the first two fingers of the dominant hand, feel the edge of the inset in an exact counterclockwise motion, starting at the bottom left. Do not lift the fingers from the edge, but make one continuous movement. The back of the hand should remain upward so that there is a simulation of the movement of the hand as in writing.
4. Using the first two fingers of the dominant hand, feel the edge of the frame in which the inset is to be placed but start at the top left. Make a continuous counterclockwise motion.
5. Place the inset into its frame.
6. Repeat the procedure with the remaining insets.
7. Stand, replace chair, and return the presentation tray to the shelf.
8. Thank the child and say that the presentation tray may be chosen.

Control of Error:

Visual and kinesthetic perception of inset shape relative to shape of frame in tray
Visual recognition of incorrect fit of inset into frame

Observations:

Carrying of presentation tray
Removal of insets
Holding and feeling insets and frames
Starting point for feeling insets and frames
Direction in which insets and frames are felt
Placement of insets into frames
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

For children who have used the first presentation tray without difficulty, prepare the second presentation tray by removing three figures from the drawers of the geometric cabinet or from a second set of geometric cabinet contents. Any three contrasting figures may be used. For example, use the rectangle with the least width, the pentagon and the oval. Remove the drawers from the cabinet which have insets removed and store out of sight. Invite children who have successfully used the first presentation tray to use the second presentation tray. No lesson is needed since repeated lessons are given with the first presentation tray.

Later, exchange the insets in the second tray for six different contrasting insets, omitting blank squares. Tell the child to place the insets on the table to the right, then to feel and replace as before.

After extensive use of these six shapes, remove and replace with six different shapes. Continue until all of the shapes from the cabinet have been introduced. (It is not necessary to introduce any circles except the one in the first presentation tray. The presentation of only one rectangle is required.)

Teach the names of the geometric shapes by the three period lesson.

Vocabulary:

presentation tray circle
 square rectangle equilateral triangle right-angled scalene triangle
 acute-angled scalene triangle obtuse-angled
 obtuse-angled isosceles scalene triangle right-
 angled isosceles
 pentagon hexagon heptagon triangle
 octagon nonagon septagon decagon
 ellipse oval quatrefoil curved or
 trapezium trapezoid rhombus curvilinear triangle
 rhomboid

GEOMETRIC CABINET

Preliminary Exercises:

Use of geometric presentation trays

Materials:

Geometric cabinet with six drawers (the bottom of each corresponding in color to the insets

as in the presentation tray) and insets arranged according to Montessori's instructions in Chapter 8 of *The Discovery of the Child* as follows:

Drawer 1: trapezoid, trapezium, rhombus, rhomboid, two blank squares

Drawer 2: square, five rectangles 10 cm in height, diminishing in width from 9 to 5 cm. Drawer 3: six circles decreasing in diameter from 10 cm to 5 cm.

Drawer 4: right-angled, acute-angled and obtuse-angled scalene triangles, right-angled, acute-angled and obtuse-angled isosceles triangles

Drawer 5: pentagon, hexagon, heptagon (septagon), octagon, nonagon, decagon

Drawer 6: oval, ellipse, quatrefoil, curved (curvilinear)

Procedure:

1. Invite a child to use any drawer of the geometric cabinet once all insets have been introduced in the presentation tray. No lesson is needed.

Control of Error:

As for presentation tray

Observations:

As for presentation tray

Vocabulary:

As for presentation tray

GEOMETRIC CARDS

Preliminary Exercises:

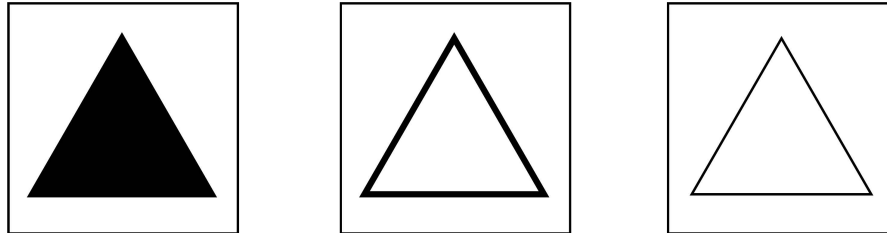
Use of geometric cabinet

Materials:

Three series of cards to match geometric forms in the cabinet:

Series 1, filled in figures; Series 2, thickly outlined figures; Series 3, thinly outlined figures

Containers for each series of cards



CARDS FOR THE GEOMETRIC CABINET

Procedure:

1. Invite the child to choose any drawer from the geometric cabinet to place on a table.
2. Take the matching set of geometric cards with filled in figures and have the child place them in two rows of three cards each at the right of the drawer.
3. Tell the child to place the geometric insets on matching cards without feeling edges. Start with the inset at the top left of the drawer.
4. Observe unobtrusively. If there is no difficulty, tell the child when he finishes the exercise that any of the cards with filled in figures may be used with their corresponding drawers from the geometric cabinet.

Control of Error:

Visual recognition of misplaced inset

Observations:

Choice of drawer and corresponding cards
Arrangement of cards
Placement of insets on cards
Directionality of work
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

After the first set of cards has been used frequently and without difficulty, invite the child to use the set with thick outlines. After the second set has been used without difficulty, invite the child to use the set with thin outlines.

Game with geometric cabinet and sets of cards with filled in figures for children who have used these cards with all the drawers:

Remove all of the drawers from the cabinet and place on a table. Show a card or inset to a child and place it on a second table, away from the one containing all the drawers.

Ask the child to remember the figure, then to bring the card or inset that corresponds in shape and to place inset and card together for verification.

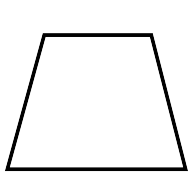
Game with geometric cabinet and three sets of cards for children who have used all three sets of cards with the drawers:

Remove the drawers from the cabinet and place on a table. Place all of the cards with filled in figures at random on another table and all of the cards with thick outlines on a third table. At a fourth table, show a thin outline card to a child and place it on that table. Ask the child to remember the figure and to bring the cards and inset which correspond in shape to the fourth table for verification.

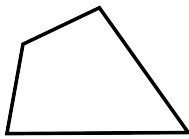
Vocabulary:

As for previous exercises with geometric cabinet

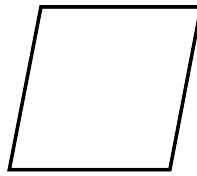
NOTE: The geometric solids from stereognostic exercises are also materials used to provide sensorial knowledge of geometry.



TRAPEZOID



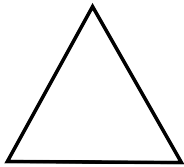
TRAPEZIUM



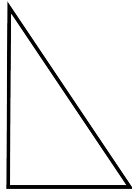
RHOMBUS



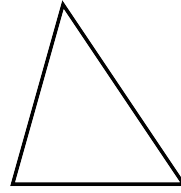
RHOMBOID



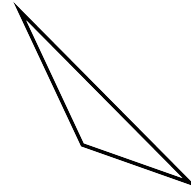
EQUILATERAL TRIANGLE



RIGHT-ANGLED SCALENE TRIANGLE

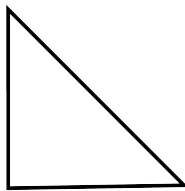


ACUTE-ANGLED SCALENE TRIANGLE

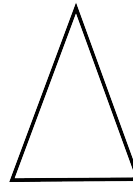


OBTUSE-ANGLED SCALENE TRIANGLE

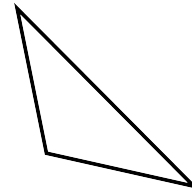
GEOMETRIC FIGURES



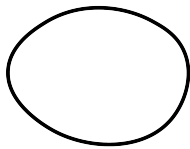
RIGHT-ANGLED ISOSCELES TRIANGLE



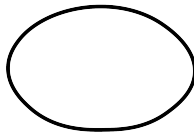
ACUTE-ANGLED ISOSCELES TRIANGLE



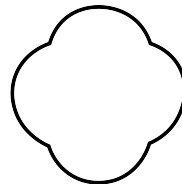
OBTUSE-ANGLED ISOSCELES TRIANGLE



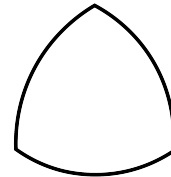
OVAL



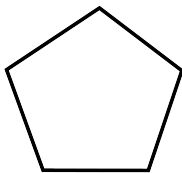
ELLIPSE



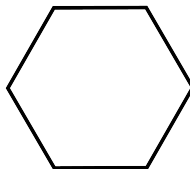
QUATREFOIL



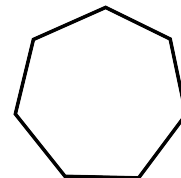
CURVED TRIANGLE



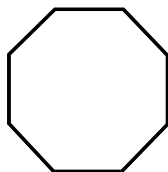
PENTAGON



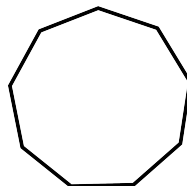
HEXAGON



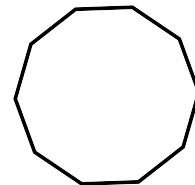
HEPTAGON



OCTAGON



NONAGON



DECAGON

CONSTRUCTIVE TRIANGLES

Preliminary Exercises:

Practical life exercises
Use of dimensional materials
Practice with stereognostic exercises
Use of geometric cabinet

Materials:

Rectangular box containing: 2 right-angled isosceles triangles, usually green, with a line on the hypotenuse; 2 small equilateral triangles, usually yellow with a line on one side; 2 right-angled isosceles triangles, usually yellow, with a line on a side; 2 right-angled scalene triangles, usually gray with a line on the hypotenuse; 1 obtuse-angled isosceles triangle, usually red with a line on the hypotenuse; 2 right-angled scalene triangles, usually yellow with a line on the base; 2 right-angled scalene triangles, usually green with a line on the altitude; 1 right-angled scalene triangle, usually red with a line on the altitude

(Note: For the first presentation only these triangles are used: 2 right-angled isosceles triangles with a line on the hypotenuse; 2 right-angled scalene triangles with a line on the hypotenuse; 2 equilateral triangles; 1 right-angled scalene triangle with a line on the altitude; 1 obtuse-angled isosceles triangle with a line on the hypotenuse.)

Triangular box containing: 1 large equilateral triangle, 2 right-angled scalene triangles, 3 obtuse-angled isosceles triangles, 4 equilateral triangles

(Note: To facilitate the removal of the large equilateral triangle, attach a ribbon in the center of the bottom of the box with glue or a thumb tack and allow enough length of ribbon to extend from the box. By lifting the loose end of the ribbon, the triangle is raised so that it can be removed easily.)

Large hexagonal box containing: 1 large equilateral triangle, 10 obtuse-angled isosceles triangles

Small hexagonal box containing: 1 large equilateral triangle, 3 pairs of obtuse-angled isosceles triangles, 11 small equilateral triangles

Rectangular box containing: 2 right-angled isosceles triangles, 3 right-angled scalene triangles, 2 equilateral triangles, 1 obtuse-angled scalene triangle. All of these are blue with no lines.

Procedure:

1. Invite a child to the lesson. Take the first rectangular box with the selected triangles to a table and place toward the back of the table. The child is seated on your dominant side.
2. Remove the lid and place under the box.
3. Remove the triangles and place those of the same color next to each other in a row in front of the box, bases parallel to front edge of the table.
4. Move two triangles of the same color, size and shape to the front of the row.
5. Trace the black lines on the triangles with the first two fingers of the dominant hand, then slide together with lines touching.
6. Repeat the procedure with the remaining triangles.
7. Return the triangles to the box, replace lid.
8. Stand, replace chair, and replace box on shelf.
9. Thank the child and say that the triangles in the rectangular box may be chosen.

Control of Error:

Lines on triangles
Colors of triangles

Observations:

- Carrying of box
- Removal of triangles from box
- Arrangement of triangles
- Return of triangles to box
- Handling of material
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

- (To be introduced ONLY after the child has worked successfully with the material according to the first presentation.)
- Demonstrate the use of two right-angled scalene triangles of the same color to make other shapes by keeping one triangle in place while sliding the other triangle around each side, pausing to observe each figure formed. Bases remain parallel to the front edge of the table.
- Invite the child to use the unlined triangles in the second rectangular box.
- Suggest that the child use the triangular box which demonstrates the division of the equilateral triangle into two, three and four equal parts.
- Suggest that the large hexagonal box be used, then later, the small hexagonal box.
- Suggest that the child draw around the triangles, using paper of the same color, then cut them into pieces as an aid to observing the

relationships. Vocabulary:

- names of shapes formed by triangles

THE SQUARE OF THE BINOMIAL

Purposes:

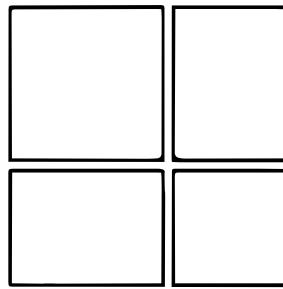
- To provide a sensorial basis for understanding the concept of the expansion of the binomial
- To assist in the perception of mathematical patterns
- To give indirect preparation for algebra
- To show relationships among geometric forms
- To develop appropriate vocabulary

Preliminary Exercises:

- Use of geometric cabinet and cards
- Practice with constructive triangles

Materials:

- Container with red square, blue square and two black rectangles which exactly match the faces of the binomial cube material
- Control chart for layout of the square of the binomial
- Note: Do not attempt to make these materials until after the lesson on preparation of material has been completed.



BINOMIAL SQUARE CONTROL CHART
(reduced size)

Procedure:

1. Invite a child to the lesson. Place the binomial square material on a table between you and the child who is seated on your dominant side.
2. Place the control chart to the right of the container of binomial square materials.
3. Remove the squares and rectangles from the container and place horizontally in front of the chart.
4. Place the red square on the control, then the blue square. Place the two black rectangles to form a square of all four components.
5. Return components to the container.
6. Stand, replace chair and return materials to the shelf.
7. Thank the child and say that the binomial square may be chosen.

Control of Error:

Control chart
Color and shape of components

Observations:

Handling of materials
Sequence of placement
Placement of components on the control chart
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

Invite the child to build the square of the binomial without the control chart.
 Note: The following variations are presented in detail in the algebra section of the mathematics manual.
 Invite the child to use a control chart which demonstrates the equation for the expansion of the square of the binomial.
 Label another control chart to show that the red square is a^2 , the blue square is b^2 , and the two black rectangles are ab .
 Provide cards on which algebraic terms are written for placement on the square and rectangular component parts of the square of the binomial.
 Once the terms are learned, provide the equation for expansion of the binomial square.
 $(a+b)^2 = a^2+2ab+b^2$

Vocabulary

binomial square rectangle component control chart

THE SQUARE OF THE TRINOMIAL

Purposes:

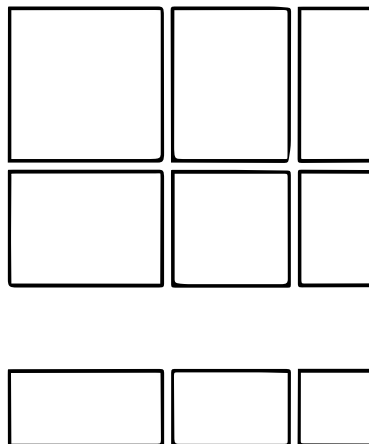
- To provide a sensorial basis for understanding the concept of the expansion of the trinomial
- To assist in the perception of mathematical patterns
- To give indirect preparation for algebra
- To show relationships among geometric forms
- To develop appropriate vocabulary

Preliminary Exercises:

- Use of geometric cabinet and cards
- Practice with constructive triangles
- Exercise for square of the binomial

Materials:

- Container with red square, blue square, yellow square, 2 large black rectangles, 2 medium black rectangles, 2 small black rectangles which exactly match the faces of the trinomial cube components
- Control chart to show the exact layout of components of the square of the trinomial



TRINOMIAL SQUARE CONTROL CHART

(reduced size)

Procedure:

1. Invite a child to the lesson. Place the trinomial square material on a table between you and the child who is seated on your dominant side.
2. Place the control chart to the right of the container of trinomial square materials.
3. Remove the squares and rectangles from the container and place horizontally in front of the chart.
4. Place the red square on the control chart, followed by the blue square and the yellow square.
5. On the control chart, place the two large black rectangles, followed by the two medium black rectangles, then the two small black rectangles to form a square of all components.
6. Replace the components in the container.
7. Stand, replace chair and return container and control chart to the shelf.
8. Thank the child and say that the trinomial square may be chosen.

Control of Error:

Control chart Color
and shape of
components

Observations:

Handling of materials
Sequence of placement
Placement of components on the control
chart Child's reaction to error
Length of work time and number of
repetitions Length of period of contemplation
Degree of interest and concentration

Variations:

Invite the child to build the square of the trinomial without the control chart.

Note: The following variations are presented in detail in the algebra section of the mathematics manual.

Invite the child to use a control chart which demonstrates the equation for the expansion of the square of the trinomial.

Label another control chart to show that the red square is a^2 , the blue square is b^2 , the yellow square is c^2 , the two large black rectangles are ab , the two medium rectangles are bc and the two small rectangles are ac .

Provide cards on which algebraic terms are written for placement on the square and rectangular component parts of the square of the trinomial.

Once the terms are learned, provide the equation for expansion of the trinomial square.

$$(a+b+c)^2 = a^2 + 2ab + b^2 + 2ac + 2bc + c^2$$

Vocabulary

trinomial

THE CUBE OF A BINOMIAL

Purposes:

- To provide a sensorial basis for understanding the concept of binomial expansion
- To assist in the perception of patterns related to mathematics
- To give indirect preparation for algebra
- To show relationships among geometric solids
- To develop appropriate vocabulary

Preliminary Exercises:

- Use of geometric cabinet and cards
- Stereognostic exercises with geometric solids
- Exercise for square of the binomial

Materials:

Box hinged at the bottom of two sides, containing 1 large red cube, 1 small blue cube, 3 black rectangular prisms (whose square red bases exactly correspond to the faces of the red cube), 3 smaller black rectangular prisms (whose square blue bases exactly correspond to the faces of the blue cube)

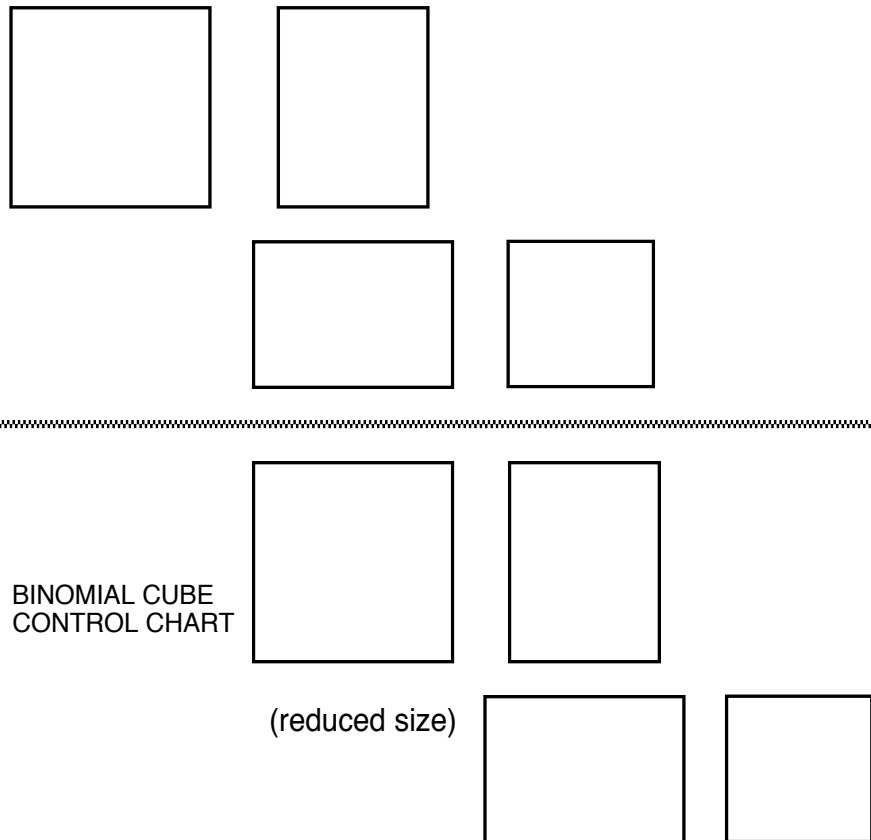
Note: Dimensions of the box and its contents vary among different manufacturers.
 Dimensions given by Montessori were 6 cm for the red cube and 4 cm for the blue so that a cube of 10 cm is formed.

Lid for box with design of the assembled cubes and prisms on the top

Note: Some boxes also have the design on the sides of the box.

Control chart showing exact layout representing expansion of the binomial cube

Two light colored felt mats of a size to accommodate the cube and prisms of each layer



Procedure:

1. Invite a child to the lesson. Take the binomial cube, two felt mats and the control chart to a table. Have the child sit on your dominant side.
2. Place the box in the upper left hand corner of the work space with the hinged sides facing front and right. Place the two felt mats to the left of the box.
3. Place the control chart to its right so that it is in front of the child who is seated on your dominant side. Leave enough space between the chart and the bottom edge of the table to accommodate the felt.
4. Remove the lid and place it at the lower right hand corner of the box, design upward.
5. Open the hinged sides and place the lid in the angle formed by the open sides, making sure that the red square is in the angle next to the box.
6. Move one felt mat to the front of the box.
7. Using the dominant hand, remove the blue cube and place on the lower right corner of the felt mat. Remove the blue-faced prism at the left, place it on the felt, black face up, to the left of the cube. Remove the other blue-faced prism and place it behind the blue cube. Remove the red-faced prism and place at the left, red face up.
8. Slide the felt containing the prisms and cube to the right front of the control chart.
9. Move the second felt mat to the front of the box and remove the prisms and cube as before, starting with the blue-faced prism. The blue face is upward and the black faces of the other two prisms are upward.
10. Slide the second felt mat in front of the control chart to the left of the other mat.
11. Working from the felt mat on the left, place the red cube on the red square in the upper left hand corner of the control chart.
12. Place the red-faced prism from the front of the mat on the control at the back, next to the cube, with a red face toward the red cube.
13. Place the second red-faced prism in front of the previously placed prism, red faces showing front and back.
14. Place the blue-faced prism on the control chart with the blue face upward.
15. Lay your dominant hand, palm down, across the top of the cube and prisms just placed on the control chart to call attention to the equal height.
16. Move the felt mat on the right to the center front and place the red-faced prism on the control chart with the red face upward.
17. Place the blue-faced prism on the control chart with blue faces showing front and back.
18. Place the second blue-faced prism in front of the first with the blue faces to the left and right.
19. Place the blue cube on the control chart, and lay your hand across the top of the cube and prisms as before to call attention to the equal height of this level.
20. Move the red cube to the red square on the lid of the box. Pick up the red-faced prism with the dominant hand. With the non-dominant hand, point to the red face and to the red cube where the faces will touch, then put the prism in place at the left front of the cube.
21. Repeat the procedure with the other red-faced prism, placing it to the right of the cube.
22. Place the blue-faced prism on the lid.
23. Now that the pattern has been reproduced on the lid, transfer the red cube back into box, then the left front prism, always pointing to the faces which will touch. Put the other red-faced prism in its place, and last the blue-faced prism so that the pattern on the lid is again reproduced.
24. Move the prisms and cubes remaining on the control chart to the lid as before, then transfer into the box, touching the red and blue faces.
25. Close the sides of the box, replace the lid.
26. Stand, replace chair and return materials to the shelf.
27. Tell the child the binomial cube may be chosen.

Control of Error:

Control chart
Lid of box
Height of assembled cube and prisms on each level
Colors of cubes and prisms

Observations:

Placement of control chart, box and lid
Placement of cubes and prisms on felt mats and on control chart
Return of material to lid, then into box
Handling of material
Child's reaction to error
Length of work time and number of repetitions
Length of period of contemplation
Degree of interest and concentration

Variations:

After much practice with the control chart, invite the child to use the binomial cube without the control. This is introduced **ONLY** after the child has worked successfully with the material according to the first presentation.

Note: The following variations are presented in detail in the algebra section of the mathematics manual.

Give the terms that each cube or prism represents by labeling another control chart.

(Red cube= a^3 ; black prisms with red faces= a^2b ; black prisms with blue faces= ab^2 ; blue cube= b^3)

Provide cards on which the terms are written for placement on the cubes and prisms.

Once the terms are learned, provide the equation for the expansion of the binomial cube:

$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$

Vocabulary:

binomial

algebraic terms for binomial expansion

THE CUBE OF A TRINOMIAL

Purposes:

- To provide a sensorial basis for understanding the concept of trinomial expansion
- To assist in the perception of patterns related to mathematics
- To give indirect preparation for algebra
- To show relationships among geometric solids
- To develop appropriate vocabulary

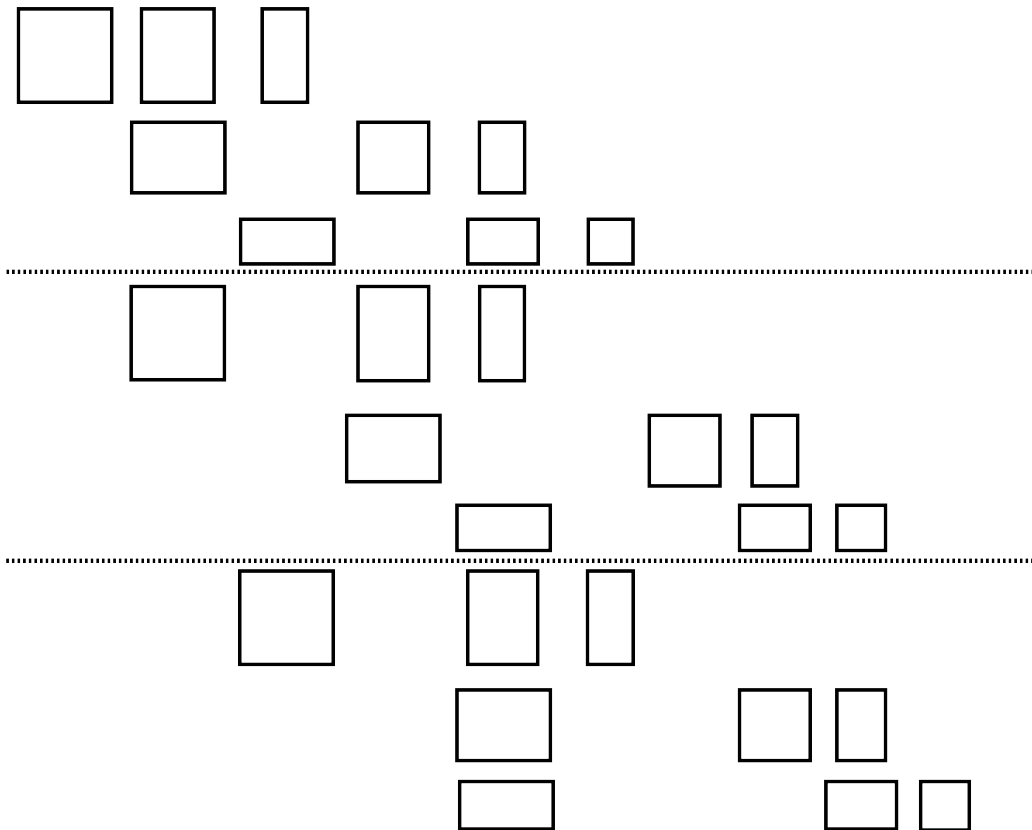
Preliminary Exercises:

- Extensive use of binomial cube with control chart

Materials:

Box hinged at the bottom of two sides, containing:

- 1 large red cube
 - 1 small blue cube
 - 1 smaller yellow cube;
 - 3 black rectangular prisms whose square red bases exactly correspond to the faces of the red cube
 - 3 smaller black rectangular prisms whose square red bases exactly correspond to the faces of the red cube
 - 3 black rectangular prisms whose square blue bases exactly correspond to the faces of the blue cube
 - 3 smaller black rectangular prisms whose square blue bases exactly correspond to the faces of the blue cube
 - 6 black rectangular prisms;
 - 3 black rectangular prisms whose square yellow bases exactly correspond to faces of the yellow cube
 - smaller black rectangular prisms whose square yellow bases exactly correspond to the yellow cube faces
 - Lid for box with design of assembled cubes and prisms on top
- Note: Some boxes also have the design on the sides of the box.
Control chart showing exact layout representing the expansion of the trinomial
Three light colored felt mats of a size to accommodate the cube and prisms of each level



TRINOMIAL CUBE CONTROL CHART
(reduced size)

Procedure:

The procedure is the same as for the binomial cube except that there is a third level .

Control of Error:

- Control chart
- Lid of box
- Height of assembled cubes and prisms on each level
- Color of cubes and prisms

Observations:

- Placement of control chart, box and lid
- Placement of cubes and prisms on felt mats and on control chart
- Return of material to lid, then into box
- Handling of material
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

After much practice with the control chart, invite the child to use the trinomial cube without the control. (To be introduced ONLY after the child has worked successfully with the materials according to the first presentation.)

Note: The following variations are presented in detail in the algebra section of the mathematics manual.

Give the terms that each cube or prism represents by labeling another control chart. Red cube= a^3

blue cube= b^3

yellow cube= c^3

black prisms with red faces= a^2b

smaller black prisms with red faces= a^2c

black prisms with blue faces= ab^2

smaller black prisms with blue faces= b^2c

black prisms with yellow faces= ac^2

smaller black prisms with yellow faces= bc^2

black prisms= abc

Provide cards (on which the terms are written) to be placed on the cubes and prisms.

Once the terms are learned, give the equation for the expansion of the trinomial cube:

$$(a+b+c)^3 = a^3 + 3a^2b + 3a^2c + 3ab^2 + 6abc + 3ac^2 + b^3 + 3b^2c + 3bc^2 + c^3$$

Vocabulary:

trinomial

algebraic terms for trinomial expansion

THE POWER OF TWO

Purposes:

- To provide a sensorial basis for understanding exponential concepts
- To assist in the perception of mathematical patterns
- To give indirect preparation for algebra
- To show relationships among geometric solids
- To develop appropriate vocabulary

Preliminary Exercises:

- Use of geometric cabinet and cards
- Stereognostic exercises with geometric solids

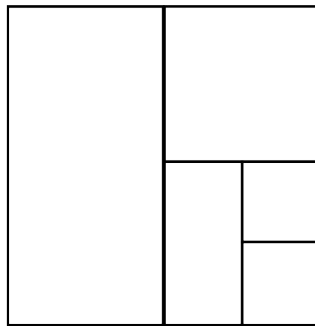
Materials:

Box with two 2 centimeter yellow cubes; a white oblong prism, 2 by 2 by 4 centimeters; a green square prism, 4 by 4 by 2 centimeters; a yellow 4 centimeter cube; a white oblong prism, 4 by 4 by 8 centimeters; a green square prism, 8 by 8 by 4 centimeters, all representing 23 through 29.

Note: To facilitate removal of the large green prism a ribbon $\frac{3}{4}$ inches wide by 8 inches long is attached to the center of the box near the hinge with the ribbon running under the green prism to the front of the box. By lifting the end of the ribbon, which extends at the front, the green prism can be removed easily.

Control chart

Felt mat large enough to accommodate the cubes and prisms



POWER OF TWO CONTROL CHART (reduced size)

Procedure:

1. Invite a child to the lesson. Take the power of two box and place toward the right back of a table. Get the control chart and place toward the right front of the box. Get the felt mat and place directly in front of the box. Seat the child on your dominant side and open the box.
2. Remove the two small yellow cubes and place at the lower right corner of the felt mat, one behind the other.
3. Remove the small white prism and place at the left of the cubes with the long side parallel to the two small yellow cubes.
4. Remove the green prism and place at the left of the white prism with the square face of the green prism facing up.
5. Remove the large yellow cube and place on the felt mat behind the two yellow cubes.
6. Remove the large white prism and place behind the small white prism with the square face toward the front.
7. Remove the large green prism and with its square face upward, place behind the small green prism.

Note: The cubes and prisms do not touch in the above layout.

8. Move a small yellow cube to its designated place on the lower right corner of the control chart to show 23.
9. Place the second small yellow cube behind the first to represent 24.
10. Place the small white prism on the control chart to the left of the two small yellow cubes to represent 2s.
11. Place the small green prism on top of the previously placed components to represent 26.
12. Place the large yellow cube on the control chart behind the the previously placed components to represent 21.
13. Place the large white prism on the control chart to the left of the previously placed components to represent 2s.
14. Place the large green prism on top of the previously placed components to represent 29.
15. Replace the large green prism in the box.
16. On top of it place the large white prism at the left of the box.
17. Place the large yellow cube on top of the large green prism at the top right corner of the box.
18. Place the small green prism, square face up, in front of the yellow cube.
19. Place the small white prism on top of the green prism to the right of the large white prism.
20. Place one small yellow cube in front of the large yellow cube.
21. Place the second small yellow cube in the remaining space and close the box lid.
22. Stand, replace chair and return the materials to the shelf.
23. Thank the child and say that the power of two box may be chosen.

Control of Error:

Control chart
 Size of box
 Height of assembled cubes and prisms
 Colors of cubes, oblong prisms and square prisms

Observations:

Placement of control chart and box
 Placement of cubes and prisms on the felt mat and on the control chart
 Return of material to box
 Handling of materials
 Child's reaction to error
 Length of work time and number of repetitions
 Length of period of contemplation
 Degree of interest and concentration

Variations:

Invite the child to use the material without the control chart.
 This is introduced **ONLY** after the child has worked successfully with the material according to the first presentation.
 Note: The following variations are presented in detail in the algebra section of the mathematics manual.
 Provide a separate label for each component part in algebraic terms and suggest that these be placed on the cubes and prisms while on the felt mat.
 Show the equation for expansion of each value.

Vocabulary:

power exponent algebra algebraic equation expansion component

FRACTIONS

Purposes:

- To assist visual perception of size and shape
- To provide a sensorial basis for the future study of fractions
- To heighten attentiveness in carrying out systematic operations
- To develop appropriate vocabulary

Preliminary Exercises:

- Practical life exercises
- Practice with geometric cabinet and cards
- Work with number rods and spindle box to ensure understanding of the concept one through ten

Materials:

- Ten fraction circles, one undivided, the others divided into equal parts from two to ten, set into frames of a contrasting color (Usually the fractions are red, the frames green.) Two trays, each long enough to accommodate five frames of fractions

Procedure:

1. Invite the child to the lesson. Take the tray of fractions up to fifth and place on the table between you and the child who is seated on your dominant side. Check to be sure the fractions are in order from one to five.
2. Using the first three fingers on the dominant hand, grasp the knob and remove the fractional pieces from each frame, one frame at a time, placing them in random order at the front edge of the table. Sort the fractions according to size and place those of the same size vertically in front of a frame.
3. Replace the fractional parts into the frame below which they were sorted.
4. Stand, replace the chair and return fractions to the shelf. Thank the child and say either that the fraction tray may be chosen or, if the child has not understood the procedure, say, "We will have another lesson later."

Control of Error:

- Placement of fractional parts directly in front of frames
- Improper fit of fractions causing overlapping or space between the parts
- Visual recognition of shape of fractional parts

Observations:

- Handling of material
- Placement of fractions upon removal and replacement
- Child's reaction to error
- Length of work time and number of repetitions
- Length of period of contemplation
- Degree of interest and concentration

Variations:

Invite the child to repeat the exercise using sixths through tenths fractional parts.

Using the tray of fractions through fifths, invite the child to remove the fractional parts, placing them in random order at the front edge of the table. Have the child sort according to size with each set of fractional parts being placed vertically in front of a frame. Tell the child to replace the fractional parts into the frame in front of which they have been placed.

Using the three period lesson, teach the names of the fractional parts. Place the frames containing the halves and the tenths on your non-dominant side. A presentation frame is acquired by removing the whole or one inset and placing it out of sight on your non-dominant side. The presentation frame is placed at the bottom edge of the table. The part being named in the three period lesson is placed into the presentation frame. Teach the names of all the fractions by the three period lesson according to the previous procedure.

Note: For the second period of the lesson when both fractional parts are presented, leave space between the fractional parts in the presentation frame.

Invite the child to place fractional part in the presentation frame according to verbal directions for example, "Place four fifths in the presentation frame." These fractional parts are removed before other fractional parts are requested.

Following the sensorial presentation of fractions, other fraction lessons are given in the mathematics manual.

Vocabulary:

fraction

names of fractional parts

vertical