

Children with Spatial Strengths: Overlooked Potential Engineers, Mathematicians, and Scientists

STEM Disciplines & Spatial Ability

Land Surveyor
Geo-spatial Technician
Satellite Operations
Surgeon
Cartographer
GIS (Geographic Information
Systems)
Computer Programmer
Architect
Inventor



Engineer

- Electrical
- Mechanical
- Aeronautical
- Environmental
- Materials

Physicist
Chemist
Geophysicist



Why Nurture Spatial Skills?

Schools emphasize verbal, not spatial skills

Traditional tests (SAT, GRE) do not assess spatial skills (Gohm, Humphreys, and Yao)

Undergraduate majors in 2000:

Only 5.6 majored in engineering

A mere 0.8 majored in mathematics

Doctorates earned in U.S. by non-citizens:

Engineering = 51%

Mathematics = 43% (NSF)

Individuals gifted in spatial ability undereducated and underemployed (Gohm, 1998)

Increasingly technological world needs ability to comprehend complex relationships and problem solvers with unique strategies (Shea, Lubinski, Benbow, 2001)

Selecting top 3% based on verbal or mathematical ability results in loss of more than half of students representing top 1% of spatial ability (Shea, Lubinski, & Benbow)

A few prominent Visual Spatial Thinkers

Albert Einstein

Thomas Edison

Leonardo daVinci

Pablo Picasso

Can you think of any more?



Strengths of Visual Spatial Learners

Visual Spatial Learners are adept at:

Puzzles and Mazes

Block Counting - 3D arrays w/ hidden blocks

Visual Transformations

Envisioning a folded & cut piece of paper when opened

Spelling words backwards and forwards

Getting around in unfamiliar territory

Reading charts, maps, diagrams Picturing objects from different angles

Recalling series of numbers/letters Numerical relations & mathematical reasoning

Pulling everything apart

Discovering patterns

Creating visual models of reality

Finding problems



Visual Spatial Learners often enjoy:

Blocks

Construx™

Daydreaming

Legos™

Movies

Tinker Toys™

Boxes

Computers

Gears

Mazes

Puzzles

Taking stuff apart



Contrasts Between Sequential and Spatial Processors

Sequential

Profoundly influenced by time

Western thought

Step by step

Learn by trial and error

Analytical thinker

Computation

Follows oral directions

Phonics

Rapid processor

Good organization

Progresses from easy to difficult

Needs repetition

Does well with Algebra

Deductive

Analysis

Orderly progression

Academic talent

Early Bloomer

Left Brain

Spatial

Preoccupied with space

Eastern thought

Whole to part

Learns concept all at once

Systems thinker

Concepts

Follows visual directions

Sight words

Slow processor

Organizationally impaired

Gets difficult concepts, struggles with easy

Learning sticks

Does well with Geometry

Inductive

Synthesis

Intuitive Grasp

Technology/Creative talent

Late Bloomer

Right Brain

(Linda Silverman)

Traits of Visual Spatial Learners

Visual Spatial Learners are:

Holistic Learners who:

Perceive relationships between the parts and the whole

Don't understand if learning is doled out in small chunks - Have difficulty attending to details

Can't grasp isolated facts until the big picture is in view

“Aha” Processors who:

Understand all or nothing - Once the “Aha” occurs, learning is relatively permanent

Often cannot explain the steps of their thinking

Detest routine, repetitive tasks and do not learn by rote memorization

Creative, they:

Arrive at surprising conclusions

Have amazing imaginations and often have imaginary playmates

Make up rich stories but can't always write them down

May do great drawings and be elaborate doodlers but have awful handwriting

Reflective:

They need extra thinking time therefore; they can appear to be lazy or to be daydreaming

Perceived as:

Unwilling to fit into time schedules or routines

Careless - Regularly forgetting homework; if it is done, handwriting may be illegible

Reluctant to take risks

Highly sensitive & hypersensitive to their environment such as:

Clothing - “the sweatpants kids”

Noise - They have poor listening skills but keen hearing, get more info than they can sift out

Emotions - Good at reading people and can sense a teacher's anxieties and ambivalence

Readers who:

Have better reading comprehension than decoding skills

Tend to skip over words but still get the thrust of the story - May never be good oral readers

Prefer reading heavily illustrated material

Strategies for Teaching Visual Spatial Learners

The Whole Picture

Explain major concepts so child understands instructional goal

Allow opportunities for inductive learning

Provide real life scenarios - service oriented projects are good

Discovery Learning - tell child the goal of the instruction and let him figure out a way to get there

Use a multidisciplinary emphasis

Hands On - Minds On

Provide manipulatives and create hands on activities
Encourage the student to make models

Visualize

Show everything - use overhead or white board, color is better than chalkboard
Encourage the child to visualize lists, patterns, and situations
Ask child if he can create a picture of the topic
Have student construct, draw or make visual representations
Ask yourself, "How would I teach this concept to a deaf child?"

Technology

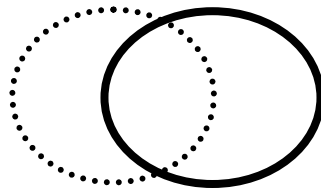
Encourage the use of computers for learning and teach keyboarding early

Increase the difficulty

Do not force the student to succeed at easier material before trying difficult work
Emphasize mastery of higher level concepts instead of perfection of simpler ones

Use

Color
Mnemonics
Humor
Meaningful material
Venn Diagrams



Rhythm
Music
Emotion
Fantasy
Manipulatives

Color

Have the child use highlighters to highlight directions or key concepts.
Color coordinate everything that has to do with one subject
i.e. purple math book cover, purple notebook, purple portfolio, etc.
Use overheads or white board with a variety of color; categorize by color.
Have the visual spatial child create his own flashcards in color.
Copy worksheets and study guides on colored paper, it is easier to organize and easier on the eyes.

Mnemonics

For Mnemonics to be effective...
The funnier the better
Make images 3D and/or moving
Exaggerate
Make images colorful
Use as many senses as possible

Acronyms

HOMES - the Great Lakes (Huron, Ontario, Michigan, Erie, Superior)
FACE - Spaces on the Treble Clef

Acrostics

Every Good Boy Does Fine - Lines on the Treble Clef

My very eager mother just sat under Ned's plate.
planets in order (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, Pluto
– oops, what do we do with Pluto now???)

Rhymes and Songs

Dividing Fractions - Yours is not to reason just invert and multiply
i before e except after c
ABC's
States/Presidents

Link Method - Visualizing things in a list in a story format.

Grocery List

Milk	Lettuce	Eggs	Orange Juice
Paper Towels	Chicken		

Humpty Dumpty (EGGS) balanced on the HEAD OF LETTUCE and floated down a river of ORANGE JUICE. Suddenly a squawking CHICKEN picked Humpty up and carried him over a PAPER TOWEL dam and dropped him into an empty MILK carton at the bottom of the falls.

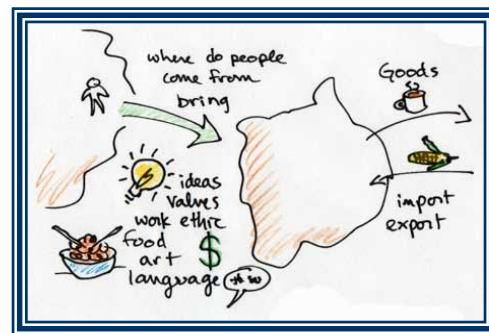
The Number/Rhyme System

Numbers are associated with images which rhyme with the number. Choose a rhyming word with which you can relate best. The images are then linked to the items on your list.

- | | |
|-----------------|---------------------------|
| 1 - Bun or Sun | 6 - Sticks or Bricks |
| 2 - Shoe or Goo | 7 - Heaven |
| 3 - Tree or Bee | 8 - Skate or Bait or Gate |
| 4 - Door | 9 - Line or Sign |
| 5 - Hive | 10 - Hen or Pen |

During lectures:

- Pause during verbal presentation to allow words to register
- Allow student to tape record lectures
- Encourage child to take notes in pictorial format
- Emphasize concepts not details i.e. dates
- Distribute handouts
- don't expect these students to take dictation



Writing

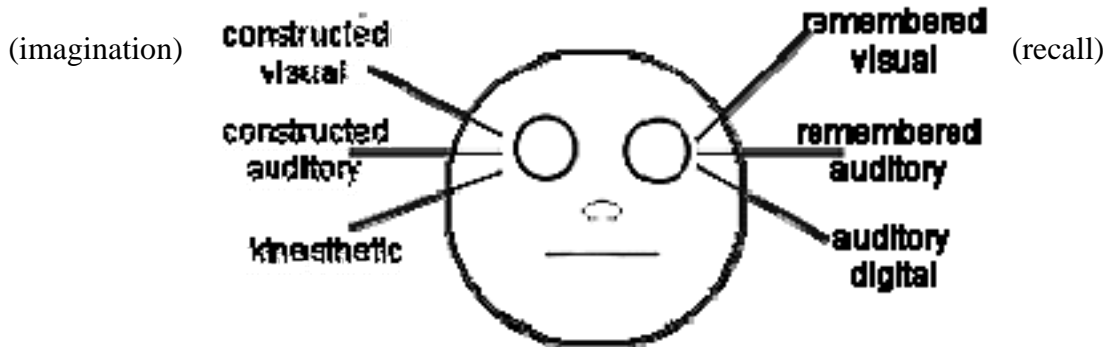
- Visual the entire sentence before writing it
- Tape record written work and then transcribe
- Grade ideas (content) and mechanics separately
- Use webbing and other graphic organizers to formulate ideas (www.inspiration.com)

Spelling

- Draw configurations for words on graph paper
- Write each word on a card in color

Visualize words - use NLP - spelling it both forwards and backwards

NLP



Math

Give chance to devise own method of problem solving

Avoid drill and repetition - No timed tests

Do five hardest problems on the page and go on if successful

Multiplication table

- Look for patterns in multiplication charts: 5678 is $56=7 \times 8$ and $4 \times 9=6 \times 6$

Teach within the context of entire number system

Division - give divisor, dividend & quotient then let child figure out the system

Patterns in Multiplication

x	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

Patterns in Multiplication

x	0	1	2	3	4	5	6	7	8	9	10
0	0	0	0	0	0	0	0	0	0	0	0
1	0	1	2	3	4	5	6	7	8	9	10
2	0	2	4	6	8	10	12	14	16	18	20
3	0	3	6	9	12	15	18	21	24	27	30
4	0	4	8	12	16	20	24	28	32	36	40
5	0	5	10	15	20	25	30	35	40	45	50
6	0	6	12	18	24	30	36	42	48	54	60
7	0	7	14	21	28	35	42	49	56	63	70
8	0	8	16	24	32	40	48	56	64	72	80
9	0	9	18	27	36	45	54	63	72	81	90
10	0	10	20	30	40	50	60	70	80	90	100

Reading

Oral Reading - child may never be a good oral reader - may tire easily and lose concentration

Get to the child before she makes a mistake so words won't imprint incorrectly

Decoding - Sight words, not phonics - difficulty hearing vowel sounds

Comprehension - Good speed readers since they don't read every word

Get content first then scan for details

Study captions and graphics in texts

Read first and last sentence of each paragraph

Skim material 4 times vs. reading slowly once

Junior Great Books is terrific program for these kid

Foreign Language

Classroom instruction can be very difficult

Total immersion in a language is much more effective



Organization

Color code calendars, assignments, books and supplies
Use an hourglass to visualize the passage of time
Make sure they have watches that are reliable
Teach them to “take a picture” of assignments as they are given
Help them learn to look up to their recall side to remember what it is they need to do
Teach them how to create priority lists and schedules – they may not like it but it is an essential survival skill!

Teacher/Student Interaction

Teach child to become a spy, notice what is going on in the classroom - take cues from classmates
Institute a moment of silence - let students can visualize what they will need for homework
Reduce unpredictable noise - music works well (walkman)
Use wait time - allow time for the child to translate the spoken word to images
Let the child completely finish answering even if she appears off target as she may get there
Discipline in private and be nonjudgmental - negative messages will cause them to shut down
Encourage the child’s strengths; don’t dwell on his weaknesses

Believe in these children, they may well be the future Edisons and Einsteins of the world

Effective Materials for use with Visual Spatial Learners

Attribute blocks	The Brown Paper Book Series
Base ten blocks	Math for Smarty Pants
Fraction bars	I Hate Math Book
Geoboards	Blood and Guts
Pattern Blocks	The Book of Think
Tangrams	Mindbenders
Geoblocks	Math Mindbenders
Soma Cubes	Logic Problems
Puzzles	Stories with Holes
Legos™ - simple machines	Lateral Thinking Problems
Construx™	Pentominoes
Gears	Three dimensional geometric shapes
Odyssey of the Mind	String Art
Destination Imagination	Strategy games
Set, The Game of Visual Perception	

Resources – Books

Silverman, L. (2002). *Upside-Down Brilliance: The Visual-Spatial Learner*. Denver: DeLeon Publishing.

Gardner, H. (1993). *Multiple intelligences : the theory in practice*. New York, NY: Basic Books.

West, T. G. (1991). *In the mind's eye: visual thinkers, gifted people with learning difficulties, computer images, and the ironies of creativity*. Buffalo, N.Y.: Prometheus Books.

Eberle, R. (1997). *Scamper: Creative Games and Activities for Imagination Development*. Prufrock Press.

SCAMPER (Substitute, Combine, Adapt, Maximize or Minimize, Put to other uses, Eliminate, Rearrange) activity to encourage creative thinking. Its creator, Michalko, says "Everything new is some manipulation of something that already exists. So, to create something new, simply manipulate a subject in some fashion".

Articles

Mann, R.L. (2005). Gifted students with spatial strengths and sequential weaknesses: An overlooked and under-identified population. *Roeper Review*, 27(2), 91-96.

Mann, R. L. (2001). Eye to Eye: Connecting with Gifted Visual-Spatial Learners. *Gifted Child Today Magazine*, 24(4), 54-57.

Silverman, L. K. (1989). The Visual-Spatial Learner. *Preventing School Failure*, 34(1), 15-20.

A Few Web Sites of Interest for Visual Spatial Learners

<http://www.inspiration.com>

Inspiration is an integrated diagramming and outlining program that allows students to organize their thoughts in either a concept mapping format and then click a button to see the outline format, or vice versa.

<http://www.gifteddevelopment.com> and www.visualspatial.com

Linda Kreger Silverman, Ph.D., The Gifted Development Center, 1452 Marion St, Denver, CO 80218

Linda Silverman has written numerous articles copies of which may be ordered by accessing the website for The Gifted Development Center or by writing and requesting a catalog of publications.

<http://www.graphic.org>

The Graphic Organizer

Some links from this page you might find useful for the use of Graphic Organizers:

Ready to Print Graphic Organizers to use with novel studies

Graphic Organizers - Many types are presented as teacher directions.

Write Design – Examples of GO

How to Effectively Organize a Paper using a Graphic Organizer

- A seven step approach.

Organization Patterns - A basic guide for the 5 paragraph essay

<http://www.puzzlecraft.com/solutions/pent/pentom/pentomin.html>

The Pentominoes Page

Pentominoes have some very interesting mathematical properties providing an endless array of challenging puzzles. For the puzzle buff, a pentominoes set will provide many hours of entertainment.

<http://www.vocabularycartoons.com>

Vocabulary Cartoons Home Page

Information on what Vocabulary Cartoons are and how to order the books.

<http://www.ex.ac.uk/cimt/puzzles/puzzindx.htm>

CENTRE for INNOVATION in MATHEMATICS TEACHING

Pages of puzzles including Tangrams, Pentaminoes, and Sliding Block Puzzles

<http://www.eduplace.com/math/brain/index.html>

Brain Teasers

Brain Teasers which are both entertaining and mentally challenging. Each Wednesday evening they provide one new Brain Teaser at each of three grade ranges.

<http://math.rice.edu/~lanius/Lessons/>

Cynthia Lanus Mathematics Lessons

Terrific math related activities. My favorite is the Pattern Blocks/Fractions page.

Million \$ Mission

Rectangle Pattern Challenges

Mathematics of Cartography

Dueling Pinwheels

Power Cards

Polyominoes

The Hot Tub

Calendar Fun

A Fractals Unit

Pattern Blocks/Fractions

Geometry Online

I Love Calculus

Slope as Rate of Change

The Hand Squeeze

<http://forum.swarthmore.edu/students/>

Math Forum

Problem of the Week

Geometry Problem of the Week

Internet Math Hunt

<http://www.bonus.com> - go to Imagine then to Illusions

Optical Illusions, Spiral Illusions, Magic Eye Puzzles, Spot the Differences and more go to Explore and How It Works - 46 things to do (try the robot)

<http://www.mindtools.com/memory.html>

Memory techniques and mnemonics - A thorough collection of mnemonic strategies.

<http://www.cyberbeach.net/~willows/mnemon.htm>

Science and Natural History Mnemonics, Proverbs, Rhymes, Acronyms, & Sayings

A great collection of mnemonics with links to many other mnemonic sites

<http://www.wm.edu/OSA/dostud/moresski/memory.htm>

Improving Your Memory Skills (Mnemonics) - Another page with mnemonic activities.

<http://www.dyslexia.com/library/silver1.htm>

Jeffrey N. Freed and Linda K. Silverman Ph.D.

“Strategies for the Visual Spatial Learner”