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**

<table>
<thead>
<tr>
<th>Sequential</th>
<th>Spatial</th>
</tr>
</thead>
<tbody>
<tr>
<td>Profoundly influenced by time</td>
<td>Preoccupied with space</td>
</tr>
<tr>
<td>Western thought</td>
<td>Eastern thought</td>
</tr>
<tr>
<td>Step by step</td>
<td>Whole to part</td>
</tr>
<tr>
<td>Learn by trial and error</td>
<td>Learns concept all at once</td>
</tr>
<tr>
<td>Analytical thinker</td>
<td>Systems thinker</td>
</tr>
<tr>
<td>Computation</td>
<td>Concepts</td>
</tr>
<tr>
<td>Follows oral directions</td>
<td>Follows visual directions</td>
</tr>
<tr>
<td>Phonics</td>
<td>Sight words</td>
</tr>
<tr>
<td>Rapid processor</td>
<td>Slow processor</td>
</tr>
<tr>
<td>Good organization</td>
<td>Organizationally impaired</td>
</tr>
<tr>
<td>Progresses from easy to difficult</td>
<td>Gets difficult concepts, struggles with easy</td>
</tr>
<tr>
<td>Needs repetition</td>
<td>Learning sticks</td>
</tr>
<tr>
<td>Does well with Algebra</td>
<td>Does well with Geometry</td>
</tr>
<tr>
<td>Deductive</td>
<td>Inductive</td>
</tr>
<tr>
<td>Analysis</td>
<td>Synthesis</td>
</tr>
<tr>
<td>Orderly progression</td>
<td>Intuitive Grasp</td>
</tr>
<tr>
<td>Academic talent</td>
<td>Technology/Creative talent</td>
</tr>
<tr>
<td>Early Bloomer</td>
<td>Late Bloomer</td>
</tr>
<tr>
<td>Left Brain</td>
<td>Right Brain</td>
</tr>
</tbody>
</table>

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

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

Rebecca L. Mann

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

**NLP**

(Imagination) (recall)

(Imagination) (recall)

**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
Teach within the context of entire number system
- Look for patterns in multiplication charts: 5678 is 56=7x8 and 4x9=6x6
Division - give divisor, dividend & quotient then let child figure out the system

**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 kids

**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**
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**

**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

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

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 Lanius 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”