

Just In Time Quick Check
Standard of Learning (SOL) G.1c

Strand: Reasoning, Lines, and Transformations

Standard of Learning (SOL) G.1c

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 determining the validity of a logical statement.

Grade Level Skills:

- Determine the validity of a logical argument using valid forms of deductive reasoning.
- Determine that an argument is false using a counterexample.

Just in Time Quick Check

Just in Time Quick Check Teacher Notes

Supporting Resources:

- VDOE Mathematics Instructional Plans (MIPS)
 - [G.1c Deductive Reasoning \(Word\) / PDF Version](#)
 - [G.1c Inductive and Deductive Reasoning \(Word\) / PDF Version](#)
- VDOE Word Wall Cards: Geometry ([Word](#)) | ([PDF](#))
 - Conditional Statements and Venn Diagrams
 - Deductive Reasoning
 - Inductive Reasoning
 - Direct Proofs
 - Law of Detachment
 - Law of Syllogism
 - Counterexample
- Other VDOE Resources
 - [Geometry, Module 1, Topic 3 – Law of Detachment\[eMediaVA\]](#)
 - [Geometry, Module 1, Topic 4 – Law of Contrapositive\[eMediaVA\]](#)
 - [Geometry, Module 1, Topic 5 – Law of Syllogism\[eMediaVA\]](#)
 - [Geometry Logic and Proofs: Inductive Reasoning Lesson 1 Part 2\[eMediaVA\]](#)

Supporting and Prerequisite SOL: None

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1. Provide a counterexample for each of the following.
 - a) If you are eating a red fruit, then you are eating an apple.
 - b) If $x + 4 > 10$, then x is greater than 8.

2. Determine if the following arguments are valid. Explain your reasoning.

Argument 1	Argument 2
All squares are rectangles. ABCD is a square. Therefore, ABCD is a rectangle	All squares are rectangles. ABCD is a rectangle. Therefore, ABCD is a square.

3. Determine if this argument is valid. If so, indicate the law(s) of logic used.

If a figure has three sides, then it is a triangle.

If a figure is a triangle, then the sum of the interior angles is 180° .

Therefore, if the sum of the interior angles is not 180 degrees, then the figure does not have three sides.

4. Given the following statement, apply the law of contrapositive to provide a valid conclusion.

If Sarah gets an A in the class, then she will not have to take the final exam.

5. Suppose the symbolic statements $a \rightarrow b$ and $b \rightarrow c$ are true. Determine two other statements that must also be true.

SOL G.1c - Just in Time Quick Check Teacher Notes
Common Errors/Misconceptions and their Possible Indications

1. Provide a counterexample for each of the following.
 - a) If you are eating a red fruit, then you are eating an apple.
 - b) If $x + 4 > 10$, then x is greater than 8.

A common error a student might make would be providing an example to make the hypothesis of the statement false. This would indicate that students may be confused about which part of the statement they are providing an example for to prove the conjecture false. Teachers should encourage students to label the hypothesis and conclusion of each statement and/or highlight the part that needs the false example. A strategy teachers could use might be to put students in small groups where some of the students in the group create one or two statements that are not always true and the other students in the group find counterexamples.

2. Determine if the following arguments are valid. Explain your reasoning.

Argument 1	Argument 2
All squares are rectangles. ABCD is a square. Therefore, ABCD is a rectangle	All squares are rectangles. ABCD is a rectangle. Therefore, ABCD is a square.

A common error a student might make would be to choose both statements are valid. This may indicate students do not recognize how to apply deductive reasoning when statements are not in "if-then" form. Some students may be able to guess the right conclusion, but may not be able to explain their reasoning. This may also indicate students cannot properly apply law of detachment. Some students may think it is valid when the conclusion follows the conditional. Teachers should encourage students to label their statements. Teachers are encouraged to use resources such as Which Law of Logic? and the Deductive Reasoning Sort from the VDOE Mathematics Instructional Plans (MIPs).

3. Determine if this argument is valid. If so, indicate the law(s) of logic used.

If a figure has three sides, then it is a triangle.

If a figure is a triangle, then the sum of the interior angles is 180° .

Therefore, if the sum of the interior angles is not 180 degrees, then the figure does not have three sides.

A common error a student might make would be to conclude that this argument is invalid. Students may think that the only valid conclusion may be “If the figure has three sides, then the sum of interior angles is 180 degrees.” This may indicate that students do not recognize that multiple laws can be used to make a valid argument. Teachers should provide examples of how multiple laws can be used to draw valid conclusions. Teachers are encouraged to use labeling techniques, symbolic representations, and VDOE Word Wall cards for references.

4. Given the following statement, apply the law of contrapositive to provide a valid conclusion.

If Sarah gets an A in the class, then she will not have to take the final exam.

A common error a student might make would be to say that “Sarah did not take the final exam. Therefore, Sarah got an A in the class.” This would indicate that the student may not be able to properly negate when “not” is already in the statement. Another common error a student might make would be to say “Sarah did not get an A in the class. Therefore, Sarah will have to take the final exam.” This may indicate that the student is improperly identifying the law of contrapositive as $\sim p, \therefore \sim q$, instead of $\sim q, \therefore \sim p$. Teachers should remind students that the law of contrapositive should follow the same order as when writing the contrapositive of a statement. Teachers are encouraged to use resources such as Which Law of Logic? and the Deductive Reasoning Sort from the VDOE Mathematics Instructional Plans (MIPs). In addition, teachers are encouraged to use labeling techniques, symbolic representations, and VDOE Word Wall cards for references.

5. Suppose the symbolic statements $a \rightarrow b$ and $b \rightarrow c$ are true. Determine two other statements that must also be true.

A common error a student might make would be to only recognize one other statement to be true such as $a \rightarrow c$, using law of syllogism. This may indicate students are not comfortable identifying conclusions that do not follow the traditional alignment. Students may also have difficulty recognizing laws when using symbolic form or when using symbols other than p and q . This may indicate students need more practice with symbolic form. Teachers are encouraged to use labeling techniques, symbolic representations, and VDOE Word Wall cards for references to help students understanding of using multiple laws to determine conclusions.