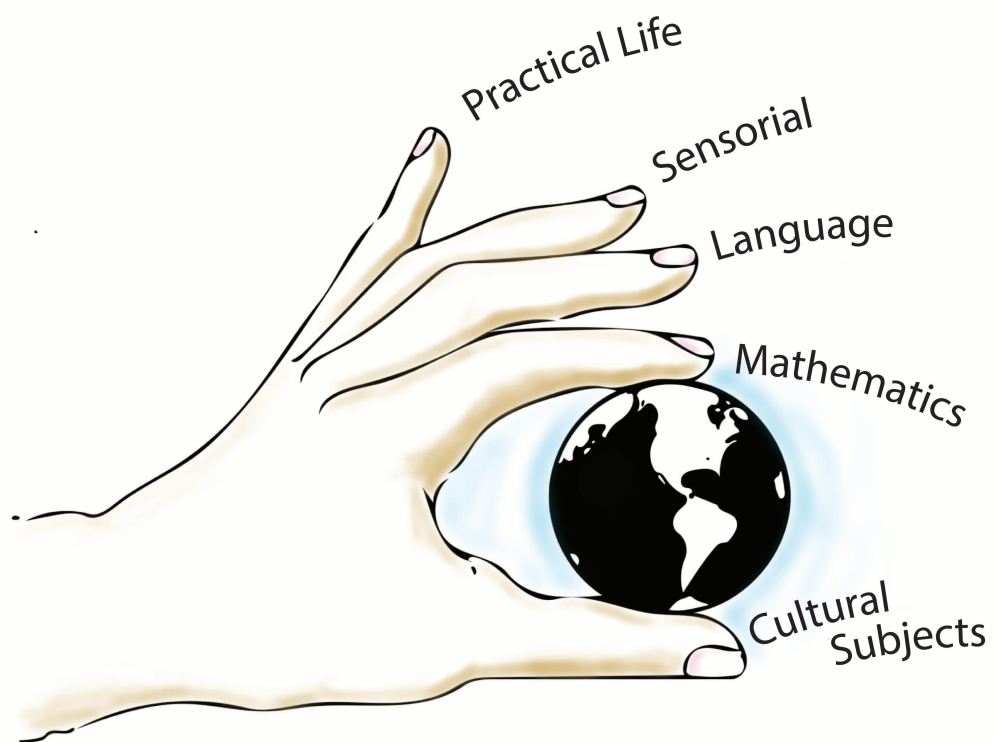


Montessori Educators International, Inc.



Experimental Science

Early Childhood

Teacher Manual

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Experimental Science

General Purposes:

- To introduce the scientific method
- To stress the process of experimentation rather than arriving at the "right" answer
- To develop independent thinking
- To further develop motor skills and hand-eye coordination
- To encourage the natural curiosity of the child
- To develop appropriate vocabulary

Experiments Involving Water

Solubility

Preliminary Exercises:

- Pouring
- Sponge squeezing
- Managing lids
- Practice in measuring liquids and solids
- Dish washing
- Putting on and taking off apron
- Practice in reading and writing phonograms

Purpose:

- To develop understanding of the properties of water
- To develop appropriate vocabulary

Materials:

- Water pitcher
- Tray of six beakers or clear glasses with straight sides
- Tray with closed containers of salt, sugar, small gravel, flour, tea leaves, soil, labeled to indicate contents
- Tray with container of six identical spoons; container with three white labels 1 by 4 1/4 inches : soluble, insoluble, soluble and insoluble; container of six stirring rods; measuring cup with lip; sponge in holder
- Container of cards with labeled pictures of objects needed for each experiment
- Apron
- Vinyl mat
- Towel
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson. Have the child put on an apron, place the vinyl mat on a table and sit on your dominant side. Select the card with pictures of objects needed for the solubility experiment and show it to the child.
2. Have the child bring the containers of solids and liquids to the table and place the tray toward the back of the mat. Ask the child to remove the containers and set in a row in front of the tray in any order.
3. Tell the child to place the tray of six beakers or glasses at the front of the mat. Have the child place one in front of each container of substances, then remove the tray and stack it on top of the other tray at the back of the mat.
4. Ask the child to place the tray with spoons, labels, measuring cup and stirring rods at the front of the table. Have the child place a stirring rod in each beaker or glass, place a spoon in front of each beaker or glass and place the container of labels and the measuring cup on the dominant side. Tell the child to stack the tray on top of the others at the back of the mat.
5. Have the child take the pitcher to the sink and put water in it, then place it at the front of the table. Ask the child to measure 1/2 cup of water into each beaker or glass.
6. Invite the child to remove the lid from the first container, placing it to the dominant side of the container. Name the substance. Have the child measure one spoonful of it into the first beaker or glass, replace the lid and return the spoon to the spoon container. Have the child proceed as before to add one spoonful of each substance to the water in front of the container.
7. Tell the child to stir each container of water five times, then observe each container.
8. Ask the child to place the labels in a row at the front of the table.
9. Tell the child that if the substance appears to have completely disappeared or dissolved, move the labeled container behind the "soluble" label. If it appears to have remained the same, it is placed behind the "insoluble" label. If the appearance of the water has changed but the substance can still be seen, it is placed behind the "soluble and insoluble" label.
10. Have the child replace labels and cup on their tray and return the card to the file, then replace all on the shelf.
11. Tell the child to return containers of substances to their tray and replace on shelf.
12. Show how to dispose of insoluble materials. Ask the child to wash the beakers or glasses, stirring rods and spoons, dry and return to their trays or containers, then wipe the mat clean, rinsing the sponge if necessary, and return to its tray. Have the child replace the tray on the shelf.
13. Tell the child to empty water from pitcher, dry it and return to shelf, then to remove the apron and place it and the mat on the shelf. The towel is hung to dry.
14. Stand, replace chair. Thank the child and say that this experiment may be chosen.

Control of Error:

Visual inspection of beakers or glasses

Observations:

Handling of materials

Placement of materials with labels

Condition of work area and materials upon completion

Child's reaction to error

Length of work time and number of repetitions Length of period of contemplation

Degree of interest and concentration

Variations:

If able to write, invite the child to record observations in a small booklet or on a lab report form which can be combined with other reports to make a science notebook. Invite the child to observe the solubility of other substances.

Vocabulary:

soluble insoluble beaker stirring rod

Relative Densities

Preliminary Exercises:

- Use of dropper bottle
- Pouring
- Sponge squeezing
- Managing lids
- Practice in measuring liquids and solids
- Dish washing
- Putting on and taking off apron
- Practice in reading and writing phonograms

Purpose:

- To develop understanding of the properties of water
- To develop appropriate vocabulary

Materials:

- Water pitcher
- Two beakers or clear glasses with straight sides
- Closed container of salt labeled to indicate contents; measuring spoons; container of stirring rods; 2 measuring cups with lip; sponge in holder
- Container of cards with labeled pictures of objects needed for each experiment
- Apron
- Vinyl mat
- Container with squeeze or dropper bottles of food coloring in blue, red and yellow
- Towel
- Small booklet or lab report sheet for recording observations

Procedure

1. Invite a child to lesson. Have child put on an apron, place the vinyl mat on a table.
2. Lay the card for this experiment on a tray and ask the child to bring the objects listed on it: 2 measuring cups, 2 beakers or glasses, spoon, container of salt, 2 stirring rods, food coloring of any color, then bring the pitcher of water separately.
3. Have the child sit on your dominant side and place the beakers or glasses in a row at the front of the table with the pitcher and cups on the dominant side.
4. Ask the child to measure one fourth cup of water into each beaker or glass, and into the other cup, then add 2 spoonfuls of salt to the beaker or glass on the left and stir with the stirring rod. The stirring rod is removed.
5. Tell the child to add two drops of food coloring to the one fourth cup of water and stir with the other stirring rod. The stirring rod is removed.
6. Have the child wait until there is no motion in the water, then very carefully pour some colored water down the side onto the surface of the salt water. Ask the child to pour the remaining colored water down the side onto the surface of the plain water on the right.
7. Invite the child to observe what happens to the colored water in each container.
8. Tell the child to empty the contents of the beakers or glasses and cups into the pitcher, empty it in the sink, then rinse and dry the pitcher and return to the shelf.
9. On a tray, have child take beakers or glasses, stirring rods and spoon to the sink, rinse and dry, then return to the shelf. Stand, replace chair. Return the card to file.
10. Tell the child to clean the mat with a sponge if necessary, then rinse, squeeze dry and return to holder before replacing on the shelf. Have the child remove the apron and return it and the mat to their storage places.
11. Thank the child and say that the density experiment may be chosen.

Control of Error:

Visual inspection of beakers or glasses to see layer of colored water in beaker with salt solution and mixing in the water without salt

Observations:

Handling of materials

Condition of work area and materials upon completion

Child's reaction to error

Length of work time and number of repetitions Length of period of contemplation

Degree of interest and concentration

Variations:

If able to write, invite the child to record observations in a small booklet or on a lab report form which can be combined with other reports to make a science notebook. Invite the child to use liquids such as syrup, liquid soap or vinegar to repeat the experiment.

Invite the child to dissolve other substances in water such as sugar or baking soda to repeat the experiment.

Vocabulary:

density

Experiments Involving Air

Air's Weight

Preliminary Exercises:

- Use of two pan balance
- Tying
- Use of air pump
- Practice in reading and writing phonograms

Purpose:

- To develop understanding of the properties of air
- To develop appropriate vocabulary

Materials:

- Two identical small balloons
- Two pan balance
- Two identical small plastic clips
- Small air pump
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson. Select the card with pictures of objects needed for this experiment and show it to the child.
2. Ask the child to bring the two pan balance and place it at the center of a table.
3. Have the child collect the other items on a tray by referring to the card, then place the tray at the front of the table with the balance.
4. Tell the child to sit in front of the equipment, then sit with the child on your dominant side.
5. Invite the child to balance the scale, then to place one balloon and one clip on each pan. The scale should stay balanced.
6. Have the child remove one of the balloons from either pan, insert the neck of the balloon on the nozzle of the air pump and inflate the balloon. With the balloon still attached to the pump, tell the child to lay both on the tray.
7. Ask the child to close the neck of the balloon with the clip to prevent air from escaping, then to remove the balloon from the pump and return the balloon to the balance pan.
8. Have the child observe what happens to the balance pan upon which the inflated balloon has been placed.
9. Stand, replace chair and tell the child to deflate the balloon then to return the materials to their places.
10. Thank the child and say that this experiment may be chosen.

Control of Error:

Visual inspection of balance pans and balloons

Observations:

Handling of materials

Condition of work area and materials upon completion

Child's reaction to error

Length of work time and number of repetitions Length
of period of contemplation

Degree of interest and concentration

Variation:

If able to write, invite the child to record observations in a small booklet or on a lab
report form which can be combined with other reports to make a science notebook.

Vocabulary:

inflate deflate

Air's Volume

Preliminary Exercises:

Pouring
Sponge squeezing
Practice in reading and writing
phonograms

Purposes:

To develop understanding of the properties of
air To develop appropriate vocabulary

Materials:

Pitcher
Tray
Large clear bowl with line drawn to designate level of water
Small, clear glass or jar such as a baby food jar
Small square of paper, about 4 by 4 inches
Towel
Aprons
Vinyl mat
Container of cards with labeled pictures of objects needed for each
experiment Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson. Select the card with pictures of objects needed for this experiment and show it to the child.
2. You and the child put on aprons.
3. Have the child place needed equipment on a tray by referring to the card, then place the tray in the center of a table
4. Tell the child to sit in front of the equipment, then sit with the child on your dominant side.
5. Ask the child to spread the vinyl mat in front of the tray and to place the bowl in the center of the mat.
6. Invite the child to bring water to the table in the pitcher and fill the bowl to the line.
7. Have the child crumple the paper and insert it as far as possible into the glass or jar.
8. Invert the glass and slowly submerge it into the bowl of water, then carefully lift the glass out of the water.

Note: A perpendicular position is essential when submerging and removing the glass from the bowl of water.
9. Invite the child to remove the paper from the glass and feel it to ascertain that it is still dry because the air in the glass did not allow water to enter the glass.
10. Ask the child to empty the water from all containers, dry them and return to the designated storage place. If any water has spilled, it should be removed with the towel. Have the child hang the towel on the rack to dry and return the paper to its place unless it got wet, in which case it is thrown away.
11. Stand, replace chair, thank the child and say that this experiment may be chosen. Remove aprons and return to their storage place.

Control of Error:

Visual and tactile examination of the paper after the experiment
Perpendicular position of glass when placing and removing glass from water

Observations:

Handling of materials
Condition of work area and materials upon completion
Child's reaction to error
Length of work time and number of repetitions Length
of period of contemplation
Degree of interest and concentration

Variation:

If able to write, invite the child to record observations in a small booklet or on a lab report form which can be combined with other reports to make a science notebook.

Vocabulary:

invert submerge

Experiments Involving Light

Distance and Intensity of Light

Preliminary Exercises:

- Use of a flashlight
- Practice in reading and writing phonograms
- Work on identification of numerals

Purpose:

- To develop understanding of the properties of light
- To develop appropriate vocabulary

Materials:

- Flashlight
- Container of white cards with black-lined circles of 5 cm, 7 cm, 9 cm and 13 cm, each size on a different card; 17 cm square, labeled as to size
- Rack or holder on which to place one card at a time
- Note: The rack or holder should hold the card in a perpendicular position.
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations
- Tray
- Blank white card 17 cm square

Procedure:

1. Invite the child to the lesson and place the card with pictures of objects needed for the experiment on a tray.
2. Ask the child to collect the materials on the tray by referring to the card and take the tray of materials to a table. Indicate that it is to be placed in the upper left corner.
3. Sit with the child at the center front of the table on your dominant side and request that the rack or holder be placed at the center back of the table. Ask the child to place the card with the 5 cm circle on the rack with the circle facing forward.
4. Have the child turn on the flashlight and hold it so that the beam of light exactly fills the circle.
5. Ask the child to remove that card and replace it with the 7 cm circle card, then hold the flashlight so that the beam exactly fills that circle.
6. Thank the child and say that the procedure may be continued with the other cards. Stand, replace chair and observe unobtrusively. The child knows to return the materials to their proper places.

Control of Error:

Black-lined circle on each card

Visual awareness of the light beam relative to the circle size

Observations:

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:

If able to write, invite the the child to record observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.

Invite the child to place an object between the blank card and the flashlight to make a shadow, then to vary the distance of the object from the card, observing the results.

Invite two children to participate in the experiment, with one holding the flashlight and the other measuring and recording the distances from the flashlight to the circles of different sizes.

Invite the child to repeat the first experiment with the cards flat on the table and the flashlight held perpendicular to the table top, noting intensity of light relative to distance.

Vocabulary:

beam of light

intensity

The Spectrum

Preliminary Exercises:

- Pouring
- Use of a prism
- Dish drying
- Putting on and taking off apron
- Practice reading and writing phonograms

Purpose:

- To develop understanding of the composition of light
- To develop appropriate vocabulary

Materials:

- Water pitcher
- Small clear glass bowl with straight sides
- Small hand mirror which will fit in the bowl
- Towel
- Apron
- Vinyl mat
- Flashlight with intense beam
- White index card about 5 inches square and rack to hold it
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. Ask the child to collect the materials on the tray and place it at the back of a table in direct sunlight, if possible.
2. Have the child put on an apron and sit on your dominant side. Ask the child to spread the vinyl mat in front of the tray, place the bowl on the mat and get a pitcher of water which is placed on the mat on the child's dominant side.
3. Tell the child to half fill the bowl with water and place the mirror into the bowl with one end on the bottom and the other end against the rim, reflective side up.
4. Show the child how to adjust the position of the mirror to reflect the sunlight from the mirror onto the ceiling, wall or piece of index card. If there is no direct sunlight, use a flashlight.
5. Ask the child to observe the colors in the reflection and say that this is called the spectrum which is composed of the colors that are in light.
6. Have the child remove the mirror, dry it and return it to the tray, then empty the water in the bowl and pitcher which are dried and returned to the tray. If necessary, the mat is dried before being returned to the tray. After removing the apron, the child returns all materials to their storage places and hangs the towel to dry.
7. Stand, replace chair. Thank the child and say that this experiment may be chosen.

Control of Error:

Visual observation of the spectrum when mirror placement is correct

Observations:

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 name the colors in sequence observed in the spectrum and to color a spectrum in sequence with colored pencils.
If the child is able to write, invite the recording of observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.

Vocabulary:

spectrum

Experiments Involving Sound

Sound Related to Height of Column of Water

Preliminary Exercises:

- Pouring
- Dish drying
- Putting on and taking off apron
- Use of bells for matching and grading tones
- Practice in reading and writing phonograms
- Work with identification of numerals

Purpose:

- To develop understanding of properties of sound
- To develop appropriate vocabulary

Materials:

- Water pitcher
- Tray of five identical glasses with straight sides, each marked from the bottom as follows: 2 cm, 4 cm, 6 cm, 8 cm, 10 cm
- Striker
- Towel
- Apron
- Vinyl mat
- Tray
- Container of cards with labeled pictures of objects needed for each experiment
- Container with labels for highest sound and lowest sound
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. Ask the child to collect the materials on the tray and place it at the back of a table.
2. Have the child put on an apron and stand on your dominant side. Ask the child to spread the vinyl mat in front of the tray, place the glasses in sequence on the mat with the lowest marked glass at the left, the highest at the right. Tell the child to get a pitcher of water which is placed on the mat on the child's dominant side.
3. Invite the child to pour water to the marks in the glasses.
4. Show the child how to hold the striker as for the bells and to strike the first glass on the left at the front of the rim, then to strike each glass in turn from left to right. The process may be repeated as many times as desired.
5. Tell the child to empty and dry all materials before returning them to their storage places. The child should know to hang the towel to dry and to remove the apron for storage when the work is completed.
6. Thank the child and say that the experiment may be chosen.

Control of Error:

- Markings on glasses to indicate water levels
- Auditory awareness of different sounds

Observations:

- 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 observe what happens to the water as the glass is struck and to touch the glass after striking to feel the vibrations .
- Invite the child who can read to place the highest and lowest sound labels appropriately. If the child is able to write, invite the recording of observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.
- Invite two children to participate in determining which sounds are higher or lower by having one child stand with back to glasses while the other strikes any two glasses. The children trade places when desired.

Vocabulary:

- vibration

Sound Related to Length and Width of a Vibrating Object

Preliminary Exercises:

- Use of bells for matching and grading tones
- Removing and replacing lids
- Familiarity with reading fractions
- Practice in reading and writing phonograms

Purpose:

- To develop understanding of properties of sound
- To develop appropriate vocabulary

Materials:

- Sturdy box approximately 6 by 4 inches and about 3 inches deep, open on one long side with marks on the top open edge to indicate $\frac{1}{4}$, $\frac{1}{2}$ and $\frac{3}{4}$ of the length
- Container with three rubber bands of identical lengths but different thicknesses or widths
- Small closed container of rice
- Tray
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. Ask the child to collect the materials on the tray, place it at the back of a table and sit on your dominant side.
2. Have the child place the box at the front of the table with the long side parallel to the edge, then stretch any one of the rubber bands around the longest dimension of the box. The $\frac{1}{4}$ mark should be at the left.
3. Demonstrate the plucking technique with the forefinger of the dominant hand. Invite the child to follow the procedure.
4. Tell the child to hold the band with the first two fingers of the non-dominant hand at the $\frac{1}{4}$ mark, then pluck as before, listening to the change of sound. Ask the child to repeat the procedure holding the band at the $\frac{1}{2}$ mark, then at the $\frac{3}{4}$ mark.
5. Stand, replace chair, thank the child and say that this experiment may be continued or may be put away and chosen at another time.
Note: By now, the child knows to return the materials to their proper storage places.

Control of Error:

Auditory awareness of changing pitch of sound as the length of the vibrating object changes.

Observations:

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 stretch the three rubber bands of the same length around the box, arranged in sequence of thickness, leaving space between each. The previous experiment is repeated.

Invite the child to place a small amount of rice in the bottom of the box with the rubber bands stretched over it, then to observe what happens when the bands are plucked.

If the child is able to write, invite the recording of observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.

Vocabulary:

vibration pluck pitch

Experiments Involving Magnets

Properties of Magnets

Preliminary Exercises:

Practice in reading and writing phonograms

Informal use of horseshoe, circular and bar magnets with environmental objects

Purposes:

To develop an understanding of the properties of magnets

To provide further practice with classification skills

To develop appropriate vocabulary

Materials:

Container of magnets of several sizes, types and strengths

Container of labels for magnetic material and non-magnetic material
Container of objects, 6 magnetic and 6 non-magnetic

Two felt mats 8 by 10 inches

Container of small paper clips identical in size

Tray

Container of cards with labeled pictures of objects needed for each experiment

Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. A strong bar magnet will be used for this experiment. Ask the child to collect the materials on the tray, place it at the back of a table and sit on your dominant side.
2. Have the child place the container of objects near the center front of the table with a felt mat on each side, long side perpendicular to the front edge with the magnetic material label at the top of one, the non-magnetic material label at the top of the other.
3. Tell the child to place the objects in a row in front of the mats, then to remove the container to the back of the mats. Have the child touch the magnet to the first object on the left and to observe if the object is attracted to the magnet. Ask the child to place the object on the mat in front of the magnetic label if the object is attracted to the magnet or on the mat in front of the non-magnetic label if it is not attracted.
4. Have the child repeat the procedure with the other objects, continuing left to right. Leave and observe unobtrusively. The child knows to return the materials to their storage places once the experiment is completed.

Control of Error:

Observation of the effect of the magnet on materials

Observations:

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 test items throughout the environment with a magnet.

Invite the child to test the strength of various magnets by determining the number of identical paper clips which each magnet will attract end to end.

If the child is able to write, invite the recording of observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.

Vocabulary:

magnetic non-magnetic bar magnet circular magnet horseshoe magnet

Preparation and Use of an Electromagnet

Preliminary Exercises:

- Use of magnets
- Work with electrical circuits
- Practice in reading and writing phonograms
- Work with identification of numerals

Purposes:

- To give experience in the construction of an electromagnet
- To develop further understanding of magnets, magnetic fields and electrical circuits
- To develop appropriate vocabulary

Materials:

- Tray
- Small 9 volt battery
- Container with three spools of insulated wire, each spool containing wire 1 meter long and each of a different gauge, indicated on the spool; iron nail (20 penny size)
- Note: Insulation is removed from both ends of the wire for a distance of 10 cm
- Container of small paper clips identical in size
- Container with two lengths of wire with alligator clips on each end
- Note: These are available at Radio Shack.
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. Ask the child to collect the materials on the tray, place it at the back of a table and sit on your dominant side.
2. Show the child how to wrap wire from one of the spools onto the nail, starting at the head which is held in the non-dominant hand. The wire must touch the nail, so tight wrapping is essential. Leave a bit of wire unwrapped at each end of the nail.
3. Invite the child to touch paper clips with the wrapped nail and observe if there is any effect.
4. Ask the child to place the battery near the front of the table and to attach an alligator clip to each battery terminal. The other end of each alligator clip is attached to the ends of the wire which has been wrapped on the nail.
5. Invite the child to touch a paper clip to the wrapped nail attached to the battery and observe if there is any effect. Tell the child to disconnect any one of the alligator clips, then touch a paper clip to the nail again and observe if there is any effect.
6. Have the child disconnect the clips, rewind the wire from the nail onto the spool, then return all materials to their storage places.
7. Stand, replace chair, thank the child and say that the experiment may be chosen.
Note: Replace nail when it becomes permanently magnetized.

Control of Error:

Observation of magnetic attraction

Number of paper clips which magnet is capable of attracting

Observations:

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:

If the child is able to write, invite the recording of observations in a small booklet or on a lab report sheet which can be placed in an experimental science note book.

Invite the child to determine the number of paper clips, touching end to end, which are attracted to the electromagnet, then to record both the number and the gauge of wire wound on the nail. Have the child repeat the experiment with wire of other gauges wound on the nail and to record these results.

Invite the child to wrap the wire different numbers of times around the nail, such as 10 times, 50 times, etc., and to test the results with paper clips for each variation.

Vocabulary:

electromagnet

alligator clip

insulated wire

gauge

20 penny nail

9 volt battery

Experiment Involving Fabric

Effect of Color on Heat Absorption

Preliminary Exercises:

- Matching pairs of fabrics sensorially
- Use of sensorial materials for thermic sense
- Activities for establishing number-numeral concepts to 100
- Use and reading of thermometers
- Practice in reading and writing phonograms

Purposes:

- To develop an understanding of heat absorption relative to color
- To develop appropriate vocabulary

Materials:

- Six identical thermometers, either Celsius or Fahrenheit scale, with identifying numerals 1 through 6
- Container with pieces of cotton fabric 2 inches wide and as long as the thermometers: 2 black cotton, 2 white cotton, 2 of any other colors available in fabric of identical weave and weight
- Container with identical pairs of fabrics of different fibers
- Note: Each pair of fabrics must be the same fiber, color and the size given above. Timer
- Large tray
- Two small trays
- Container of cards with labeled pictures of objects needed for each experiment
- Small booklet or lab report sheet for recording observations

Procedure:

1. Invite a child to the lesson and place the card with pictures of objects needed for the experiment on a tray. Ask the child to collect the materials on the tray and take the tray to an area on a shelf or table where there is direct sunlight.
2. Have the child place thermometers numbered 1, 2 and 3 on a small tray in the sun, cover one with white fabric, one with black fabric and leave one uncovered.
3. Ask the child to take another small tray to a shelf or table where the sun is not shining directly and repeat the procedure with thermometers numbered 4, 5 and 6, setting the timer for 5 minutes.
4. Tell the child to read the temperature of the thermometers and record the results in a booklet or on a lab report sheet, noting the number of each thermometer, the conditions (sun or shade, color of fabric or no fabric) and conclusions.
5. Thank the child, say that this experiment may be chosen and have the child return the materials to their storage places.

Control of Error:

- Numbered thermometers
- Reading of temperatures

Observations:

- 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 repeat the experiment, using fabrics of different fibers and of different colors.
- Invite the child to repeat the experiment at different times of the year and at locations outside.

Vocabulary:

- names of fibers and fabrics used

Experiment Involving Soil

Water Absorption by Various Soils

Preliminary Exercises:

- Pouring
- Exercises for measuring solid materials
- Use of dropper
- Dish washing
- Putting on and taking off apron
- Exercises in putting on and taking off lids
- Work with Seguin boards
- Practice in reading and writing phonograms

Purpose:

- To develop understanding concerning properties of various soils relative to absorption of water
- To develop appropriate vocabulary

Materials:

- Measuring cup with lip
- Small tray with labeled closed container of sandy soil, closed container of clay soil, closed container of potting soil
- Tablespoon measure and spatula
- Coffee filters
- Tray
- Three plastic flower pots, 1 cup size, with drain-holes
- Dropper
- Vinyl mat
- Three small racks or one long rack to accommodate the 3 pots
- Note: Inverted plastic berry baskets may be used for racks
- Tray to hold racks
- Small booklet or lab report sheet for recording observations
- Container for used soil
- Towel
- Apron
- Container of cards with labeled pictures of objects for experiment

Procedure:

1. Invite a child to the lesson and place on a tray the card with pictures of objects needed for this experiment. Have the child put on an apron, then collect the materials on a tray which is placed near the back of a table.
2. Tell the child to spread the mat at the front of the table before getting water in the cup to place on the mat on the child's dominant side. The small tray of soils is placed at the back of the mat.
3. Sit with the child on your dominant side.
4. Ask the child to remove the lids from the containers of soil, placing lids behind the containers, then to arrange the pots in front of each container of soil.
5. Have the child place a coffee filter in each pot, then add 4 tablespoons of a different soil to each, pressing the soil firmly into the filter. The prepared pots must be kept in front of each corresponding labeled container. Lids are replaced once soil is removed from the container.
6. Show the child how to arrange the rack(s) in the tray at the front of the table, then place the prepared pots on the rack(s).
7. Tell the child to write the names of the 3 types of soil in the booklet or on the lab report sheet, leaving room to record numbers.
8. Have the child add water to the soil in the first pot at the left with the dropper, counting and recording under the appropriate name the number of drops of water required to cause water to drip from the bottom of the pot.
9. Tell the child to repeat the procedure with the other pots of soil and to observe which soil can hold the most water.
10. Show the child how to dispose of the used soil in the designated container, then fold the filters with the remaining dirt to the inside before placing in the waste basket.
Note: Periodically, this soil is mixed and transferred to the garden outside.
11. Have the child clean and dry the equipment as necessary before returning items to their storage places and removing apron. The towel is hung to dry.
12. Stand, replace chair, thank the child and say that this experiment may be chosen.

Control of Error:

Measured amounts of soil and water
Observation of water dropping from pots
Counting ability

Observations:

Handling of materials
Condition of work place and materials at conclusion of experiment
Child's reaction to error
Length of work time and number of repetitions
Degree of interest and concentration

Variations:

Invite the child to bring soil from home to test for absorption.
Invite the child to mix various soils by measured amounts to determine if absorption can be altered.

Vocabulary:

absorption	absorb	filter	soil	clay soil
sandy soil	potting soil	flower pot		

Botanical Experiments

Water Absorption by Seeds

Preliminary Exercises:

- Pouring
- Dish washing
- Putting on and taking off apron
- Exercises in putting on and taking off lids
- Practice in reading and writing phonograms

Purposes:

- To develop understanding of properties of seeds
- To reinforce observational skills
- To develop appropriate vocabulary

Materials:

- Water pitcher
- Two small identical clear containers with snap-on lids
- Closed container of dried beans
- Disposable aluminum pie pan
- Apron
- Vinyl mat
- Towel
- Container of cards with labeled pictures of objects needed for experiments Control and mute cards with labels for parts of the seed (See the Botany manual.)

Procedure:

1. Invite a child to the lesson and place on a tray the card with pictures of objects needed for this experiment. Have the child put on an apron, then collect the materials which are placed near the back of a table on the tray.
2. Ask the child to spread the mat at the front of the table before getting water in the pitcher which is placed on the child's dominant side. Have the child sit on your dominant side.
3. Tell the child to move the empty containers to the front of the mat, to remove lids which are placed behind them, then to fill the containers as full as possible with beans.
4. Have the child pour water into only one small container of beans so that all spaces are filled with water and it is even with the top. The lids are snapped on both small containers of beans.
5. Ask the child to place the containers of beans in a designated place with the one containing water on an aluminum pie pan.
6. Tell the child to observe the two containers from time to time.
Note: As the beans absorb water and swell, the lid will come off and beans will fall onto the aluminum pan.
7. Have the child dry the pitcher and mat, if necessary, remove apron and return all materials to their designated storage places. The towel is hung to dry. Thank the child and say that this experiment may be chosen. The child is instructed to discard the wet beans at the end of the day and to clean, dry and replace the container. The dry beans are returned to the large container.

Control of Error:

Observation of containers

Sound of beans falling out of the container with water
Control container with no water in which beans do not change

Observations:

Handling of materials

Condition of work place and materials at conclusion of experiment

Child's reaction to error

Length of work time and number of repetitions

Degree of interest and concentration

Variations:

Invite the child to use 3 small containers of beans, one with no water, one with cold water and the third with hot water.

Invite the child to dissect one of the hydrated seeds, looking first for the microphyle where water entered the seed, then, after removing the seed coat and separating the cotyledons, locating the plumule and the hypocotyl which would penetrate the seed coat through the microphyle.

Invite the child to soak beans in colored water, then dissect the seed.

Invite the child to allow the seeds to sprout by rinsing after the initial hydration, then keeping damp.

Invite the child who can write to record observations in a small booklet or on a lab report sheet.

By the three period lesson, teach parts of the seed, using the cards from botany.

Invite the child who can read to use the botany cards to learn seed parts.

Vocabulary:

hydrate testa tegman embryo cotyledon hilum microphyle hypocotyl
epicotyl plumule

Passage of Water to Leaves

Preliminary Exercises:

- Pouring
- Cutting plant stems
- Removing and replacing lids
- Use of squeeze bottles
- Dish washing
- Practice in measuring liquids
- Exercises with materials for learning parts of plants
- Use of apron
- Practice in reading and writing phonograms

Purposes:

- To develop understanding of plant function through capillary action
- To reinforce observational skills
- To develop appropriate vocabulary

Materials:

- Plant stem with leaves or white flowers, for example, celery stalk, carnation or daisy
- Floral scissors
- Towel
- Tall, clear container to hold plant stem, calibrated for 50 ml as indicated with a line marked on the side of the container
- Red food coloring
- Water pitcher
- Stirring rod
- Apron
- Tray
- Vinyl mat
- Container of cards with labeled pictures of objects needed for experiments

Procedure:

1. Invite a child to the lesson and place on a tray the card with pictures of objects needed for this experiment. Have the child put on an apron, then collect the materials which are placed near the back of a table on the tray.
2. Ask the child to spread the mat at the front of the table before getting water in the pitcher which is placed on the child's dominant side. Have the child sit on your dominant side.
3. Tell the child to add water to the container up to the mark, then mix with the stirring rod 3 drops of red color into the water.
4. Instruct the child to cut the plant stem to be used for the experiment and to place it in the container of colored water. This is moved to a designated place on a shelf. Tell the child to observe the experiment during the day to note the progress of colored water up the vascular bundles by capillary action or to note the color of the flower.
5. Have the child clean and dry the equipment before returning it to the proper storage places. The towel is hung to dry and the apron is removed and stored.
6. Stand, replace chair, thank the child and say that this experiment may be chosen. The child is instructed to discard the plant stem at the end of the day and to clean, dry and replace the container.

Control of Error:

Observation of plant in colored water
Passage of colored water through plant

Observations:

Handling of materials
Condition of work place and materials at conclusion of experiment
Child's reaction to error
Length of work time and number of repetitions
Degree of interest and concentration

Variations:

Invite the child to split the stem into two parts for about 10 cm and put each part in a different container with a different color of water in each, then observe for a day.
Invite the child to split the stem into two parts for about 10 cm and put one part into cold red water, the other in warm red water, then observe for a day.
Invite the child to use three of the same plant, placing one in red water for 4 hours, one in blue water for 4 hours and one in red water for 2 hours, then moved to blue water for 2 more hours. Observe for a day.
Invite the child who can write to record observations in a small booklet or on a lab report sheet.

Vocabulary:

veins vascular bundles capillary action name of plant used in the experiment