

Richmond Public Schools
Curriculum Framework
Geometry

Strand: Reasoning, Lines, and Transformations	
<p>G.1 The student will use deductive reasoning to construct and judge the validity of a logical argument consisting of a set of premises and a conclusion. This will include</p> <ul style="list-style-type: none"> a) identifying the converse, inverse, and contrapositive of a conditional statement; b) translating a short verbal argument into symbolic form; and c) determining the validity of a logical argument 	
Suggested Pacing	Cognitive Demand
First Nine Weeks	G.1a-c
5 instructional days (including assessment)	Evaluate
Spiraling Down Standards	Spiraling Up Standards
N/A	N/A
Essential Questions	Common Misconceptions
<p>What is the importance or need for symbolic representation of words? <i>Symbolic logic is a way to represent logical expressions by using symbols and variables in place of natural language, such as English, in order to remove vagueness.</i></p> <p>What is the relationship between reasoning, justification, and proof in Geometry? <i>Mathematical proof is a formal way of expressing particular kinds of reasoning and justification. When you see a set of facts, your mind</i></p>	<ul style="list-style-type: none"> • Converse and contrapositive sound similar. Emphasize these two during lesson and make students compare and contrast. • Inverse of a statement that includes the word “not”. Example: What is the inverse of “I am not going to the store today”? Answer: “I am going to the store today”. • Students get confused with inductive and deductive reasoning. Practice, practice, practice. • Symbols and their meanings can get confusing. Keep a reference page in their notebooks of the symbols and their meanings.

Richmond Public Schools
Curriculum Framework
Geometry

<p><i>automatically wants to form a conjecture or statement about the information. The trick to using logical reasoning is to be able to support any statement (conjecture) you make with a valid reason. In geometry, we use facts, postulates, theorems, and definitions to support conjectures.</i></p> <p>How does deductive reasoning help judge the validity of logical arguments?</p> <p><i>Validity applies to deductive arguments. A valid argument is a deductive argument that succeeds in providing decisive logical support. 'Valid' does not necessarily mean good or bad. It just means succeeding in establishing conclusive support for its conclusion. Claiming that an argument is valid is not to claim that the premises are true. Validity is about succeeding in providing conclusive support for the conclusion, if the premises were true. If a deductive argument is valid and its premises are true, then its conclusion must be true.</i></p>	
<p style="text-align: center;">Understanding the Standard</p>	<p style="text-align: center;">Essential Knowledge and Skills</p>
<ul style="list-style-type: none"> • Inductive reasoning, deductive reasoning, and proof are critical in establishing claims. • Deductive reasoning is the method that uses logic to draw conclusions based on definitions, postulates, and theorems. • Valid forms of deductive reasoning include the law of syllogism, the law of contrapositive, the law of detachment, and the identification of a counterexample. • Symbolic notation is used to represent logical arguments, including the use of \rightarrow, \leftrightarrow, \sim, \therefore, \wedge, \vee • The law of syllogism states that if $p \rightarrow q$ is true and $q \rightarrow r$ is true, then $p \rightarrow r$ is true. • The law of contrapositive states that if $p \rightarrow q$ is true and $\sim q$ is true, then $\sim p$ is true. 	<p>The student will use problem solving, mathematical communication, mathematical reasoning, connections, and representations to</p> <ul style="list-style-type: none"> • Identify the converse, inverse, and contrapositive of a conditional statement. (a) • Translate verbal arguments into symbolic form using the symbols of formal logic. (b) • Determine the validity of a logical argument using valid forms of deductive reasoning. (c) • Determine that an argument is false using a counterexample. (c)

Richmond Public Schools
Curriculum Framework
Geometry

<ul style="list-style-type: none"> • The law of detachment states that if $p \rightarrow q$ is true and p is true, then q is true. • A counterexample is used to show an argument is false. • Inductive reasoning is the method of drawing conclusions from a limited set of observations. • Proof is a justification that is logically valid and based on initial assumptions, definitions, postulates, theorems, and/or properties. • Logical arguments consist of a set of premises or hypotheses and a conclusion. • When a conditional ($p \rightarrow q$) and its converse ($q \rightarrow p$) are true, the statements can be written as a biconditional, p iff q; or p if and only if q, or $p \leftrightarrow q$. • Logical arguments that are valid may not be true. Truth and validity are not synonymous. • Exploration of the representation of conditional statements using Venn diagrams may assist in deepening student understanding. <p>NOTE: Venn diagrams provide a good visual approach for determining if a logical argument is valid, but is not a tested standard anymore.</p> <ul style="list-style-type: none"> • Formal proofs utilize symbols of formal logic to determine validity of a logical argument. 	
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Vocabulary			Instructional Activities Organized by Learning Objective
Logic	Converse	Inverse	<p>Virginia Department of Education</p> <ul style="list-style-type: none"> • Logic and Conditional Statements • Inductive and Deductive Reasoning <p>Textbook</p> <ul style="list-style-type: none"> • Geometry, ©2012, Price, et al, McGraw-Hill School Education Group page(s) 89-123(in part; exclude Venn Diagrams)
Contrapositive	Counterexample	Biconditional	
Logically equivalent	Proof	Valid	
Invalid	Conditional	Inductive Reasoning	
Deductive Reasoning	Law of Syllogism	Law of Contrapositive	
Law of Detachment	Hypothesis	Conclusion	

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Curriculum Framework
Geometry

Assessment	
<p>1. PowerSchool Assessments G.1a (E:028AJL) G.1b (E:06TZYV) G.1c (E:KVV2VW)</p> <p>2. Mulligan Checkpoint G.1 Checkpoint G.1 without Venns</p> <p>3. Formative Assessments (paper) G.1a,b,c FA</p> <p>4. Cumulative Assessment #2 (SOLs G.1a-d, G.3a-d, G.4a-d) Cumulative Assessment #2</p>	<p>Notes Notes G.1a,b,c Homework G.1a,bc</p> <p>Resources</p> <ul style="list-style-type: none">● Print<ul style="list-style-type: none">○ Coach book, Virginia edition Lessons 2, 4, 5 page(s) 16-23, 32-45.○ Mulligan Math in Minutes, G.1 ● Technology<ul style="list-style-type: none">○ Gizmo<ul style="list-style-type: none">▪ Conditional Statements▪ Bi-conditional Statements○ Interactive lesson on counterexamples○ Youtube Videos<ul style="list-style-type: none">▪ Conditional Statements Youtube video▪ Converse, Inverse, Contrapositive Youtube video▪ 3 Laws of Logic Youtube video▪ Counterexample Youtube video○ Quizizz Practice<ul style="list-style-type: none">▪ G.1a Conditionals Practice on Quizizz▪ G.1b Symbolic Form Practice on Quizizz▪ G.1c Laws of Logic Practice on Quizizz▪ G.1 Counterexamples Practice on Quizizz <p>Instructional Activities G.1a</p>

Richmond Public Schools
Curriculum Framework
Geometry

	<ul style="list-style-type: none"> ● Conditionals Sort and Key ● Create own conditionals and sort ● Conditionals Advertising Project ● G.1a Conditional Practice <p>G.1b</p> <ul style="list-style-type: none"> ● Symbolic Form Stories Activity ● G.1b Symbolic Form Practice <p>G.1c</p> <ul style="list-style-type: none"> ● Law Sort ● Chain of Reasoning Project ● G.1c Deductive Reasoning Practice <p>Beginning Proof Practice Introduction of Proof Practice</p> <p>Logic Snapshots and Exit Tickets</p>
Cross-Curricular Connections	Tiered Interventions
<p>English <i>If You Give A Mouse A Cookie</i>, by Laura Numeroff. This can be used to introduce conditional statements and deductive reasoning. Statements from the book can be taken and have students apply converse, inverse, and contrapositive along with the laws of logic.</p> <p>Real-World Examples of Converse, Inverse, and Contrapositive: interactive activity relating converse, inverse, contrapositive to English, Science, and advertising</p>	<p>Tier 3: Recall and Reproduction Vocabulary Have students study flashcards, create their own flashcards, play a matching game or test themselves on Quizlet. Quizlet Flashcards Logic</p> <p>G.1a Use hand gestures to help remember the difference between the related conditional statements. Helping Hands Have students make a chart comparing conditional, converse, inverse, and contrapositive.</p> <p>G.1b Have students make a chart with the symbols and their meanings.</p>

Richmond Public Schools
Curriculum Framework
Geometry

	<p>G.1c Use Venn diagrams to show the validity or invalidity of a logical argument.</p> <p>Tier 2: Basic Concepts and Skills Practice and Drill Logic Drills Using a song stanza to identify converse, inverse, contrapositive activity</p> <p>G.1b,c Have students sort logical arguments as valid or invalid and explain why.</p> <p>Tier 1: Strategic Thinking and Reasoning Application G.1a Writing Activity</p> <ol style="list-style-type: none">1. Write at least one conditional statement in “If-then” form related to mathematics and one that is not math related.2. Write the conditional statements above not using the “If-then” form.3. Write the converse of the conditional statements.4. Write the inverse of the conditional statements.
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Geometry

5. Write the contrapositive of the conditional statements.

G.1b,c

Have students create logical arguments and then write them in symbolic form.

G.1c

Have students compare valid and invalid arguments both in words and symbols.