

# **Spatial Analysis and Planning**

# **SPATIAL ANALYSIS AND PLANNING**

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## **Definition**

Spatial analysis and planning refers to the ability to interpret spatial information and to use it in an organized, systematic way for planning movement. This ability is used in all activities that require appreciation of spatial arrangements, no matter which sensory systems are involved. Copying of designs and letters can reveal difficulty using and organizing visual information about spatial relationships. Difficulty with recognition of objects by feel (stereognosis) or telling which finger has been touched can be due to weak spatial analysis of touch information; and poor awareness of the position of the body or body parts can involve difficulty with use of spatial information received from the muscles and joints (kinesthesia).

## **Development**

As infants develop awareness of their ability to control their own movements and to act on the environment, they learn to perceive distance and direction between objects and their own body parts. Early spatial judgments are made using the self as reference (intrapersonal space). Children gradually develop awareness of objects and external space as separate from themselves, and they apply the information learned in reference to their body to objects in extrapersonal space.

By moving about, children provide multiple sensory experiences which are necessary for development of awareness of space and themselves in space. Through physical exploration, they learn spatial relationships of body parts, and then later learn to judge size, shape, and distance between body parts and objects. Finally they learn relationships between objects and other objects in space. The ability to use spatial information for more and more spatially complex motor responses continues to develop throughout childhood. The progression of increasing spatial awareness can be seen in preschool development.

During the first six months, children begin to learn about relationships of body parts to objects in space and to each other. They reach for objects and bring objects or hands to their mouths.

Between six and 12 months, they relate to objects in space by crawling, then walking around, toward, or away from them. They understand relationships of simple parts of objects to each other and can place rings on pegs, put telephone receivers on telephones, and remove pegs from pegboards. At this age children also understand the concept of *in* and can place objects into containers and take them out.

By age 24 months, children understand simple relationships of body parts to each other; and by 30 months, most can name at least six body parts and replace simple body parts on a puzzle or doll accurately. At 24 months, most understand spatial concepts of *out*, *up*, *down*, *on*, and *under*, and begin to understand spatial relationships of one object to another in three dimensions, for building towers with blocks and putting together two-piece toys.

At 30 to 36 months, children can add a body part to an incomplete drawing of a person and can draw a partial person, with head and body or head, eyes, nose, and mouth. At this age they are also able to relate all body parts to parts of objects for dressing and undressing, and can remember the locations of their own homes. Children at this age understand simple part-to-whole relationships and are able to use this knowledge for assembling simple puzzles and formboards.

Between ages three and four, they begin to understand the relationships of lines in two dimensions for drawing simple figures; and by four to five years, they can understand diagonal directions in two dimensions and combine lines and shapes to make representational drawings.

Around age four or four-and-a-half years, children learn to understand the relationship of body parts well enough to put together a puzzle of a person; and by five years, they can name all body parts, draw a complete person, and understand *right* and *left* in relationship to their own bodies. At that age, children also can use their understanding of relationships of parts of a whole to each other in three dimensions to imitate the construction of simple block shapes such as pyramids or bridges.

In the early school years, children practice and perfect the skills developed earlier and begin to attend to spatial aspects of putting lines and shapes together to form letters and numbers, arranging letters on the page, combining shapes to make detailed drawings, finding their way around a school building, and following directions that include spatial concepts and prepositions, including *left* and *right*.

Identification of left and right sides of the body is often difficult for many children in kindergarten and the beginning of first grade, but is usually performed easily by second grade. Reversals of letters and numbers are common in the early grades, as children learn left-and-right directions, as well as learning to remember the arbitrary direction that distinguishes similar letters such as *b* and *d* from each other. The ability to identify right and left on people facing the opposite direction can be confusing into later childhood—and for some, into adulthood.

## Difficulty with Spatial Skills

Movement occurs in space and is ineffectual without accurate spatial reference. Children with weak spatial skills experience difficulty with any motor activity that has strong spatial components or which involves organization or manipulation of spatial information. These children often do not have a clear understanding of spatial relationships of their own body parts, or their bodies

in space, to serve as a reference for making spatial judgments about objects in external space. They often do not automatically develop systems for organizing randomly displayed spatial information so that it can be manipulated or remembered.

Common areas of difficulty include identification of body parts or right and left sides of the body; following maps or routes around the school or neighborhood; estimating size of objects; poor memory for spatial positioning or location of objects in a picture or room; constructing things from a model (two-dimensional design copying or three-dimensional building with blocks); judging distance of objects from the child or trajectories of moving objects; putting clothing on correctly (frontward, buttons aligned correctly, shoes on correct feet, and so on); running in the right direction in ball games; completing puzzles; following directions that include spatial concepts and prepositions; and understanding distance and measurement concepts and geometry.

Poor spatial skills may be due to a number of causes, including lack of physical exploration experience (for example, as is often seen in children with cerebral palsy); learning disability; brain damage (especially when the right hemisphere is involved); or slow development or dysfunction of one of the perceptual modalities (kinesthetic, visual, touch, vestibular) which contribute to the development of spatial abilities.

## **Beneficial Activities**

Many children with weak spatial skills are likely to experience difficulty in this area throughout life. For some children (especially younger ones), remedial activities are helpful, but teaching strategies for organizing and using spatial information should be a major focus for all children with difficulty in this area.

For children in preschool and early grades, provide physical manipulative experiences which will help to develop space concepts and use of spatial prepositions. Body awareness activities (people puzzles, Simon Says games, following the leader, and so on) can emphasize relationships of body parts to each other and to objects in space. Imitation drawing and construction games can be used for teaching space concepts and prepositions ("Put one of these on top of this one.") for spatial manipulation of objects in external space. Use spatial activities, such as copying of arrangements of objects or copying designs, to teach strategies for organizing and using spatial information to plan motor responses. For example, for children with weak understanding of part-to-whole relationships, use picture-copying activities to teach them to talk themselves through the copying activity, using strengths in the language area to organize the activity. A child who is unable to accurately count a group of colored discs for replication would do better if taught to count them in a systematic fashion, such as counting in horizontal lines or by color, to assist with remembering which ones have already been counted.

For children age 12 and up, focus primarily on teaching compensatory problem-solving strategies for dealing with spatial information. Carry this practice into actual classroom activities. Focus on developing skills in stronger areas. For example, a child with weak spatial skills who is floundering in geometry might

be allowed to replace the geometry course with an extra language course. Later, this child would most likely go on to a course of study or employment which did not emphasize spatial skills such as those learned in geometry.

Improvement in specific skills is sometimes seen with repetition of gross motor spatial activity, starting with a simple level of spatial complexity and increasing difficulty as skill improves. However, this improvement does not necessarily carry over to other activities. The most practical approach for choosing gross motor activities is to build skills which the child has an interest in or needs for gym class or playground activity; or to devise ways to simplify spatial demands so that the child can avoid embarrassment in sport activities.

### **Compensatory Strategies**

Color-code objects to indicate placement in space. For example, use green, blue, and red mats at the bases to indicate which direction to run on a baseball field, or a spot of paint on puzzle pieces and puzzle board to indicate where pieces line up.

Draw directional arrows to help with directions or placement.

Use familiar visual or motor images to assist with recall of movement in space. ("Make a circle by moving your hand as if you are stirring chocolate milk"; "Stand like a crane.")

Wear a watch on the left arm to help identify *left* direction.

Allow oral arithmetic.

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**SPATIAL CONCEPTS**

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**Purpose**

To improve understanding of spatial concepts such as position, direction, size, distance, and measurement

**Activities**

Encourage any physical activity that explores movement of the body, body parts, or objects from one position in space to another; and variations in size, distance, or quantity.

**Large-Muscle Physical Exploration of Spatial Concepts**

1. Body-image activities such as drawing a line around outline of body and playing Simon Says games.
2. Obstacle courses that involve moving into, out of, through, under, between, over, and around objects.
3. Target activities with beanbag or balls. Start with large targets located close to the child, and move targets farther away as judgment improves.
4. Crawling through tunnels, large boxes, or barrels.
5. Climbing or playing on jungle gyms, ladders, seesaws, merry-go-rounds, swings, and other playground equipment.
6. Walking or crawling through ladders placed horizontally on the ground or over two cement blocks.



**Small-Muscle Activities**

1. Filling containers with liquid, sand, or uncooked macaroni and pouring from one container to another. Guessing about quantities needed to fill a container; pouring over objects; guessing which container holds more (different-shaped containers); stopping pouring when container is full; and so on.
2. Feeling objects of different sizes or lengths and inserting them into other objects (for example, nested cups or dolls, graded sizes of rings on a peg, shape nesting boxes).
3. Puzzles presented in a variety of orientations.
4. Cutting out pictures and shapes with scissors and arranging and pasting them on paper to form a collage.
5. Building with blocks and construction sets.

6. Poking fingers and objects into clay or dough, wrapping clay around objects, cutting through and pulling apart clay.
7. Cutting pipe cleaners into a variety of lengths and arranging them by length.
8. Cutting out pictures from magazines, pasting them on poster board, and cutting them into segments to make a puzzle. As the child's skill in putting them back together improves, increase the number of pieces.

**Desired Response**

Child actively engages in activities that involve spatial movement and judgments.

**Undesired Responses**

Child approaches activities in a disorganized, impulsive manner; uses large and undifferentiated movements in space; does not attempt to explore spatial aspects of the activity.

**Variations and Adaptations**

Carry child or encourage child to roll or crawl during large-muscle activities if mobility is limited.

Provide physical assistance, if needed, to enable child to explore spatial aspects of objects and their relationships in space. Place objects in child's hands and assist with finger or hand movement. Encourage child to make spatial judgments.

If child is unable to use an organized approach for dealing with these activities, focus on teaching the child a systematic way for completing the activity. For example, present nested cups; start by telling the child to find the largest cup first, then to find the next largest and place it inside the largest. Continue to organize the task in this manner, asking the child to find the next-largest cup. Repeat the activity and similar activities that involve size gradation. Decrease assistance as the child begins to use the organization strategy.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**SPATIAL TERMS APPLIED TO SELF AND OBJECTS**

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**Purpose**

To improve understanding and use of language used to describe spatial concepts such as position, direction, size, distance, and measurement

**Activities**

Encourage any physical activity that uses spatial terms to describe movement of the body, body parts, or objects from one position in space to another; and variations in size, distance, or quantity. Develop skills in the order in which they normally develop, as described below.

**Spatial Terms**

1. In, out, up, down, on, under, over
2. Large, big, little, small, next to, over, off, beside, above, below
3. Bigger, smaller, in front of, behind, closer, near, far, farther away, through, around
4. Longer, taller, shorter, close to, far away from, higher, lower, more, less, towards, away from
5. Right, left

**Procedure**

1. Child follows commands and answers questions dealing with the position of the whole body in space, using spatial terms ("Stand behind this line"; "Stand in front of that chair"; "Go outside this room"; "Is your body bigger or smaller than this block? the room? the chalkboard?"; "Stand to the right of this chair"; "Make your body higher.")
2. Child uses spatial terms to describe relationships between body parts ("Is your head above or below your feet? Is your foot larger or smaller than your thumb? Is your head or your foot closer to your neck?"); and to move parts of the body as instructed ("Move your hand away from your body").
3. Following the adult's instruction, child places objects and makes judgments in relation to the body or body parts. ("Place this block above your head, under your hand, below your chin"; "Is this block smaller or larger than your hand?"; "Is this block or that chair farther from you?"; "Move this block closer.")





4. The child places objects in relationship to other objects and describes relationships of one object to another, using spatial terms, in response to instructions and questions from the adult. ("Put this book on top of that book"; "Put your coat on the shelf"; "Is the shelf higher or lower than your coat?"; "Is your coat bigger or smaller than the shelf?"; "Put this pencil in the drawer; on the desk; outside of the room"; "Does this cup contain more or less water than this one?")

### **Desired Response**

Child follows directions that involve spatial terms and uses correct words for describing spatial relationships.

### **Undesired Response**

Child guesses correct responses, or randomly tries several until correct movement or answer is achieved.

### **Variations and Adaptations**

This activity can be fun for children working in pairs. The children take turns giving instructions or asking questions, using the word list above, and determining whether another child's response is correct.

Start with simple relationships, such as "Is your head above your feet?" As the child's skills improve, progress to finer discriminations, such as "Is your knee above your ankle?"

Provide physical assistance, if needed, to enable child to carry out movement of objects from place to place. Place objects in child's hands and assist with finger or hand movement. If child is unable to manipulate objects, move objects and encourage the child to identify whether your movement followed the instructions.

Write spatial words on cards. Have child read the cards and place the body, body parts, or objects according to the word on the card; or use the word to describe the size or location of objects in the room.

For any of these activities, let the child instruct you to move yourself or objects in various directions or ask you questions about relative sizes and distances and tell you if your answer is correct.

If the child is unable to speak the words, ask the questions so they can be answered with a "yes" or "no," thus showing that the child understands the words.

If the child has difficulty with body part relationships, practice using the terminology while putting together people puzzles or looking in the mirror.

Use spatial words for describing movement and spatial relationships whenever possible throughout the child's day.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**TERMS FOR SPATIAL ARRANGEMENT ON**  
**PAPER OR CHALKBOARD**

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**Purpose**

To improve understanding of language used for organizing writing or drawing on paper (horizontal) and chalkboard (vertical) surfaces

**Materials**

Chalkboard; orange and white chalk; one sheet of unlined paper; orange marker; pencil

**Preparation**

Draw a large rectangle on the chalkboard, with side proportions similar to those of a sheet of paper.

**Position**

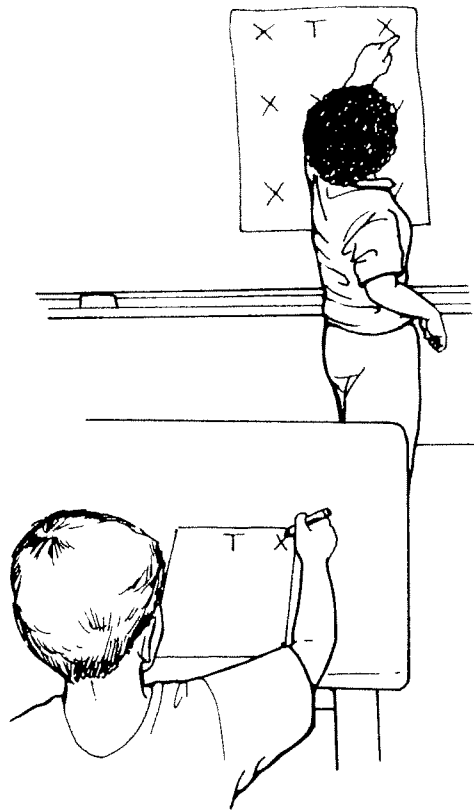
Desk or table and chair are placed 3' away from and facing chalkboard. Child stands in front of desk, facing board, with trunk lined up directly in front of chalk rectangle.

**Spatial Terms**

1. Center, middle, between
2. Top, bottom
3. Below, above, next to, over
4. Upper, lower
5. Center/middle of the top, center/middle of the bottom
6. Beside, to the right side, to the left side
7. To the right of, to the left of, left-hand corner, right-hand corner
8. Upper and lower right- and left-hand corners

**Procedure**

1. Child makes a T with the orange chalk, to identify the top of the rectangle.
2. Adult says each of the terms in reference to the rectangle on the chalkboard.
3. After adult says each word, child makes a mark (circle, X, line, etc.) with white chalk, in each position as it is described (for example, in the center of the rectangle, at the bottom or top of the rectangle, or above the center mark).



4. Child sits at desk, with paper positioned directly in front of body, and identifies the top of the paper with a T, using the orange marker.
5. Adult points to each mark on the chalkboard.
6. Child describes the position of the mark which adult is pointing to, finds that position, and marks it on the paper.
7. Child engages in a writing or art activity which uses the skills practiced above; for example:
  - Making a collage and pasting objects in specified locations on the paper, or identifying positions in relation to the paper as pieces are pasted.
  - Creating a book, with words on the right-hand page, pictures on the left-hand page, and name written in a specified location.
  - Practicing spelling words in specified locations (for example, "Write the word cat on the upper left-hand side of the chalkboard").

#### **Desired Response**

Child locates, identifies, and marks all spatial positions according to the descriptive terms, in both the upright and flat planes.

#### **Undesired Response**

Child randomly tries several positions until correct movement or answer is achieved.

#### **Variations and Adaptations**

If child is unable to make the transition from the spatial positioning on the board (vertical plane) to the paper (horizontal plane), encourage child to lift the top edge of the paper up slightly (and more if necessary) until the child recognizes the relationship to the positions on the chalkboard. If this is still difficult, hold the paper next to the rectangle on the board, and point out how the Ts are in the same position. Replace paper on desk, and repeat questions about the top, bottom, sides, and center of the paper, while child points to the position described. Continue until this is done easily on paper or chalkboard.

Draw lines on the rectangle on the board. Use lined paper to practice terms related to the use of lines (such as, "the third line down," "in the center of the first line," or "on the line below your name . . ."). If child has difficulty with left-and-right directions, teach child to associate the color red with right (both start with R) and green with left, and use red and green chalk and markers to indicate right and left on the board and paper. This also helps with remembering the left-to-right (green for go, red for stop) direction for writing; and once this is mastered, the left-to-right progression can assist with remembering left and right directions. In classroom activities, use the same colors to assist with directions.

Write spatial words on cards. Have child read the cards and locate the specified position on chalkboard, felt board, or paper. Place the cards that are difficult in a separate pile and repeat until child completes them successfully.

Combine with letter or number practice by requesting letters or numbers in specific locations. Do this on paper first; then turn over the paper and repeat on chalkboard. Have child compare to see whether letters are in the same positions on board and paper.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**LEFT AND RIGHT IDENTIFICATION**

**Purpose**

To improve ability to identify left and right directions

**Prerequisite Skill**

Before working on these left-and-right identification procedures, child should have established a dominant hand which is used consistently for most fine motor activities.



**Procedure 1**

- a. Child provides strong sensory input to the dominant hand before beginning activity, while saying "This is my right (or left) hand." The more memorable the sensation, the better. A few ways to do this are:
  - Rub hand firmly against textured surface such as sandpaper, rough plastic surface, or carpeting.
  - Squeeze muscles of arm and fisted hand as tightly as possible, for many seconds, then release slowly.
  - Hold a weight, or lift a bucket or bag filled with heavy objects, until the arm begins to tire.
- b. Child participates in an activity that requires use of left-and-right directions, starting with left and right sides of body and progressing to left and right directions for locating and moving objects in space. Examples include:
  - Games that involve showing right hand, left hand, right foot, etc., on request. This can be played as a group activity, with the leader calling out commands and players being "out" after three errors. The last remaining player wins the game.
  - Large-muscle activities that require movement in specified directions, such as following a leader's instructions to run right, stop, run left, hop three times, etc.; dance routines; "hokey-pokey" dances; and baseball games.
  - Locating writing and drawing in various positions on the chalkboard or paper.
  - Putting shoes on the correct feet. Shoes can be marked with *R* (right) or *L* (left).
- c. Whenever child is unsure of left or right, ask which hand experienced the sensory input at the beginning of the session, and what hand that is. Child then knows that the other hand is the opposite. If child has difficulty remembering, repeat the sensory input.

**Procedure 2**

Ask child to pick up a pencil, as if to write, and to tell you which hand is being used. Whenever child needs to remember left or right, have child make a few writing motions to identify the dominant hand.

**Procedure 3**

Teach child to associate the color red with right (both start with R) and green with left, and use red and green chalk and markers to indicate right and left on the board or paper. This also helps with remembering the left-to-right (green for go, red for stop) direction for writing; and once this is mastered, the left-to-right progression can assist with remembering left and right directions.

**Procedure 4**

To help older children (eight years or more) understand that when a person is facing you, the person's right and left sides are opposite yours, cut out a paper or cardboard doll and use it as follows:

- a. Child draws a face on one side and turns the doll over so that it is facing the same direction as the child. Child identifies the right and left sides of the doll and colors the doll's right side red and left side green.
- b. Child turns the doll over so that its face is visible and colors each side of the front of the doll, in the same color as the back.
- c. Child places the doll upright, facing away from child. Discuss how the right and left sides are the same for child and doll. Then turn the doll to face child, and discuss how the directions are opposite.
- d. Face child; ask child to identify your right and left body parts.

**Desired Response**

Child identifies right and left sides of body and uses these directions for planning movement.

**Undesired Response**

Child guesses directions randomly, or watches the movements of others.

**Variations and Adaptations**

Reinforce Procedure 1 throughout the day by asking the child which hand felt the rubbing, squeezing, or weight, and which hand that is. Repeat the sensory input at the beginning of an activity period or the beginning of each day until it is no longer needed.

For any activity, present writing implements and materials and ask the child to reach for them with the right or left hand. Alternate hands.

In classroom activities, use the colors taught in Procedure 3 to assist with directions. For example, place a red star on the right side of the desk as a reminder; or have child use a pencil with a red or green shaft, depending on which hand is dominant.

Provide a red string, watchband, or ring for child's right wrist or finger; or provide green for child's left side.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

SPATIAL ANALYSIS AND PLANNING  
Classroom and Individual Practice

## LETTER AND NUMBER ORIENTATION

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### Purpose

To improve the ability to write letters and numbers in the correct spatial orientation

Letters and numbers are commonly reversed in the early primary grades because children are unfamiliar with the symbols and may still be unclear about the concepts of right and left, top and bottom. Most children no longer experience this confusion by age nine years. These activities can help younger children to learn the correct orientations for letters and can help older children to resolve their confusion.

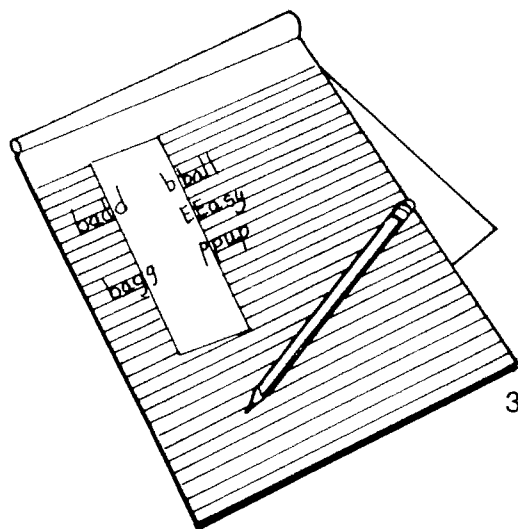
### Strategies

Identify letters which are troublesome for the child, and teach a reliable method which the child can use independently for writing the letters correctly. At the same time, provide plenty of activities for practicing recognition and writing of letters and numbers in the correct orientation.

### Procedure

1. Identify and record problem letters and numbers by observing the child in classroom writing activities; having the child produce a writing sample of upper- and lower-case letters and numbers; or examining classroom writing papers. Check the letters which are often the most difficult: *S, M, W, Z, N, u, n, w, m, P, b, d, p, g*.
2. Choose those which are commonly reversed, or pairs of letters which are often confused. Teach the child to use cognitive strategies and physical cues to consistently produce each letter in the correct direction. Examples of strategies include:
  - **Visual images.** For example, if the child knows how to form capital B, point out that when facing the correct direction, "small b fits inside large B." The word *bed* looks like a bed when both letters b and d are facing the correct direction.
  - **Verbal descriptions.** "The points of *u* face up, the points of *n* never do."
  - **Where they start.** "When writing *d*, you start in the middle; *b* starts at the top." Make sure the child forms letters in the stroke sequence that is being taught. Emphasize the different strokes that form similar-looking letters.





- **Rhymes.** "E faces 3." This is useful if the child consistently forms 3 in correct orientation but forgets how to orient E.
  - **Starting at edge of paper or on correct side of strip of paper.** Write a problem letter that starts with a straight line (such as b, E, F, K) on the right side of a ruler or strip of cardboard; and allow child to use the strip to remember the direction of the letter. Make similar strips, with letters on the left side, for letters that end with a straight line (such as d, g, q). Child uses the strip as a ruler for drawing the starting or ending lines of letters. If letters b and d are a problem, make a strip that focuses on these two letters.
3. Child practices activities that involve the letter or letter pair until able to use one of the strategies independently. Practice activities include:
- Type a paragraph or story with one reversed letter per line. Have child find and correct the errors.
  - Have child practice writing and number problems on a felt or magnetic board so that some letters will fall off if placed incorrectly.
  - Have child sort cutout or plastic letters into marked containers. If the child sorts by shape without understanding which letter it is (for example, b and d, p and q), mark containers with the upper-case form of the letters.

### Desired Response

Child consistently uses methods to write all problem letters in the correct spatial orientation.

### Undesired Response

Child reverses letters or numbers, or depends on adult to remember method for correct orientation.

### Variations and Adaptations

Work on only one problem letter or letter pair per session, and don't present another until the child is consistently producing the first correctly.

When working on pairs of letters which are confused, overlearn one letter of the pair before presenting the second letter.

Often, cursive writing is easier for children who have difficulty with spatial relationships, since it eliminates many of the reversal problems seen in manuscript.

Writing with a word processor or typewriter reinforces use of the letters with correct orientation in space.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

SPATIAL ANALYSIS AND PLANNING  
Classroom and Individual Practice

**LETTER ORIENTATION—  
PRACTICE ACTIVITY FOR P, p, b, d, g, q**

**Purpose**

To improve the ability to write letters *P, p, b, d, g,* and *q* in the correct spatial orientation

Many children find these letters confusing until around age nine years. This activity can help younger children to learn the correct orientations for these letters and can help older children to resolve their confusion.

**Prerequisite Skill**

Child should be able to identify left and right directions on the body and in space.

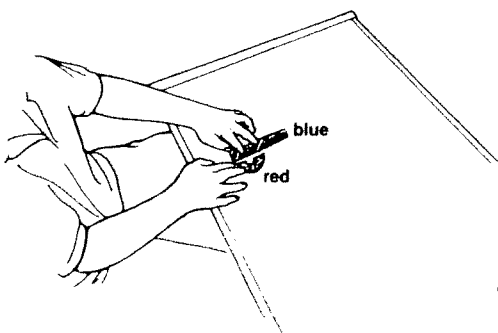
**Materials**

Three strips each of brown and blue construction paper or plastic place-mat material (4" long by  $\frac{3}{4}$ " wide); five red and two green semicircles (1½" high by  $\frac{3}{4}$ " wide); red, green, blue, and brown pencils or markers; lined paper

**Procedure**

These letters are often difficult to learn because when turned in different directions they can be transformed into one other. To help reduce this confusion, focus the child's attention on the spatial rules for formation of each letter.

1. Place colored strips and semicircles to form one letter, while describing how the letter looks (for example, "*b*: the line goes above the loop, and the loop is on the right side of the line").
  - Use blue strips for strokes that "go up to the sky" (extend above the loop of the letter), as in letters *d* and *b*.
  - Use brown strips for strokes that "go down to the ground" (extend below the loop of the letter), as in letters *P, p, g, q*.
  - Use red semicircles for loops that go to the right of the line, as in letters *P, p, b*.
  - Use green semicircles for loops that go to the left of the line, such as *d, g, q*.
2. As you say each letter name, child uses colored pieces to form the rest of the letters in the same way. Repeat those which are formed incorrectly.



3. When child is able to form all letters using correct pieces, write the letters with pencil on paper.
4. Child identifies each letter, again describing the rules for forming each one. If unable to remember the rules, child uses colored markers to color the parts and tries again.
5. Follow this activity with a writing activity that provides practice in forming these letters.

### **Desired Response**

Child uses the rules for identifying and forming all letters in the correct spatial orientation.

### **Undesired Response**

Child has no clear idea of the rules for arranging these letters in space, or does not use them to tell letters apart.

### **Variations and Adaptations**

This activity may take many sessions before the rules are learned. Some children do better if only one letter is presented at each session and the rules for forming that letter are repeated many times. When that letter has been overlearned, present the next.

Make letters with the colored pieces and have child identify them; or make errors and have child identify them.

Children can work in pairs, taking turns making letters with the pieces and identifying the letters.

Vary this activity by using chalkboard and colored chalk, colored pieces of felt on a felt board, or colored markers or pencils.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

## SPATIAL ANALYSIS AND PLANNING Classroom and Individual Practice

# PART-TO-WHOLE RELATIONSHIPS

### Purpose

To encourage use of strategies for analyzing and reproducing designs with accurate relationships between parts of the object and the whole object

Children with difficulty in this area often draw the parts of a design but "string" them together, one after another, with no overall plan for the whole design.

### Strategies

Before the child begins the task, encourage the child to analyze the design and its parts and to develop an end plan for putting the parts together to form the design.

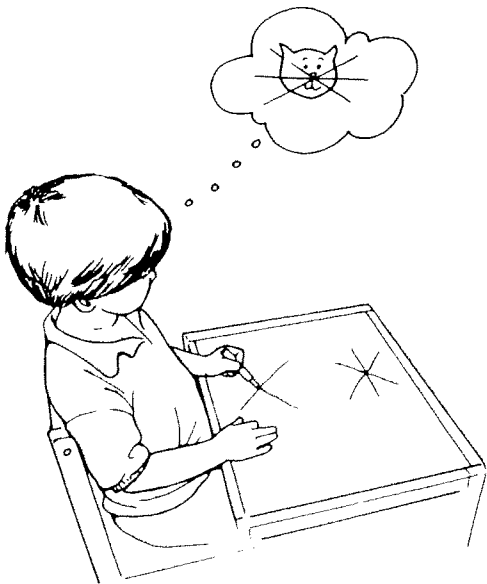
- Identify and describe the parts of the design.
- Verbally describe the position of each part in relationship to the other parts and to the whole design.
- Form a plan using words or images, thinking of what the whole design looks like or reminds you of ("It looks like a dinosaur's head, with a big eye"); or verbally describing what the whole design looks like ("a triangle with a circle inside").

### Activities

Encourage any activity that involves putting pieces together to form a whole. Teach the child to use strategies such as those above. A few examples of this kind of activity are:

**Puzzles**—Have child make puzzles by cutting out pictures of objects from magazines, gluing them onto cardboard, and cutting them into pieces. Start with a few pieces; increase the number as skills improve. Model putting a puzzle together while verbalizing strategies; then ask questions to encourage application of the same strategies as child puts one together. (For example, ask, "What is the whole picture going to look like when you put it together?"; "What parts do you have?"; "Where do you think the piece with the feet and ground would go?") Decrease your assistance as the child begins to use these strategies independently.

**Design copying**—Model the process of copying a design while verbally describing your strategies. ("I am going to make this design, which looks like a cat's whiskers. It's made of three lines that all meet in the middle. One goes straight across the middle, and the other two make an X.") Child repeats this process with the same designs, then with different designs.



Building with blocks—Using the process described above, child copies models to create various designs or three-dimensional shapes.

Drawing and painting—Books that teach drawing in a step-by-step manner of copying parts (such as the drawing books by Ed Emberley) are excellent for practicing the strategies described above. Drawing and painting objects from three-dimensional models is a more complex level.

Parquetry blocks—Use these for modeling and practicing part-whole strategies at a number of levels of difficulty. Start with combining simple shapes (such as two halves of a circle or square) to form a simple whole. Increase complexity as skill and strategy improve.

Math activities—Part-whole strategies can be incorporated into a number of math activities, including cutting shapes apart and putting them back together for studying fractions, and counting and removing objects from a group and replacing them in the same arrangement.

#### **Desired Response**

Child analyzes parts and their relationships to the whole design and develops an end plan for constructing the whole from the parts.

#### **Undesired Response**

Child arranges objects using a trial-and-error method, or attaches them so that the whole is not accurately constructed from the parts.

#### **Variations and Adaptations**

Start with plenty of modeling and questioning to focus the child's attention on a systematic approach. Progress toward independent use of this approach.

Start with copying from simple models, progress first to more complex models, and finally to drawing or writing letters and numbers from memory.

Encourage child to use this approach for any classroom or home activities that involve constructing things from parts.

#### **References**

*Ed Emberley Drawing Books*, published by Little, Brown and Company, Boston:

*Ed Emberley's Drawing Book: Make a World*

*Ed Emberley's Drawing Book of Animals*

*Ed Emberley's Little Drawing Book of Birds*

*Ed Emberley's Little Drawing Book of the Farm*

*Ed Emberley's Little Drawing Book of Trains*

*Ed Emberley's Little Drawing Book of Weirdos*

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**ONE-TO-ONE CORRESPONDENCE FOR SPATIAL PLACEMENT**

**Purpose**

To encourage use of a systematic approach for arranging objects in space so that the position of one object corresponds to the position of another

**Materials**

Blocks; button-up shirt; paper; pencil

**Strategies**

Encourage the child to develop strategies for using one-to-one correspondence for organizing arrangements of objects in space.

- Begin the activity by identifying a point of reference (top, left-hand side, and so on). The top works well for a series of objects arranged in a circle or vertical line; the left-hand side works well for a horizontal series of objects; and the bottom works well for three-dimensional constructions that must be built up.
- Verbally describe the position of the next object, and place the corresponding object according to the same description (for example, "The next circle is about an inch below and to the left of the first").
- Work in order from left to right or top to bottom (for example, for copying a series of dots or aligning and buttoning buttons on a shirt).
- Verbalize and point ("One here, one here, one here").
- Count ("The second one down on the model matches the second one down on the copy").
- Work in order by rows (for example, for copying a circle of dots, start with the top dot and copy the next two dots down, and then the next two, and so on).

**Activities**

Throughout the child's day, encourage as many activities as possible that involve matching the position of one object with that of another, using these strategies and any others you find that work. Examples include:

Imitating three-dimensional arrangements—Build a simple line of blocks. Progress to building bridges, pyramids, and other more complex forms. Place a few blocks; say, "I'll start at this side, and put down one, two, three blocks." Have child imitate your actions.

Copying three-dimensional arrangements—Set up lines of blocks (and, eventually, more complex arrangements) without child watching. Have child copy the arrangements from the model.

Imitating two-dimensional arrangements—Draw designs, or arrange objects (coins, sticks, blocks, cutout shapes) in various designs on the table surface while saying your strategies out loud. Child imitates the arrangement. Start with simple designs (three dots or objects in a row) and progress to more complex (a circle of dots).

Two-dimensional copying—Procedure is same as above, except child does not watch you draw or arrange objects. Child copies from the model.

Arranging objects with corresponding objects—Demonstrate organized arrangement of a set of objects with another set of objects. For example, align a vertical row of buttons on a shirt with a corresponding row of buttonholes while verbalizing your strategy (“I’m starting with the top button and lining it up with the top hole. Now I’m finding the next ones down”). Child repeats the activity.

**Desired Response**

Child uses an organized approach for arranging objects in corresponding positions in space.

**Undesired Response**

Child arranges objects using a trial-and-error approach, or arranges them so that numbers are unequal or objects are not in corresponding positions.

**Variations and Adaptations**

Start with copy close to model. Move away as organization improves.

To organize the task and avoid confusion, use a piece of construction paper to cover all of the model except for the object which the child is placing.

Children can do these activities in pairs, taking turns arranging objects and copying the arrangements.

Encourage child to use this approach for any classroom or home activities that involve corresponding spatial arrangements.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Classroom and Individual Practice**

**DESIGN-COPYING STRATEGIES**

**Purpose**

To teach strategies for analyzing and remembering positions of two-dimensional objects in space for more accurate copying of designs

**Prerequisite skills**

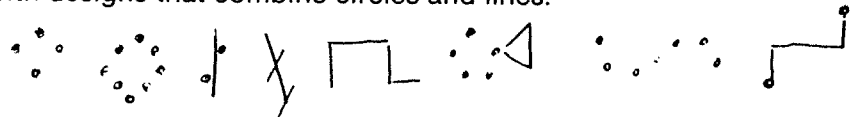
Child should be able to visually discriminate (recognize the difference) between correctly and incorrectly copied designs and be able to trace over a design with good control. If child is weak in these areas, work on visual-perceptual activities and visual motor control before beginning this activity.

**Materials**

Ten small circular objects (checkers, coins, plastic game discs); ten linear objects (five 4" and five 2"), such as pipe cleaners, craft sticks, or plastic strips; 15 manila file folders, one sheet of construction paper (Circles and strips can be cut out of plastic place mats.)

**Preparation**

Open a folder, arrange objects on one side to make a simple design, and trace around them. Make five folders with circles and five with linear objects, with increasing design complexity. Make five folders with designs that combine circles and lines.



**Position**

Adult and child sit facing each other across a table. Folder is opened and placed so that design-side is directly in front of adult and blank side is in front of child.

**Procedure**

1. Adult asks questions to encourage the child to analyze the design and use an organized approach and problem-solving strategies, such as:
  - Counting and grouping the objects by location, size, or shape.
  - Developing a plan by saying how the design is constructed, then following the verbal description.
  - Imagining something the shape looks like.
  - Verbally describing spatial relationships of the design.
  - Breaking the design into parts and analyzing them.
  - Closing eyes and trying to visualize the shape ("Imagine the shape in your mind").



**Example for design**

**Adult:** What kinds of pieces do you need, and what size?

**Child:** There are four short lines and one long one. (*Child separates out these pieces*)

**Adult:** What does the design look like?

**Child:** It looks like a diamond on a balance beam. (*Child tries, but can't make a diamond*)

**Adult:** What does the bottom half of the diamond look like?

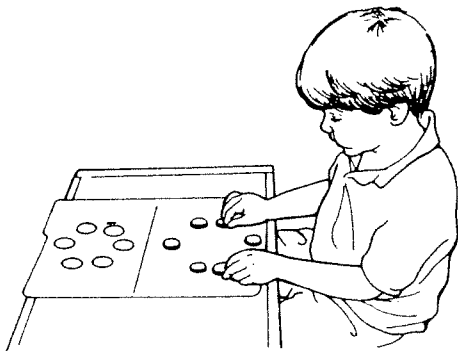
**Child:** Two short lines are made like a V. (*Child makes bottom of diamond*)

**Adult:** What do the top two lines look like?

**Child:** The top two look like a roof. (*Child completes diamond*)

**Adult:** Is it finished?

**Child:** The diamond is balancing on the middle of the long stick. (*Child completes design*)



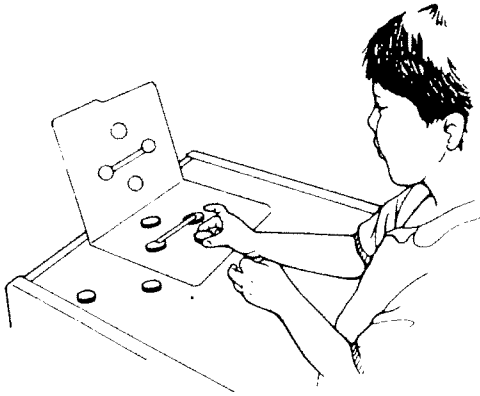
2. Child copies the design with circles and/or line pieces; repeats with several designs.
3. After child uses strategies for copying several designs, child looks at the next design for several seconds while adult asks questions to encourage analysis.
4. When the design has been described clearly, place a sheet of paper over the design.
5. Child uses circles and lines to copy the design from memory, using the same strategies. If design is copied inaccurately, show the model again and encourage child to discuss the difference between the model and the copy. Then cover the model while child corrects the copy.
6. Practice copying designs with pencil and paper.

**Desired Response**

Child uses a systematic approach and strategies to analyze and remember the spatial relationships for copying designs.

**Undesired Response**

Child relies on adult's questions and does not use a systematic approach when copying designs independently.



### Variations and Adaptations

As child does more analysis independently, decrease questioning. Progress to asking only, "How did you do that?" and praising any systematic strategies which the child uses.

Place design-side of folder straight up so that it faces child on an upright plane. Child practices making the transition from vertical to horizontal plane by copying the design on the flat side of the folder.

Help the child to discover which strategies work best for that particular child. Encourage child to use them whenever working on design-copying activities.

Books that demonstrate how to draw by breaking drawings into parts and copying them (for example, *Ed Emberley Drawing Books*) are an excellent way to practice strategies.

Encourage use of these same strategies for letter and number formation.

### References

*Ed Emberley Drawing Books*, published by Little, Brown and Company, Boston:

*Ed Emberley's Drawing Book: Make a World*

*Ed Emberley's Drawing Book of Animals*

*Ed Emberley's Little Drawing Book of Birds*

*Ed Emberley's Little Drawing Book of the Farm*

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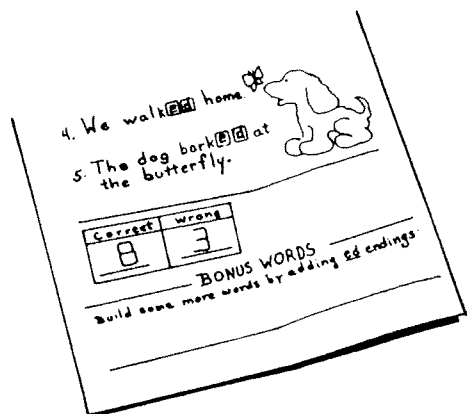
*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

## SPATIAL ANALYSIS AND PLANNING Classroom and Individual Practice

# INDEPENDENCE OF FIGURE FROM SURROUNDING SHAPE



Children with spatial analysis and planning difficulties tend to “square off” circular letters, shapes, or numbers, when writing them in boxes on worksheets or in workbooks.

### Purpose

To encourage use of strategies for drawing accurate shapes within boundaries of different shapes

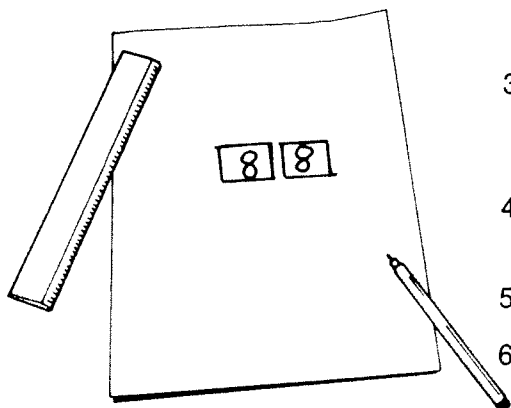
### Materials

Several sheets of large paper; ruler; red marker or pencil; one sheet of graph paper with large boxes (about  $\frac{3}{4}$ "); classroom worksheet or workbook activity that requires writing within boxes

### Procedure

Any activity which requires drawing of one shape within an outline of another shape will be helpful. Teach the child to identify the significant details of the shape, letter, or number that is being written (how it looks and how it feels); and to maintain those details regardless of the shape that surrounds it.

1. Child forms a 1" letter, number, or shape with rounded parts (b, c, o, 5, 3, 8, etc.) in the center of a piece of paper, using red marker or pencil.
2. Focus child's attention on the roundness of parts of the letter or number. ("Think about how it feels to make that letter"; "Does the number have sharp corners?") Encourage child to imagine the feeling of making the letter or number, and to describe the difference between it and the shape of the paper.
3. Child uses a ruler to draw a small box surrounding the letter, number, or circular shape, and again discusses the difference between the circular shapes and the shape of the outlining box.
4. Child makes an identical box on the paper, next to the first one, and writes the letter or number in it.
5. Repeat for several letters, numbers, and shapes.
6. Child writes letters and numbers within boxes of graph paper, using red marker.
7. Follow this activity with a workbook activity that involves writing letters, numbers, or problems within boxes.



**Desired Response**

Child focuses on the details of shapes, letters, and numbers, and maintains these details when drawing them within outlines of different shapes.

**Undesired Response**

Child draws letters, numbers, and shapes that take on spatial characteristics of areas in which they are written.

**Variations and Adaptations**

If child is unable to draw shapes independent of their surrounding shapes, provide objects of different shapes for the child to trace within the outlines. For example, have child trace dimes or plastic letters within a square or rectangular outline, then try again to draw these shapes freehand within the outline.

It helps some children to close their eyes and make the desired shape several times with their fingers "to get the feel of it," before drawing it within the outline.

Reinforce this activity in the classroom whenever letters or numbers take on the squareness of boxes in which they are written. Encourage the child to focus on how the letter feels and the details of its shape. Encourage child to try not to pay attention to the box outline.

Draw a large box on the chalkboard. Ask child to write a letter or number or draw a shape within the box. Erase and repeat with smaller and smaller boxes, and encourage child to write or draw with increased speed.

Provide a red marker for child to write in boxes. Encourage child to focus on the letter and to separate it from the outline.

Child draws simple shapes, letters, and numbers within triangular, rectangular, and circular shapes, using the same approach.

Child draws circles within the squares of graph paper, as fast as possible.

Start with paper or outline shapes that are much larger than the inside shape. Reduce the size difference to make the task more difficult.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING  
Compensatory Strategies**

**SCHOOL AND HOME ADAPTATIONS**

**Purpose**

To adapt fine motor activities so that they can be performed with minimal spatial confusion

**Strategy**

A child with weak spatial skills will have difficulty achieving accuracy when performing motor tasks which involve spatial judgments, or organization of objects in space. When adapting activities for this child, consider providing cues or landmarks; minimizing spatial aspects of the activity; using visual or motor imagery; and changing classroom expectations.

**Provide cues or landmarks to assist with spatial arrangements.**

Color-code objects to assist with placement. Color the bottoms of puzzle pieces to match the location where they belong on the board. Color the tops of containers to match the bottoms. Color-code parts of items that fit together. Place small dots of different colors on clothing or objects to indicate front and back. Indicate left and right by green and red shoelaces, or small dots of color on clothing or objects, watchband, or ring. Place color cues on the desk or paper for remembering directions for positioning words or objects in response to spatial directions.

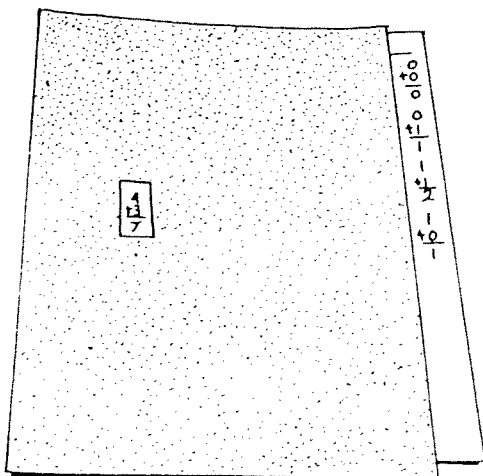
Teach child to use landmarks, such as labels in clothing, to find the back and front of objects.

Number lines to assist child in remembering the downward progression for writing.

Outline writing lines on paper with bright markers (green for top, red for bottom line) if child has trouble remembering top-to-bottom direction for forming letters.

Place tape on paper, or draw lines with marker (green for left, red for right), to assist with maintaining right and left margins.

Construct a "writing frame" by cutting out a rectangle from poster board and placing it over paper during writing to remind child of the outer boundaries of the writing area. For math problems, construct a writing frame with small boxes cut out, and place it over the paper to assist with organization.



Draw directional arrows on objects to identify how objects fit together. When the arrows on each part point to each other, the pieces are lined up correctly.

Draw outlines of objects on the desk or table, or on containers to assist child in remembering where to replace them after use.

Use lined paper to assist with organization of letters on the page.

Use graph paper or lined paper turned on its side for aligning numbers for math problems.

**Minimize spatial aspects of activities whenever possible.**

If the child has difficulty copying from the chalkboard because of the change in spatial orientation from vertical to horizontal, provide a copy of the work to be placed on the desk.

For many children with spatial confusion, cursive writing eliminates many of the spatial judgments involved in manuscript; once it is learned, it is easier to use. *Loops and Other Groups: A Kinesthetic Writing System* (Benbow 1990) is a system for teaching cursive handwriting to children with learning disabilities which is particularly helpful for those with spatial confusion. It teaches writing as a motor activity, with plenty of cues and strategies to assist with spatial positioning and memory.

Use of a word processor may be more difficult for this child to learn but will eventually provide a means of writing that decreases or eliminates spacing, placement of letters on the line, and letter formation.

**Use visual or motor imagery to assist with planning movement in space.**

For some children, imagining familiar objects can make it easier to remember or plan how to draw shapes or copy designs. For example, imagining a sun can help with drawing a circle, imagining a roof can help with a triangle, and visualizing a house can assist with drawing a square or rectangle.

Movement images can help in the same way. Thinking of stirring batter can help a child to draw a circle. Resting the arms on the desk "like a forklift" may be easier than imitating the desired position or following verbal directions for spatial placement.

**Change classroom expectations to match the child's level of ability.**

Focus on the content and legibility of written material, rather than appearance and organization.

Provide worksheets with fill-in answers for math rather than requiring the child to focus on lining up numbers for problem copying.

Encourage oral arithmetic.

Anticipate that this child may have difficulty and need extra assistance with geometry.

### **Comments**

These suggestions may increase the child's ability to participate in activities independently. However, unless it has been determined that compensation is the top priority, it's also important to teach strategies for organizing and using spatial information.

### **Reference**

Benbow, M. D. 1990. *Loops and other groups: A kinesthetic writing system*. Tucson, AZ: Therapy Skill Builders.

*Use of these activities should be directed by a qualified therapist.*

Child's Name \_\_\_\_\_

Date \_\_\_\_\_

**SPATIAL ANALYSIS AND PLANNING**  
**Compensatory Strategies**

**GYM, SPORTS, AND EXTRACURRICULAR ACTIVITIES**

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**Purpose**

To improve ability to participate in sport activities

**Strategy**

Modify spatial activities so they require less accuracy and less complex spatial judgments. Provide directional cues.

1. Provide opportunities for the child to develop skill in sports that are not highly dependent on spatial judgment. These sports include hiking (with supervision), running, jogging, skating, climbing, wrestling, and skiing.
2. Independent sport activities (jogging, swimming, bowling) may be easier than team sports for this child. The child is able to make spatial judgments at an individual speed, rather than responding quickly to the actions of other players.
3. Beanbags are often easier to catch and throw than balls. A commercially available rope ball has large open spaces that make it easier to grip, catch, and throw. When teaching ball skills, practice with large balls first, throwing from and to someone nearby. Decrease the size of the ball and increase the distance as skills improve. When this child participates in games such as dodge ball, provide a larger ball and allow the child to stand closer to the target children.
4. Children with spatial confusion are often fearful of balls, reacting defensively when the ball approaches rather than moving forward to catch, hit, or kick it. Recognize this as a real fear; it may be a protective response. Softer or lighter balls are less likely to be threatening (and safer) for children who cannot consistently protect themselves by catching a ball thrown in their direction. Kicking games are less threatening than throwing and catching, because the ball is less likely to hit the child in the face.
5. Allow simpler movements if the child is unable to coordinate more complex movement in space. For tennis or badminton, modify the serve to allow child to place the ball or shuttlecock on the racket and throw it across the net; for volleyball, allow child to throw the ball during the serve; and for basketball allow child to carry the ball instead of dribbling. Hitting, kicking, or catching is easier if the ball is stopped on the ground. If the child is unsuccessful with a moving ball, loosen the game rules to allow the child to follow the ball until it stops, or to stop it with feet or mitt before kicking or throwing.





6. For any activities that involve aiming at a target, allow the child to stand close to the target and increase the target size. For example, in basketball, allow child to shoot at the basket from less distance than the other children, or provide a lower basket under the regular one. In goal games, an entire wall can be used for the goal instead of a three-foot "cage."
7. Soccer and other ball-kicking games are often easier than throwing and catching games because balls are projected on a flat surface. Spatial judgments are simpler than in baseball or basketball, in which balls can travel in more complex trajectories.
8. In team sports, choose or create a position on the team which minimizes the need for quick and crucial spatial judgments. For example, if the child is unable to hit a ball, even off a T, consider allowing the child to be a "runner" who runs from base to base after another child hits the ball.
9. If a team sport cannot be adapted so the child can participate without embarrassment, consider making the child a goalkeeper or umpire, to encourage active participation without focusing on an area of weakness.
10. Use color cues to assist the child with directional orientation. Color the goal areas different colors and identify clearly for the child which color to aim for. For running the bases in baseball, first base can be green and third base can be red. For races and relays, the starting line can be green and the finish line can be red.
11. Create large directional arrows with tape or chalk on the gym floor to remind the child of the direction of movement.

**Desired Response**

Child is able to participate in sport activities, as a member of a team or group, without frustration or embarrassment.

*Use of these activities should be directed by a qualified therapist.*