Got Math?

A Newsletter from the Secondary Mathematics Team www.rpdp.net

Southern Nevada Regional Professional Development Program

NACS MINI-SERIES HS #5
NEVADA ACADEMIC CONTENT STANDARDS

Modeling with Mathematics—High School NACS*

Making mathematical models is a Standard for Mathematical Practice, and specific modeling standards appear throughout the high school standards indicated by a star symbol (□). **Modeling in High School is best interpreted not as a collection of isolated topics but rather in relation to other standards that links classroom mathematics and statistics to everyday life, work, and decision-making. Modeling is the process of choosing and using appropriate mathematics and statistics to analyze empirical situations, to understand them better, and to improve decisions.** Quantities and their relationships in physical, economic, public policy, social, and everyday situations can be modeled using mathematical and statistical methods. When making mathematical models, technology is valuable for varying assumptions, exploring consequences, and comparing predictions with data.

A model can be very simple, such as writing total cost as a product of unit price and number bought, or using a geometric shape to describe a physical object like a coin. Even such simple models involve making choices. It is up to us whether to model a coin as a three-dimensional cylinder, or whether a two-dimensional disk works well enough for our purposes. Other situations—modeling a delivery route, a production schedule, or a comparison of loan amortizations—need more elaborate models that use other tools from the mathematical sciences. Real-world situations are not organized and labeled for analysis; formulating tractable models, representing such models, and analyzing them is appropriately a creative process. Like every such process, this depends on acquired expertise as well as creativity.

Standards for Mathematical Practice

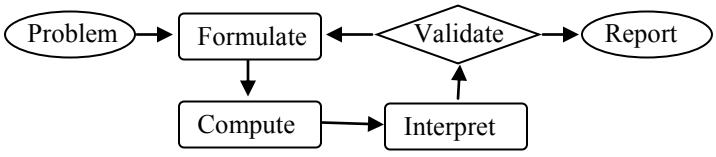
1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. **Model with mathematics.**
5. Use appropriate tools strategically.
6. Attend to precision.
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Some examples of such situations might include:

- Estimating how much water and food is needed for emergency relief in a devastated city of 3 million people, and how it might be distributed.
- Planning a table tennis tournament for 7 players at a club with 4 tables, where each player plays against each other player.
- Designing the layout of the stalls in a school fair so as to raise as much money as possible.
- Modeling operations, solving equations, factoring with algebra tiles.
- Modeling savings account balance, bacterial colony growth, or investment growth.
- Modeling relationships between the sides in right triangle, and relationships in other special triangles.
- Displaying numerical data in plots on a number line, including dot plots, histograms, and box plots.
- Using geometric shapes, their measures and their properties to describe objects (a cylinder to model a tree trunk or human torso).

In situations like these, the models devised depend on a number of factors: How precise an answer do we want or need? What aspects of the situation do we most need to understand, control, or optimize? What resources of time and tools do we have? The range of models that we can create and analyze is also constrained by the limitations of our mathematical, statistical, and technical skills, and our ability to recognize significant variables and relationships among them.

The basic modeling cycle involves:



1. **identifying variables** in the situation and selecting those that represent essential features,
2. **formulating a model** by creating and selecting geometric, graphical, tabular, algebraic, or statistical representations that describe relationships between the variables,
3. **analyzing and performing operations** on these relationships to draw conclusions,
4. **interpreting the results** of the mathematics in terms of the original situation,
5. **validating the conclusions by comparing them with the situation**, and then either improving the model or,
6. **reporting on the conclusions and the reasoning behind them**. Choices, assumptions, and approximations are present throughout this cycle. Graphs of observations and diagrams of various kinds, spreadsheets and other technology, and algebra are powerful tools for understanding and solving problems drawn from different types of real-world situations.