

## ALGEBRA

In implementing the Algebra process and content performance indicators, it is expected that students will identify and justify mathematical relationships. The intent of both the process and content performance indicators is to provide a variety of ways for students to acquire and demonstrate mathematical reasoning ability when solving problems. Local curriculum and local/state assessments must support and allow students to use any mathematically correct method when solving a problem.

Throughout this document the performance indicators use the words *investigate*, *explore*, *discover*, *conjecture*, *reasoning*, *argument*, *justify*, *explain*, *proof*, and *apply*. Each of these terms is an important component in developing a student's mathematical reasoning ability. It is therefore important that a clear and common definition of these terms be understood. The order of these terms reflects different stages of the reasoning process.

**Investigate/Explore** - Students will be given situations in which they will be asked to look for patterns or relationships between elements within the setting.

**Discover** - Students will make note of possible patterns and generalizations that result from investigation/exploration.

**Conjecture** - Students will make an overall statement, thought to be true, about a new discovery.

**Reasoning** - Students will engage in a process that leads to knowing something to be true or false.

**Argument** - Students will communicate, in verbal or written form, the reasoning process that leads to a conclusion. A valid argument is the end result of the conjecture/reasoning process.

**Justify/Explain** - Students will provide an argument for a mathematical conjecture. It may be an intuitive argument or a set of examples that support the conjecture. The argument may include, but is not limited to, a written paragraph, measurement using appropriate tools, the use of dynamic software, or a written proof.

**Proof** - Students will present a valid argument, expressed in written form, justified by axioms, definitions, and theorems.

**Apply** - Students will use a theorem or concept to solve an algebraic or numerical problem.

### Problem Solving Strand

*Students will build new mathematical knowledge through problem solving.*

A.PS.1 Use a variety of problem solving strategies to understand new mathematical content

A.PS.2 Recognize and understand equivalent representations of a problem situation or a mathematical concept

***Students will solve problems that arise in mathematics and in other contexts.***

A.PS.3 Observe and explain patterns to formulate generalizations and conjectures

A.PS.4 Use multiple representations to represent and explain problem situations (e.g., verbally, numerically, algebraically, graphically)

***Students will apply and adapt a variety of appropriate strategies to solve problems.***

A.PS.5 Choose an effective approach to solve a problem from a variety of strategies (numeric, graphic, algebraic)

A.PS.6 Use a variety of strategies to extend solution methods to other problems

A.PS.7 Work in collaboration with others to propose, critique, evaluate, and value alternative approaches to problem solving

***Students will monitor and reflect on the process of mathematical problem solving.***

A.PS.8 Determine information required to solve a problem, choose methods for obtaining the information, and define parameters for acceptable solutions

A.PS.9 Interpret solutions within the given constraints of a problem

A.PS.10 Evaluate the relative efficiency of different representations and solution methods of a problem

## **Reasoning and Proof Strand**

***Students will recognize reasoning and proof as fundamental aspects of mathematics.***

A.RP.1 Recognize that mathematical ideas can be supported by a variety of strategies

***Students will make and investigate mathematical conjectures.***

A.RP.2 Use mathematical strategies to reach a conclusion and provide supportive arguments for a conjecture

A.RP.3 Recognize when an approximation is more appropriate than an exact answer

***Students will develop and evaluate mathematical arguments and proofs.***

A.RP.4 Develop, verify, and explain an argument, using appropriate mathematical ideas and language

A.RP.5 Construct logical arguments that verify claims or counterexamples that refute them

A.RP.6 Present correct mathematical arguments in a variety of forms

A.RP.7 Evaluate written arguments for validity

***Students will select and use various types of reasoning and methods of proof.***

A.RP.8 Support an argument by using a systematic approach to test more than one case

A.RP.9 Devise ways to verify results or use counterexamples to refute incorrect statements

A.RP.10 Extend specific results to more general cases

A.RP.11 Use a Venn diagram to support a logical argument

A.RP.12 Apply inductive reasoning in making and supporting mathematical conjectures

## **Communication Strand**

***Students will organize and consolidate their mathematical thinking through communication.***

A.CM.1 Communicate verbally and in writing a correct, complete, coherent, and clear design (outline) and explanation for the steps used in solving a problem

A.CM.2 Use mathematical representations to communicate with appropriate accuracy, including numerical tables, formulas, functions, equations, charts, graphs, Venn diagrams, and other diagrams

***Students will communicate their mathematical thinking coherently and clearly to peers, teachers, and others.***

A.CM.3 Present organized mathematical ideas with the use of appropriate standard notations, including the use of symbols and other representations when sharing an idea in verbal and written form.

A.CM.4 Explain relationships among different representations of a problem

A.CM.5 Communicate logical arguments clearly, showing why a result makes sense and why the reasoning is valid

A.CM.6 Support or reject arguments or questions raised by others about the correctness of mathematical work

***Students will analyze and evaluate the mathematical thinking and strategies of others.***

A.CM.7 Read and listen for logical understanding of mathematical thinking shared by other students

A.CM.8 Reflect on strategies of others in relation to one's own strategy

A.CM.9 Formulate mathematical questions that elicit, extend, or challenge strategies, solutions, and/or conjectures of others

***Students will use the language of mathematics to express mathematical ideas precisely.***

A.CM.10 Use correct mathematical language in developing mathematical questions that elicit, extend, or challenge other students' conjectures

A.CM.11 Represent word problems using standard mathematical notation

A.CM.12 Understand and use appropriate language, representations, and terminology when describing objects, relationships, mathematical solutions, and rationale

A.CM.13 Draw conclusions about mathematical ideas through decoding, comprehension, and interpretation of mathematical visuals, symbols, and technical writing

## **Connections Strand**

***Students will recognize and use connections among mathematical ideas.***

A.CN.1 Understand and make connections among multiple representations of the same mathematical idea

A.CN.2 Understand the corresponding procedures for similar problems or mathematical concepts

***Students will understand how mathematical ideas interconnect and build on one another to produce a coherent whole.***

A.CN.3 Model situations mathematically, using representations to draw conclusions and formulate new situations

A.CN.4 Understand how concepts, procedures, and mathematical results in one area of mathematics can be used to solve problems in other areas of mathematics

A.CN.5 Understand how quantitative models connect to various physical models and representations

***Students will recognize and apply mathematics in contexts outside of mathematics.***

A.CN.6 Recognize and apply mathematics to situations in the outside world

A.CN.7 Recognize and apply mathematical ideas to problem situations that develop outside of mathematics

A.CN.8 Develop an appreciation for the historical development of mathematics

## **Representation Strand**

***Students will create and use representations to organize, record, and communicate mathematical ideas.***

A.R.1 Use physical objects, diagrams, charts, tables, graphs, symbols, equations, or objects created using technology as representations of mathematical concepts

A.R.2 Recognize, compare, and use an array of representational forms

A.R.3 Use representation as a tool for exploring and understanding mathematical ideas

***Students will select, apply, and translate among mathematical representations to solve problems.***

A.R.4 Select appropriate representations to solve problem situations

A.R.5 Investigate relationships between different representations and their impact on a given problem

***Students will use representations to model and interpret physical, social, and mathematical phenomena.***

A.R.6 Use mathematics to show and understand physical phenomena (e.g., find the height of a building if a ladder of a given length forms a given angle of elevation with the ground)

A.R.7 Use mathematics to show and understand social phenomena (e.g., determine profit from student and adult ticket sales)

A.R.8 Use mathematics to show and understand mathematical phenomena (e.g., compare the graphs of the functions represented by the equations  $y = x^2$  and  $y = -x^2$ )