

Mode of Spatial Thinking	M a t h   L i n k a g e s   a t   V a r i o u s   L e v e l s			
	K - 2	3 - 5	6 - 8	9 - 12
0. Location – a. Condition – b. Connection –	closer/farther hot/cold crowded/empty near/far linked/not	coordinates, latitude-longitude measuring temperature, rain, elevation, rock hardness measuring distance, relative cost of transport modes	polar coordinates working with census data calculating densities, other ratios speed/time relationships, 2D table of place links	backsighting, trilateration complex index (e.g., HDI) based on several variables gravity model, measuring connectivity
1. Comparison –	tall/short many/few	bar graphs based on measurements, pie graphs based on counts	percentages of total, deviations from average	calculating a comparing index (localization quotient)
2. Aura (Influence) –	near/far within range	cost per unit of distance, effect per unit of distance	inverse-square “law” (e.g. gravity), graphs of influence with distance	non-symmetrical influence (e.g. smoke plume in wind)
3. Region –	this group/that one	estimating similarity to the “typical one” in several groups	multi-factor regions, add-up-the-points indices	cluster analysis, elementary sampling
4. Hierarchy –	inside/outside part/whole	whole/parts, enclosure, counties-states-countries	ordinal rank in political hierarchy, stream order in drainage system	central place theory, administrative hierarchy
5. Gradient –	between/beyond first/next/last	line graph of some variable observed along path	side profile, slope calculation, interpolation between measurements	change in slope, complex interpolation
6. Analog –	middle/edge of desk side/corner of desk	similar latitude, similar distance from road	similar direction from center e.g. of city, field, park, lake	proportional distance in different-sized cities, lakes
7. Pattern –	bunched/spread out line/string/ring	rough count on each side of center (estimate of balance)	percentage on one side, direction of alignment	nearest-neighbor analysis (alignment, clustering)
8. Association –	together/separate	estimation of overlap (quantitative Venn diagrams)	2x2 contingency table	correlation scattergrams
X. Spatio-temporal Thinking				
a. Change – (change in condition)	then/now	difference in count, difference in measurement	percentage change in some measured trait	graph showing rate of change
b. Movement – (change in position)	here/there	distance traveled, estimated travel time	speed per unit of time, estimated arrival time	acceleration
c. Diffusion – (change in region/pattern)	smaller/larger	distance from center to edge, fraction of area changed	percentage growth, expansion per unit of time	asymmetrical expansion, measures of imbalance