

## Mathematical Literacy for College Students (MLCS)

### New Life Project October 2013 update

AMATYC Developmental Mathematics Committee

#### Purposes of MLCS Course:

The Mathematical Literacy course is intended to be an initial math course appropriate for any college student. The content of the course prepares students for the quantitative demands they will encounter in future math classes as well as science, technology, and other disciplines. In MLCS, the focus is on concepts, understanding, and reasoning; symbolic methods are included, in a balanced approach. The Mathematical Literacy course can begin a STEM-path (Science, Technology, Engineering, and Math), and can also serve students who need a different path.

#### Prerequisites to MLCS Course:

Limited quantitative skills are required prior to the MLCS course. Students should be able to do the following prior to this course:

- Understand various meanings for basic operations, including relating each to diverse contextual situations
- Use arithmetic operations to solve stated problems (with and without the aid of technology)
- Order real numbers across types (decimal, fractional, and percent), including correct placement on a number line
- Use number sense and estimation to determine the reasonableness of an answer
- Apply understandings of signed-numbers (integers in particular)

The New Life Project recommends that students be provided any needed instruction for these areas in either a short-term format ('boot-camp') or just-in-time (within the course).

#### Content Goals of MLCS:

1. Numeracy
2. Proportional Reasoning
3. Algebraic Reasoning
4. Functions

The content is intended to be integrated and connected, with an overall goal of improving general mathematical literacy. For example, concepts about proportional reasoning arise in all 4 content goals.

#### Learning Outcomes of MLCS:

These are listed within the content goal structure, even though some outcomes would be addressed in multiple goals. Some outcomes are clarified by selected exemplar(s).

#### 1. Numeracy: **Students will develop and apply the concepts of numeracy to investigate and describe quantitative relationships and solve problems in a variety of contexts.**

- A. Demonstrate operation sense, and communicate verbally and symbolically about numbers. [Predict whether a result will be larger or smaller than the operands; demonstrate understandings of inverse operations; exhibit flexibility in performing calculations.]
- B. Demonstrate competency and understanding of magnitude for place values, fractions, and numbers in scientific notation.
- C. Use estimation skills. [Know when to estimate. Use estimation to detect errors.]
- D. Apply quantitative reasoning to problems involving one or more quantities, and rates. [Scale a rate up or down. Convert units by multiplying or dividing. Find a total given a rate and a quantity. Find a rate given two quantities.]
- E. Demonstrate measurement sense. [Analyze composite shapes to find perimeter, area, and volume. Understand patterns of units in geometry. Understand formulas and variables for calculations, and solve for an unknown. Communicate information clearly and concisely. Use dimensional analysis.]
- F. Demonstrate basic understanding of numeric summaries (mean, median and mode) and graphical summaries (line graphs, bar graphs, scatterplots, and/or histograms). [Compare advantages and disadvantages of each summary. Create an appropriate scale for graphical summaries.]

#### 2. Proportional Reasoning: **Students will represent proportional relationships and solve problems that require an understanding of ratios, rates, proportions, and scaling.**

- A. Understand proportional relationships presented in different ways, including verbal and numeric representations. [Categorize a table of values as representing a proportional relationship or not. Use scaling and proportional reasoning to solve problems. Use dimensional analysis to convert rates to different units.]
- B. Use symbolic methods with proportions to solve arbitrary as well as applied problems. [Solve a proportion involving monomial or binomial expressions leading to a linear equation. Use proportions to answer practical questions.]
- C. Connect the rate with the slope of a line or with ordered pairs on a line.

3. Algebraic Reasoning: **Students will reason using the language and structure of algebra to investigate, represent, and solve problems.**

- A. Understand multiple uses of variables. [Distinguish between variables and constants. Represent situations using variables. Represent patterns in data with expressions and formulas. Identify the variables in a context as being independent or dependent. Use correct notation and vocabulary, such as coefficient, exponents, and subscripts.]
- B. Demonstrate understanding of basic properties of algebraic expressions. [Know when expressions can be simplified. Apply properties for sums and products to simple expressions, including distributing. Understand basic properties of integer exponents.]
- C. Understand the meaning of relationships given in symbolic form. [Given a formula, describe the effect that a change of one variable has on the other variable(s).]
- D. Construct equations and inequalities to represent relationships. [Given a context or realistic problem, write an equation using appropriate variables. From a table of values, write an equation that can be used to answer a question.]
- E. Understand how to solve equations using properties of numbers. [Demonstrate how to identify solutions for equations with one or two variables. Explain the steps needed to solve a linear equation in one variable. Identify equations that do not have a unique solution. Apply concepts of inverse operations to solve equations.]
- F. {Optional} Use systems of equations to represent and solve problems. [Write a system of two linear equations for a realistic problem. Solve a two variable system by numeric/graphical methods, or by symbolic methods.]
- G. {Optional} Use basic factoring concepts, especially the greatest common factor. [Write sums as a product when possible. Solve formulas when the variable appears in two terms.]

4. Functions: **Students will represent relationships between quantities in multiple ways and solve problems that require an understanding of functions.**

- A. Understand the values needed to write a linear function, or an exponential function. [Find the slope of a line from two points. Find the equation of a line from the slope and a point. Given a starting value, write an exponential function for a doubling situation. Given a starting value and a percent change, write an exponential model.]
- B. Translate problems from a variety of contexts into mathematical models or functions (linear, exponential, or simple squaring).

- C. Describe the behavior of basic functions (especially linear and exponential). [Given a slope, identify the function as increasing or decreasing. Given a graph, identify an exponential function as increasing or decreasing.]
- D. Identify a data set as more likely to represent a linear function, an exponential function, or neither. [Given a set of graphs, identify which represent linear or exponential patterns.]
- E. Identify important characteristics of basic functions. [State the meaning of slope or rate of change in a context. Interpret the starting value for exponential functions, or y-intercepts for linear functions, in context.]
- F. Understand the differences between an approximate model compared to a known relationship.
- G. {Optional} Understand correlation and the concept of residuals for analyzing models.
- H. {Optional} Use numeric methods on quadratic functions. [Find a maximum or minimum value with use of technology. Calculate a rate of change in an interval with use of technology.]

Cross Reference of Outcomes

Target / Purpose	1. Numeracy	2. Proportional Reasoning	3. Algebraic Reasoning	4. Functions
STEM/Calc Path	A, B, C, E	A, B, C	A, B, C, D, E, F, G	A, B, C, E, H
Quantitative Reasoning	A, B, C, D, E, F	A, B, C	A, B, C, D	A, B, C, D, E, F
Intro Statistics	A, B, C, D, E, F	A, B, C	A, C, D	A, C, D, E, F, G
Basic Science/Tech	A, B, C, D, E, F	A, B, C	A, B, C, D	A, B, C, D