Arizona's College and Career Ready Standards

Mathematics-High School Conceptual Categories
Contemporary Mathematics (Arizona addition)

The high school standards specify the mathematics that all students should study in order to be college and career ready. Additional mathematics that students should learn in order to take advanced courses such as calculus, advanced statistics, or discrete mathematics is indicated by (+), as in this example:

> (+) Represent complex numbers on the complex plane in rectangular and polar form (including real and imaginary numbers).

All standards without a (+) symbol should be in the common mathematics curriculum for all college and career ready students. Standards with a (+) symbol may also appear in courses intended for all students.

The high school standards are listed in conceptual categories:

- Number and Quantity
- Algebra
- Functions
- Modeling
- Geometry
- Statistics and Probability
- Contemporary Mathematics (Arizona addition)

Conceptual categories portray a coherent view of high school mathematics; a student's work with functions, for example, crosses a number of traditional course boundaries, potentially up through and including calculus.

Modeling is best interpreted not as a collection of isolated topics but in relation to other standards. Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (★). The star symbol sometimes appears on the heading for a group of standards; in that case, it should be understood to apply to all standards in that group.

NGA Center for Best Practices (NGA Center), Council of Chief State School Officers (CCSSO). (2012). *Core Standards for Mathematics: Mathematics Standards for High School.* Retrieved August 31, 2012, from College and Career Ready State Standards Initiative: http://corestandards.org/

Mathematics-High School Conceptual Categories
Contemporary Mathematics Introduction (Arizona addition)

Discrete mathematics is contemporary mathematics. This area of mathematics is very relevant in today's technologically advanced society. Discrete mathematics provides the underpinnings for many features of the Internet, from encryption of credit card numbers to decompression and compression of photographs, music, and video. It also informs the efficiency of our communication and transportation systems, such as determining the shortest path through a network or identifying the most cost effective design of airline or bus routes. The power of discrete mathematics is exemplified through the motivational impact on students. They are not only immersed in interesting mathematics but are actively engaged in the "doing" of mathematics. Mathematics is not a bystander sport.

Discrete mathematics topics, particularly vertex-edge graphs, afford students the opportunity to access problem solving in a meaningful context. Students strengthen their skills in problem solving, reasoning, conjecturing, communication, analysis, and proof. They apply the Standards for Mathematical Practice as they solve discrete mathematics problems. Discrete mathematics courses play an increasingly important role in the high school curriculum as possible pathways for those students who seek meaningful 4th credit courses that connect to technology and the needs of the 21st century learner.

Graph theory is the formal study of vertex-edge graphs. Unlike graphs used in data analysis, vertex-edge graphs are used to visually represent problem situations. Vertex-edge graphs are used to model and solve problems related to paths, circuits, or the relationship among a set of objects.

Connections to Modeling

Mathematical modeling occurs when students follow a multistep process of solving problems and represent the key ideas through a visual representation. These visual representations allow students multiple entry points for solving a problem, ensuring material that is both engaging and accessible. Examples of real word situations that could be modeled using a vertex-edge graph are 1) planning a table tennis tournament for 7 players at a club with 4 tables, where each player plays against each other player or 2) engaging in critical path analysis, e.g., applied to turnaround of an aircraft at an airport.

Discrete Mathematics (CM-DM)

Understand and apply vertex-edge graph topics

- **AZ.HS.CM-DM.1.** Study the following topics related to vertex-edge graphs:
  - Euler circuits,
  - Hamilton circuits,
  - Traveling Salesperson Problem (TSP),
  - Minimum weight spanning trees,
  - Shortest paths,
  - Vertex coloring, and
  - Adjacency matrices.
- **AZ.HS.CM-DM.2.** Understand, analyze, and apply vertex-edge graphs to model and solve problems related to paths, circuits, networks, and relationships among a finite number of elements, in real-world and abstract settings.
- **AZ.HS.CM-DM.3.** Devise, analyzes, and applies algorithms for solving vertex-edge graph problems.
- **AZ.HS.CM-DM.4.** Extend work with adjacency matrices for graphs, such as interpreting row sums and using the ***n***th power of the adjacency matrix to count paths of length ***n*** in a graph.