

Ways of Thinking about Geometry Selected Quotes

“The word *geometry* is of Greek origin. *Geo* refers to the earth or land, and *metry*, to measure. ... [We] think of geometry both as a description of physical space and as an axiomatic system. ... So, what is geometry? Years ago an information definition might have been that it was the branch of mathematics devoted to the study of shapes and space. Now, however, a more apt definition might be ‘the branch of mathematics that studies visual phenomena.’” (pp. 9 & 14)

Malkevitch, J. (2009). What is geometry? In T. V. Craine & R. Rubenstein (Eds.), *Understanding geometry for a changing world*, seventy-first yearbook (pp. 3-16). Reston, VA: National Council of Teachers of Mathematics

“The Geometry Standard emphasizes as major unifying ideas *shape* and the ability to analyze characteristics and properties of two- and three-dimensional objects and develop mathematical arguments about geometric relationships; *location* and the ability to specify positions and describe spatial relationships using various representational systems; *transformations* and the ability to apply motions, symmetry, and scaling to analyze mathematical situations; and *visualization* and the ability to create and manipulate mental images and apply spatial reasoning and geometric modeling to solve problems. Each of these components of geometric thinking requires nurturing and developing throughout the school curriculum.” (p. 2)

Gavin, M. K., Belkin, L. P., Spinelli, A. M., & St. Marie, J. (2001). *Navigating through geometry in grades 3-5*. Reston, VA: National Council of Teachers of Mathematics.

“The Geometric Habits of Mind (GHOMs) framework:

- *Reasoning with relationships*: Actively looking for relationships (e.g., congruence, similarity, parallelism, and so on) in and among geometric figures in one, two, and three dimensions, and thinking about how the relationships can help your understanding or problem solving.
- *Generalizing geometric ideas*: Wanting to understand and describe the “always” and the “every” related to geometric phenomena.
- *Investigating invariants*: An *invariant* is something about a situation that stays the same, even as parts of the situation vary. This habit of mind shows up, for example, in analyzing which attributes of a figure remain the same and which change when the figure is transformed in some way (e.g., through translations, reflections, rotations, dilations, dissections, combinations, or controlled distortions).
- *Balancing exploration and reflection*: Trying various ways to approach a problem and regularly stepping back to take stock. This balance of “what if ...” with “what did I learn from trying that?” is representative of this habit of mind.” (pp. 161-163)

Driscoll, M., Egan, M., DiMatteo, R. W., & Nikula, J. (2009). Fostering geometric thinking in the middle grades: Professional development for teachers in grades 5-10. In T. V. Craine & R. Rubenstein (Eds.), *Understanding geometry for a changing world*, seventy-first yearbook (pp. 155-171). Reston, VA: National Council of Teachers of Mathematics.

“**Big Idea 1.** Behind every measurement formula lies a geometric result.

Essential Understanding 1a. Decomposing and rearranging provide a geometric way of both *seeing that* a measurement formula is the right one and *seeing why* it is the right one.

Essential Understanding 1b. In addition to decomposing and rearranging, shearing provides another geometric way of both *seeing that* a measurement formula is the right one and *seeing why* it is the right one.

Big Idea 2. Geometric thinking involves developing, attending to, and learning how to work with imagery.

Essential Understanding 2a. Geometric images provide the content in relation to which properties can be noticed, definitions can be made, and invariances can be discerned.

Essential Understanding 2b. Symmetry provides a powerful way of working geometrically.

Essential Understanding 2c. Geometric awareness develops through practice in visualizing, diagramming, and constructing.

Big Idea 3. A geometric object is a mental object that, when constructed, carries with it traces of the tool or tools by which it was constructed.

Essential Understanding 3a. Tools provide new sources of imagery as well as specific ways of thinking about geometric objects and processes.

Essential Understanding 3b. Geometric thinking turns tools into objects, and in geometry the process of turning an action undertaken with a tool into an object happens over and over again.

Big Idea 4. Classifying, naming, defining, posing, conjecturing, and justifying are codependent activities in geometric investigation.

Essential Understanding 4a. Naming is not just about nomenclature: it draws attention to properties and objects of geometric interest.

Essential Understanding 4b. Definition can both generate and reflect structure: definitions are often dependent on a specific classification.

Essential Understanding 4c. Conjectures can emerge out of a problem-posing process that generates claims that need to be justified.” (pp. 7-8)

Sinclair, N., Pimm, D., & Skelin, M. (2012). *Developing essential understanding of geometry for teaching mathematics in grades 6-8*. Reston, VA: National Council of Teachers of Mathematics.