



Topic D:

Creating Equations to Solve Problems

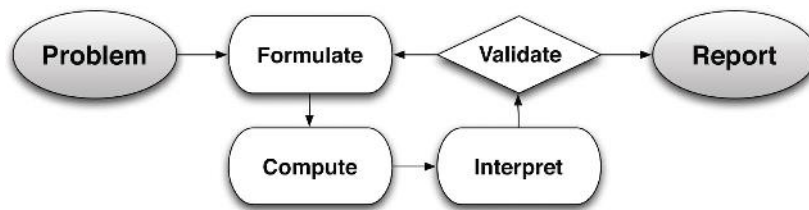
N-Q.A.1, A-SSE.A.1, A-CED.A.1, A-CED.A.2, A-REI.B.3

Focus Standard:	N-Q.A.1	Use units as a way to understand problems and to guide the solution of multi-step problems; choose and interpret units consistently in formulas; choose and interpret the scale and the origin in graphs and data displays.
	A-SSE.A.1	Interpret expressions that represent a quantity in terms of its context. ★
	A-SSE.A.1a	Interpret parts of an expression, such as terms, factors, and coefficients.
	A-SSE.A.1b	Interpret complicated expressions by viewing one or more of their parts as a single entity. <i>For example, interpret $P(1+r)^n$ as the product of P and a factor not depending on P.</i>
	A-CED.A.1	Create equations and inequalities in one variable and use them to solve problems. <i>Include equations arising from linear and quadratic functions, and simple rational and exponential functions.</i>
	A-CED.A.2	Create equations in two or more variables to represent relationships between quantities; graph equations on coordinate axes with labels and scales.
	A-REI.B.3	Solve linear equations and inequalities in one variable, including equations with coefficients represented by letters.
Instructional Days:	4	
	Lesson 25:	Solving Problems in Two Ways—Rules and Algebra (M) ¹
	Lessons 26–27:	Recursive Challenge Problem—The Double and Add 5 Game (M, M)
	Lesson 28:	Federal Income Tax (M)

In this topic, students are introduced to the modeling cycle (see page 61 of the Common Core Learning Standards) through problems that can be solved using equations and inequalities in one variable, systems of equations, and graphing. From the CCLS (page 61):

¹ Lesson Structure Key: **P**-Problem Set Lesson, **M**-Modeling Cycle Lesson, **E**-Exploration Lesson, **S**-Socratic Lesson

Modeling links classroom mathematics and statistics to everyday life, work, and decision-making.



The basic modeling cycle is summarized in the diagram. It 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; (6) or if it is acceptable, reporting on the conclusions and the reasoning behind them. Choices, assumptions, and approximations are present throughout this cycle.

The first lesson introduces parts of the modeling cycle using problems and situations that students have encountered before: creating linear equations, tape diagrams, rates, systems of linear equations, graphs of systems, etc.

The next lesson, *The Double and Add 5 Game*, employs the modeling cycle in a mathematical context. In this 2-day lesson, students formulate a model and build an equation to represent the model (in this case, converting a sequence defined recursively to an explicit formula). After they play the game in a specific case, “double and add 5,” they have to interpret the results of the mathematics in terms of the original model and validate whether their model is acceptable. Then they use the model to analyze and report on a problem that is too difficult to do “by hand” without the model.

Finally, Lesson 28 serves as a signature lesson on modeling as students take on the very real-life example of understanding federal marginal income tax rates (i.e., the progressive income tax brackets). Students are provided the current standard deduction tables per dependent or marital status and the marginal income tax table per marital filing status. For a specific household situation (e.g., married filing jointly with two dependents), students determine equations for the total Federal Income Tax for different income intervals, graph the piecewise-defined equations, and answer specific questions about the total effective rate for different income levels. All elements of the modeling cycle occur as students analyze the information to find, for example, roughly how much their favorite famous performer paid in federal taxes last year.