

Deductive Reasoning

Strand: Reasoning, Lines, and Transformation

Topic: Applying deductive thinking

Primary SOL: G.1 The student will use deductive reasoning to construct and judge the validity of a logical argument of a set of premises and a conclusion. This will include

- c) determine the validity of an argument.

Related SOL: G.1 ab

Materials

- Comic Strip Organizer activity sheet (attached)
- Deductive Reasoning Sort activity sheet (attached)
- Which Law of Logic? activity sheet (attached)
- *If You Give a Mouse a Cookie*, by Laura Numeroff

Vocabulary

conclusion, deductive reasoning, hypothesis, law of contrapositive, law of detachment, law of syllogism, valid

Student/Teacher Actions: What should students be doing? What should teachers be doing?

1. Read *If You Give a Mouse a Cookie*, by Laura Numeroff, to the class.
2. Have students identify the p , q , r , etc., of the story. Connect the story to the law of syllogism. (An alternative method would be to place students in groups and have them read and identify the statements.)
3. Distribute the Comic Strip Organizer activity sheet. Have students create a conditional comic strip of their own. They should identify the p , q , r , etc., of each frame. Have the students share their original comic strip with the class.
4. Review the law of contrapositive, law of detachment, and law of syllogism with students. Distribute the Deductive Reasoning Sort activity sheet. Have students sort the statements under the following headings: Law of Contrapositive, Law of Detachment, Law of Syllogism, and Not Valid. When students have finished sorting all cards, have them create an original example, one for each heading. Check answers as a class. Use the student-created cards as a closure activity by reading each statement aloud to the class and having students determine which of the four categories their statements belongs in.
5. Distribute the Which Law of Logic? activity sheet. Have students use the statements to draw a conclusion, if possible, and state the law used to justify the conclusion.

Assessment

- **Questions**
 - What conclusion can you draw using all of the following statements?

$$\sim q \rightarrow s \quad t \rightarrow \sim r \quad q \rightarrow t \quad u \rightarrow \sim s$$

- Explain what is wrong with this statement: Bread crumbs are better than nothing. Nothing is better than a good steak. Therefore, breadcrumbs are better than a good steak.
- If two angles are a linear pair, they are adjacent. Have students identify the hypothesis and conclusion. Then, say $\angle ABC$ and $\angle DEF$ are adjacent. What conclusion can you make?
- **Journal/writing prompts**
 - Write a paragraph that explains the differences between the law of detachment, law of syllogism, and law of contrapositive.
 - Explain how advertising uses the law of syllogism.
- **Other Assessments**
 - Have students create an advertisement that uses the law of syllogism and law of logic. They should identify the p , q , r , etc.
 - Ask students to create a set of statements and conclusion for each of the laws.

Extensions and Connections

- Have students investigate Lewis Carroll's logic puzzles.
- Have students research other laws of logic.
- Have students find examples of advertising that incorporate the law of syllogism and law of logic.

Strategies for Differentiation

- Have students work in pairs to complete the sorting activity.
- Color-code the p and q in the card sorts, to help students identify the parts.
- Provide students with a premade cartoon (cut up) and have them place the panels in the correct order.

Note: The following pages are intended for classroom use for students as a visual aid to learning.

Comic Strip Organizer

If _____, then _____.

P: Q:	Q: R:	R: S:	S: T:
T: U:	U: V:	V: W:	W: P:

Deductive Reasoning Sort

Law of Detachment	Law of Syllogism	Law of Contrapositive	Neither
If $P \rightarrow Q$ and P is true then Q is true.	If $P \rightarrow Q$ and $Q \rightarrow R$ then $P \rightarrow R$.	If $P \rightarrow Q$ and Q is false then P is false.	If $P \rightarrow Q$ and Q is true then P is true.
If x is even, then x^2 is even. $X = 4$. 4^2 is an even number.	If a figure is a kite, then it is a quadrilateral. If a figure is a quadrilateral, then it is a polygon. If a figure is a kite, then it is a polygon.	If a figure is a quadrilateral, then it has four sides. A triangle has three sides. A triangle is not a quadrilateral.	All 45-degree angles are congruent. $\angle A \cong \angle B$ $\angle A$ and $\angle B$ are 45 degrees.
If a figure is a quadrilateral, then it has four sides. A rhombus is a quadrilateral. A rhombus has four sides.	If a number ends in zero, it is divisible by 10. Ninety ends in zero. Ninety is divisible by 10.	If two angles are vertical, then they are congruent. $\angle A$ and $\angle B$ are not congruent. Therefore, $\angle A$ and $\angle B$ are not vertical.	If you eat too much turkey, then you will get sick. Javon got sick. Javon ate too much turkey.
If an angle is acute, then it is not obtuse. $m\angle ABC$ is 45° . $\angle ABC$ is not obtuse.	If $\angle 2$ is acute, then $\angle 3$ is obtuse. If $\angle 3$ is obtuse, then $\angle 4$ is acute. If $\angle 2$ is acute, then $\angle 4$ is acute.	If $x = 3$, then it is a solution to $x + 2 = 5$. $X = 1$, so it is not a solution to $x + 2 = 5$.	If Kim gets money, she gives half of it to Sid. If Sid gets money, he gives half of it to Kim. Kim and Sid share their money equally.

Which Law of Logic?

Name _____ Date _____

Directions: Determine what conclusion, if any, can be drawn from the following statements. Indicate whether the law of detachment, or law of syllogism was used.

Statements	Conclusion	Which Law?
If Point <i>A</i> divides a segment into two congruent segments, Point <i>A</i> is the midpoint of that segment. Point <i>M</i> divides \overline{CD} into two congruent segments.		
If a figure has three sides, then it is a triangle. If a figure is a triangle, then it has three angles.		
If a quadrilateral is a square, then it is equilateral. A rectangle is not equilateral.		
If you mail the payment by noon, then it will arrive by tomorrow. If your payment arrives by tomorrow, then you will not be charged a late fee.		
If the geometry students score 100% on the test, the teacher will dye her hair. The geometry students scored 100% on the test.		
Right angles are congruent. Angle <i>A</i> and Angle <i>B</i> are right angles.		
If Jamal misses practice, then he is not allowed to play in tomorrow's game. Jamal missed practice.		

The law of contrapositive states that a conditional statement is logically equivalent to its contrapositive. Create a statement that is logically equivalent to the following statement:

If an animal is not a mammal, then it is not a bat.

If a polygon is a hexagon, then the sum of its interior angles is 720 degrees.
