February 2, 2009

Middle School Mathematics Task Force
Algebra Subcommittee Report

Name of Subcommittee: Algebra Subgroup
Name of Facilitator: Karen Cribbs and Bill Haver

Date of Report:

Current Course Overview:
The Functions and Algebra course is designed to develop a deep understanding of topics from algebra: variables, patterns, and functions; modeling and interpreting graphs; linear functions including slope and intercepts. The course is also designed to introduce non-linear functions, including quadratics and exponentials. Additionally, participants will connect these concepts to the underlying concepts in primary and middle grades mathematics. Attention will be given to interpreting and assessing students' work and learning.

Current Goals of the Course:
1. Exploring and developing an understanding of algebraic proof, representation, and generalization:
    *   Investigating the real number system and its subsets including basic operations. How the truth of relationships hold for all numbers may be established, even though there are infinitely many numbers,
    *   Investigating and using components of valid mathematical argument and justification,
    *   Making meaning, interpretation, and manipulation of variables, algebraic expressions, and algebraic equations,
    *   Applying basic properties of arithmetic operations, e.g. the distributive property, to manipulating numerical and algebraic expressions and equations,
    *   Representing and interpreting algebraic functions: linear, quadratic, and exponential,
    *   Solving linear equations and systems of equations and identifying the solution set for a linear function,
    *   Moving fluidly and flexibly between verbal, graphical, tabular, and symbolic representations of functions.

2.   Studying how children develop their mathematical understanding, especially using case studies.

3.   Developing the mathematical habits of mind.

Rationale for adaptations to accommodate the needs of Middle School Specialists:

Mathematics Specialists serving in middle schools need to focus a large portion of their time improving student achievement and teacher content knowledge in grades six and seven and in those grade eight classes for students who are not yet taking algebra. The need is great in this area since most of the teachers at this level have not completed the

more extensive coursework required to complete a major in mathematics or even the coursework required to obtain the Algebra I add-on endorsement required for those who teach Algebra I. In supporting sixth and seventh grade teachers and students particular attention needs to be given to work with rational numbers. Knowing how this foundation of rational numbers leads into the concepts and skills in Algebra I and Algebra II is crucial.

As one middle school mathematics specialist stated, "I have seen algorithms and skills taught in the middle grades that will be counterproductive once students try to apply this knowledge in Algebra II."

The October 2008 draft of the revisions to Virginia's Mathematics Standards of Learning sets forward the expectation that students who successfully complete the seventh-grade standards should be prepared to study Algebra I in grade eight. A conclusion can be drawn that as more students enroll in Algebra I in grade 8 more middle school teachers will be called upon to teach Algebra I and the diversity of the middle school population taking Algebra I will increase. The Middle School Specialists will need a strong understanding of algebra to support and assist Algebra I teachers in reaching the increasingly diverse student population in grade 8 Algebra I.

Recommended Course Adaptations:

More attention needs to be given to ensure that specialists are prepared to work in grades 5-8. The committee recognizes the current Functions and Algebra course for the strong connections it makes between arithmetic and algebra, for developing a foundation in algebraic thinking, and for introducing the concept of function. However, the specialists working in middle schools need to gain an extended and stronger and understanding of algebraic concepts in Algebra I and Algebra II. The committee recommends that an additional algebra course beyond the current Functions and Algebra course be required for middle school specialists.

The committee recommends that the following content be added to the algebra sequence when it is missing and existing content be strengthened to better align with the content in Algebra I and Algebra II. The content should focus on the specific concepts and skills taught in Algebra I and II that have foundations in grades 5-8. It is important that mathematics specialists have a strong understanding of high school Algebra I and II and understand how these foundational concepts and skills are necessary for students to be successful at higher levels.

The following specific topics need to be included beyond those covered in the Functions and Algebra course.

- Functions
- Factoring/Zeros/Roots
- Number Theory
- Proportionality/Direct Variation
- Rational Numbers
- Transformations
- Inequalities
- Sequences/Series

Some of these topics are included in the current elective course, Algebra for Middle School Specialists. However, it will likely be difficult to include an in-depth study of all of these topics in the Algebra for Middle School Specialists course. Beyond just adding a second course, the committee recommends that the two courses be reviewed carefully in light of the required content and the depth at which the content must be studied. The development of the two course sequence should 1) distribute and sequence the content across the two courses to maximize students' opportunities to make connections and build understanding and 2) identify material that, if necessary, may be reassigned to Numbers and Operations or Rational Numbers and Proportional Reasoning to provide space in the curriculum to strengthen and broaden the algebra content for the specialists who will work in middle schools.