**II—PATTERNS AND ALGEBRA**

**Competency 004**

**The teacher understands and uses mathematical reasoning to identify, extend, and analyze patterns and understands the relationships among variables, expressions, equations, inequalities, relations, and functions.**

• Uses inductive reasoning to identify, extend, and create patterns using concrete models, figures, numbers, and algebraic expressions.

• Formulates implicit and explicit rules to describe and construct sequences verbally, numerically, graphically, and symbolically.

• Makes, tests, validates, and uses conjectures about patterns and relationships in data presented in tables, sequences, or graphs.

• Gives appropriate justification of the manipulation of algebraic expressions.

• Illustrates the concept of a function using concrete models, tables, graphs, and symbolic and verbal representations.

• Uses transformations to illustrate properties of functions and relations and to solve problems.

**Competency 005**

**The teacher understands and uses linear functions to model and solve problems.**

• Demonstrates an understanding of the concept of linear function using concrete models, tables, graphs, and symbolic and verbal representations.

• Demonstrates an understanding of the connections among linear functions, proportions, and direct variation.

• Determines the linear function that best models a set of data.

• Analyzes the relationship between a linear equation and its graph.

• Uses linear functions, inequalities, and systems to model problems.

• Uses a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve systems of linear equations and inequalities.

• Demonstrates an understanding of the characteristics of linear models and the advantages and disadvantages of using a linear model in a given situation.

**Links:**

<http://www.sparknotes.com/math/algebra1/variation/section2.rhtml> Direct and indirect variation

<http://www.purplemath.com/modules/systlin1.htm> Systems of Equations

<http://oregonstate.edu/instruct/mth251/cq/FieldGuide/linear/lesson.html> Linear functions

**Competency 006**

**The teacher understands and uses nonlinear functions and relations to model and solve problems.**

• Uses a variety of methods to investigate the roots (real and complex), vertex, and symmetry of a quadratic function or relation.

• Demonstrates an understanding of the connections among geometric, graphic, numeric, and symbolic representations of quadratic functions.

• Analyzes data and represents and solves problems involving exponential growth and decay.

• Demonstrates an understanding of the connections among proportions, inverse variation, and rational functions.

• Understands the effects of transformations such as f(*x* ± *c*) on the graph of a nonlinear function f(*x*).

• Applies properties, graphs, and applications of nonlinear functions to analyze, model, and solve problems.

• Uses a variety of representations and methods (e.g., numerical methods, tables, graphs, algebraic techniques) to solve systems of quadratic equations and inequalities.

• Understands how to use properties, graphs, and applications of non-linear relations including polynomial, rational, radical, absolute value, exponential, logarithmic, trigonometric, and piecewise functions and relations to analyze, model, and solve problems.

**Links:**

<http://www.purplemath.com/modules/grphquad.htm> Graphing Quadratic Functions

<http://www.mathsisfun.com/algebra/quadratic-equation.html> All about Quadratic Functions

<http://mathbitsnotebook.com/Algebra1/Quadratics/QDVertexForm.html> Vertex form of Quadratics

<http://www.sosmath.com/algebra/logs/log4/log4.html> Logarithms

<http://www.rapidtables.com/math/algebra/Ln.htm> Natural Logarithms

<http://www.purplemath.com/modules/fcntrans.htm> Transformations of Function

<http://www.mathsisfun.com/sets/set-builder-notation.html> Domain and range, interval notation

<http://www.mathsisfun.com/money/compound-interest.html> Compound interest

<http://www.regentsprep.org/regents/math/algebra/ae7/expdecayl.htm> Exponential growth and decay

**Competency 007**

**The teacher uses and understands the conceptual foundations of calculus related to topics in middle school mathematics.**

• Relates topics in middle school mathematics to the concept of limit in sequences and series.

• Relates the concept of average rate of change to the slope of the secant line and instantaneous rate of change to the slope of the tangent line.

• Relates topics in middle school mathematics to the area under a curve.

• Demonstrates an understanding of the use of calculus concepts to answer questions about rates of change, areas, volumes, and properties of functions and their graphs.

**Links:**

<http://www.analyzemath.com/calculus/limits/introduction.html> Limits

<http://www.algebralab.org/studyaids/studyaid.aspx?file=Calculus_6-22.xml> Average Rate of Change