ArtSmart

Robert Root-Bernstein, Ph. D.
Department of Physiology
Michigan State University
East Lansing, MI 48824 USA
rootbern@msu.edu
Root-Bernstein
“Building Blocks of Life 2”
Exploration of My Complementarity Theory of Evolution
J. H. van’t Hoff, the 1st Nobel Laureate in Chemistry: Flautist, Poet, Artist
Polymathy as the Basis of Imagination in Science

- ‘Imagination plays a role both in the ability to do scientific research as well as in the urge to exploit this capability…. I have been prompted to investigate whether or not this [imaginative] ability also manifests itself in famous scientists in ways other than their researches. A study of more than two hundred biographies showed that this was indeed the case, and in large measure.’”

Polymathy Predicts Career Success

Correlations Between Avocations, Scientific Style, Work Habits, and Professional Impact of Scientists

Robert S. Root-Bernstein
Department of Physiology
Michigan State University

Maurine Bernstein and Helen Garnier
Department of Psychiatry and Biobehavioral Sciences
University of California, Los Angeles
The More Successful a Scientist, the More Likely He or She Is to Have One or More Adult Arts and Crafts Avocations.
Adult Avocations Correlate with Scientific Success

Compared with typical scientist, Nobel laureates are at least:

- 2X photographers
- 4X musicians
- 17X artists
- 15X craftsmen
- 25X writers
- 22X performers

Root-Bernstein, et al., 2008
Cultural Economy Research Team:  
ArtSmarts And Innovators  
In Science, Technology, Engineering And Mathematics (STEM)

Robert Root-Bernstein, Ph.D., Professor of Physiology  
Rex LaMore, Ph.D., Director Center for Community & Economic Development  
James Lawton, MFA, Professor and Studio Artist, College of Arts & Letters  
John Schweitzer, Ph.D., Professor, Center for Community & Economic Development  
Michele Root-Bernstein, Ph.D., Adjunct Faculty, College of Arts and Letters  
Eileen Roraback, Ph.D., College of Arts and Letters  
Amber Peruski, MSU Honors College Undergraduate  
Megan VanDyke, MSU Honors College Undergraduate  
Laleah Fernandez, Doctoral student, College of Communication Arts & Sciences

Acknowledgements:  
Michigan State University’s Honors College  
The Institute for Public Policy and Social Research
Continuous Arts Participation Correlates with Patents & Companies

- Drawing
- Painting
- Ceramics
- Dancing
- Metalwork
- Mechanics

![Graph showing continuous arts participation correlates with patents & companies.](Image)
In Sum, Best Scientists & Inventors Have More Skills Associated With Making And Communicating

- Musical scientists duet (and do it) better
- Artistic scientists have more image to their imagination
- Crafty scientists are more handy
- Literary scientists have the making of pundits
- And performing scientists perform better
- Moreover, successful scientists know this!
Visual Thinking Training Improves Science and Engineering Ability


Physicist, Historian and Novelist MITCHELL WILSON

• "The particular kinds of sensibilities required by a scientist are [even] more complicated," and include an “intense awareness of words and their meanings.... [He must be] capable of inventing new words to express new physical concepts. He must be able to reason verbally by analogy.... The scientist must also think graphically, in terms of dynamic models, three-dimensional arrangements in space... Formulas and equations printed on a two-dimensional page have three-dimensional meaning, and the scientist must be able to read three dimensions to 'see the picture' at once."

• Mitchell Wilson, A Passion to Know, 1972, pp. 11-12.)
Need to Train Scientists and Engineers In ALL Thinking Tools!
The “Tools for Thinking” Taught By Scientists Are INSUFFICIENT!

- **High School Explicit**
- **Scientists (103) Explicit**
Dorothy Hodgkin, Nobel Laureate in Chemistry
Alexis Carrel, the 1912 Nobel Laureate in Medicine or Physiology, "learned [as a child] the intricate stitching required for his [later surgical experiments] from the renowned lace makers of Lyon, one of whom was his mother."

Alexander Fleming played at painting...
with a twist!

“This is not written with ink but with bacteria which develop colour as they grow.

(1) P. violaceus
(2) P. prodigiosus
(3) Staphylococcus
(4) A. baillus
(5) Sarcina
Fleming Left His Petri Dishes Open to Collect Microbes for His Palette
Result Was PENICILLIN, Which Depended on Practices Forbidden by Bacteriology
Kenneth Snelson: Tensegrity

- **PLAY**: What would happen if I combined a Buckminster Fuller Geodesic dome structure with an Alexander Calder mobile?
- **Tensegrity** = structural integrity resulting from tension of flexible elements acting upon inflexible ones producing compression
Skwish”: Kid’s Play with Tensegrity
Tensegrity Engineering: The Kurilpa Bridge in Brisbane, Australia

The suspension Bridge - Waterloo
Don Ingber (Harvard) & Steve Heidemann (Michigan State)
TENSEGRITY MODEL OF CELL ARCHITECTURE
Acting Brings Words – And Equations! – to Life:

PHYSICIST JACOB SHAHAM

“Acting taught me how to read equations like a script with characters I had to bring to life…”

2000 Nov 30
2001 Dec 11
2001 Dec 29
2002 Apr 03
George Antheil & Hedy Lamarr Invented Frequency Hopping
Sommer Gentry: Teaching Robots To Dance At MIT
James Dewar: Ultra-Low Temperature Physicist
Singer Manuel Garcia Invented the Laryngoscope
Louis de Broglie: Harmonics of Electrons
In Sum, Arts Provide STEM:

- Tools for Creative Thinking
- Practice with the Creative Process
- Transferable Skills
- Effective Techniques and Methods
- Useful Knowledge
- Fruitful Analogies
- And much, much more!