

Spatial Reasoning

Science data analysis, visualization, communication, and education

THE IMPORTANCE OF SPATIAL REASONING FOR GEOSPATIAL EDUCATION

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ABOUT US

- Bill Hazelton

- Surveyor for 40+ years and licensed 35 years

- Educator and researcher for over 30 years

- Worked as a surveyor on 3 continents

- Professor at Troy University

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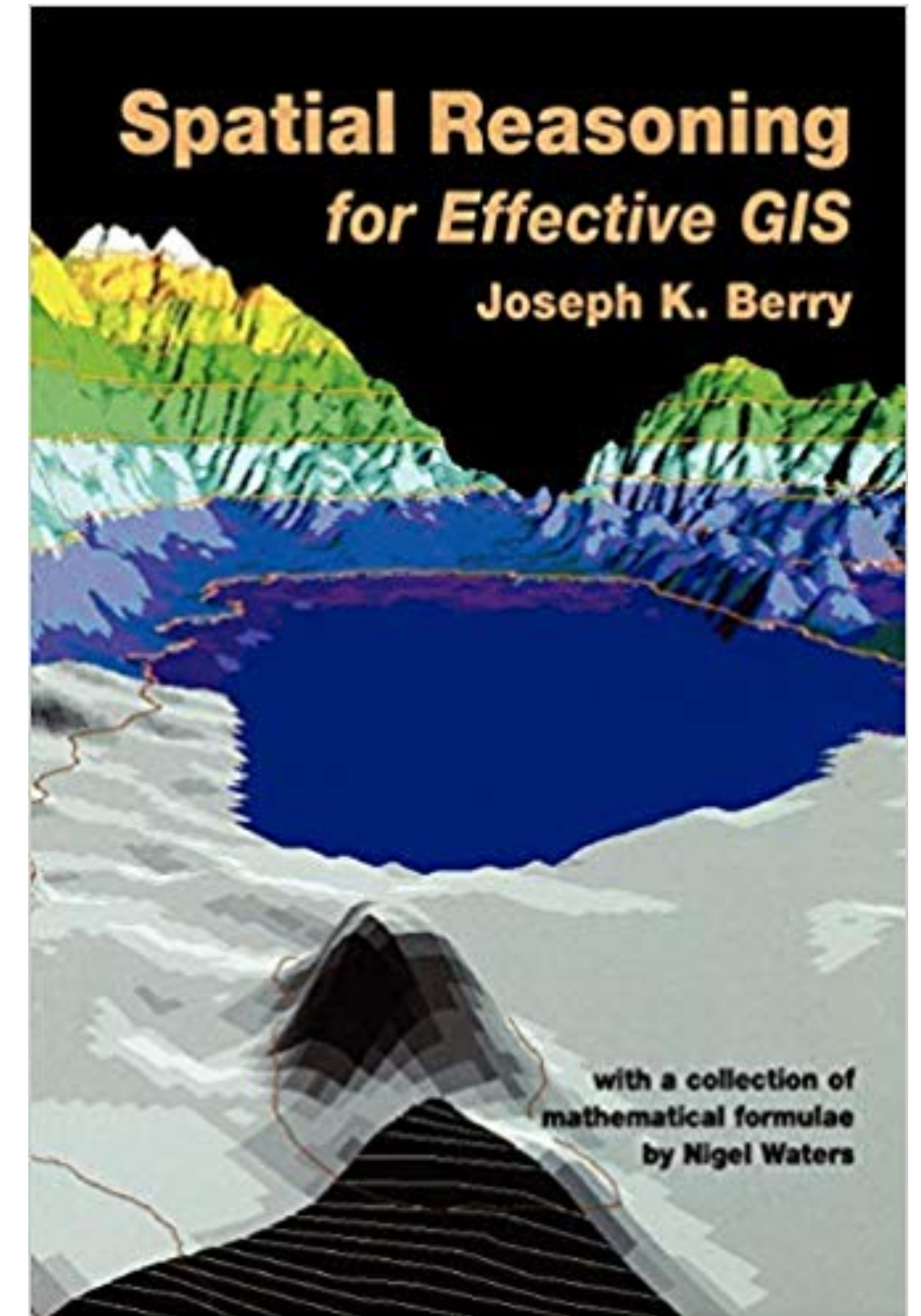
WHAT IS SPATIAL REASONING?

- There are many definitions
 - “A category of reasoning skills that refers to the capacity to think about objects in 3-D and to draw conclusions about those objects from limited information”
 - “...also called spatial visualization ability, refers to the ability to see a 2-D or 3-D object and then mentally manipulate it.”
 - “Spatial ability is the capacity to understand and remember the spatial relations among objects.”
 - “Spatial reasoning is the effective application of [map analysis] tools to solve problems.”
- It includes numerous ‘sub-abilities,’ such as image interpretation, navigation, map analysis, spatial analysis, visualization, etc.



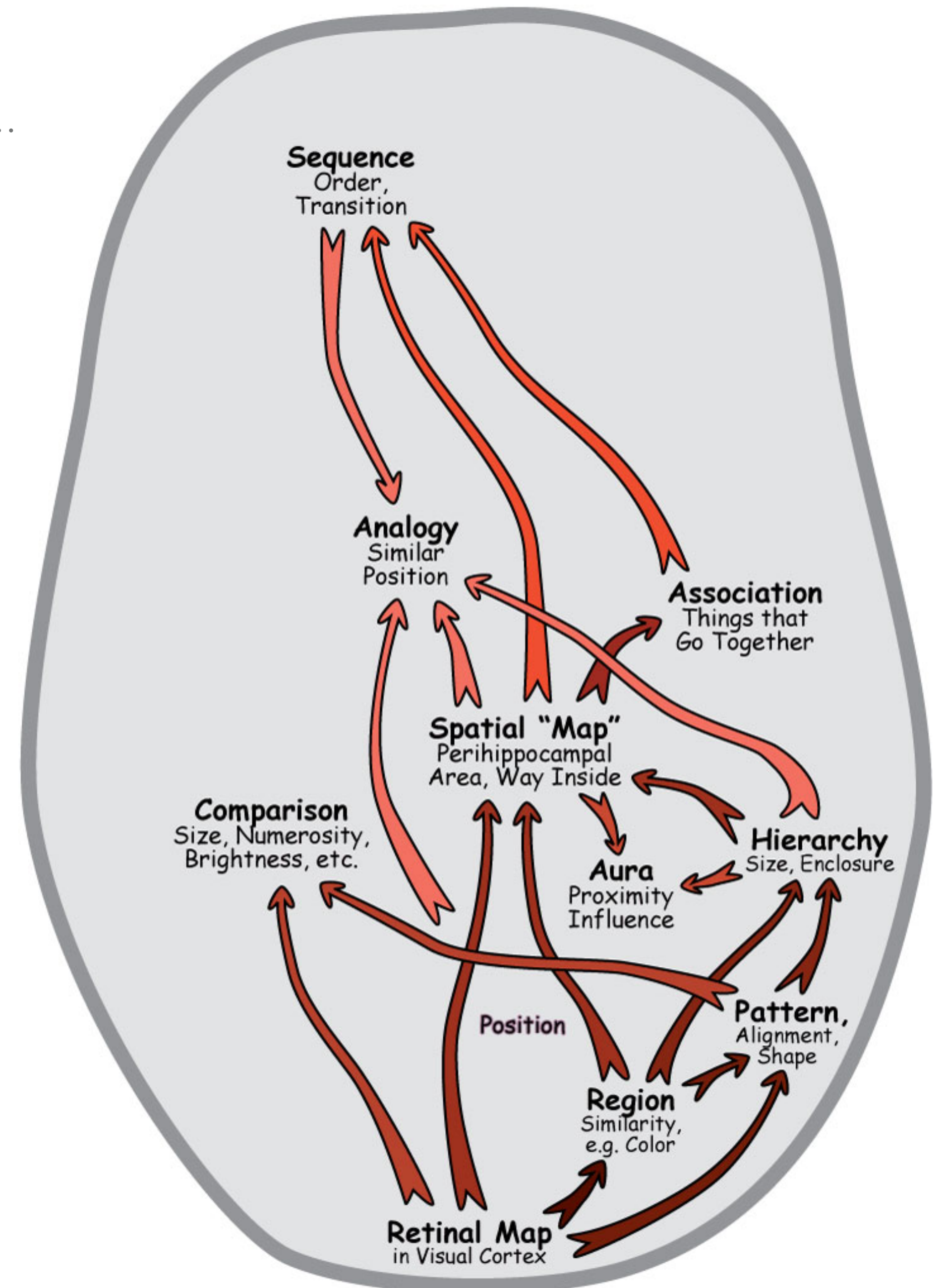
SPATIAL REASONING

- Joe Berry published *Spatial Reasoning for Effective GIS* in 1995
- The expression “spatial reasoning” appeared twice in the text of the book, on pages 4 and 5!
 - This is in the introduction
 - It is never mentioned again
- The book was a compilation of the author’s columns, and no real attempt was made to knit these together into anything coherent relating to spatial reasoning
 - It was largely about things to do with GIS



SPATIAL REASONING

- Spatial reasoning uses multiple regions of the brain to achieve a result
- The different components of spatial reasoning are scattered across the brain, allowing significant parallel processing
- As neural connectivity is a physiological indicator of intelligence, the greater the skill in spatial reasoning, the stronger the connectivity within the brain
- The increases intelligence potential across the board, hence the STEM relevance



WHY IS SPATIAL REASONING IMPORTANT?

- Spatial reasoning is a critical component of ability in STEM fields
- “Spatial reasoning is linked to positive education outcomes in STEM and is a strong predictor of success in the visual arts, and vocational, manufacturing and technical careers.”
- Spatial reasoning is a strong predictor of success over and above mathematics and verbal reasoning in predicting success in educational and occupational domains, including STEM and the humanities
- “Spatial ability has a unique role in the the development of creativity, beyond the roles played by the abilities traditionally measured in educational selection, counseling, and industrial-organizational psychology.”

WHY IS SPATIAL REASONING IMPORTANT?

- Spatial reasoning is a teachable and learnable skill
 - Recent research indicated that males outperform females at spatial reasoning tasks, but that there is no significant difference in very young children
 - Boys are encouraged spatially from elementary school
 - This suggests that we (as a society) are working (indirectly) against females entering occupations and professions that require spatial reasoning
 - That spatial reasoning is teachable and learnable means this can be reversed

WHY IS SPATIAL REASONING IMPORTANT?

- Spatial reasoning is strongly correlated with academic performance across the curriculum, including the visual arts
- It is subject to very limited testing in schools, and often lumped in with testing of mathematical ability
- As spatial ability / spatial reasoning is so important for so many disciplines (most especially the geospatial disciplines), even more so than mathematical ability, should we not be pushing scholarships based on spatial reasoning rather than TrigStar?

ENCOURAGING SPATIAL REASONING

- Play that has a significant component based on construction and building emphasizes spatial reasoning skills
- Physical manipulation of objects in 3-D allows the brain to develop the skills to replicate the manipulation mentally
 - Note that stereoscopic vision is not required for spatial reasoning
- Everybody has spatial ability and can learn to improve its use

ENCOURAGING SPATIAL REASONING

- Since this is a clear gap in how we educate young people for critical STEM careers, is this something that we, as a profession, can use as a means to gain access to the nation's youth?
- Can we develop very basic learning modules to help build spatial reasoning?
 - These would be available to schools and families at low to zero cost
 - We could incorporate scenarios that have a definite geospatial leaning to increase awareness of geospatial occupations
- Could we built a 'testing' system that encouraged development of spatial reasoning?
- Can we make it something that is 'mainstream' in schools?

RECRUITMENT

- We, as a profession, need people with spatial reasoning skills, perhaps more than any other profession
 - This need is growing, in lockstep with the growth in spatial information
- As we gain more capable analytical tools, we need people with the skills to understand both the answers and the questions
 - We also need people to develop the analytical tools
 - We also need the next generation of educators
- We have needs, can we manage some action?

QUESTIONS?

THANK YOU!