Literacy Project:

Geometry Basic Logic Vocabulary

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TE 846:
Accommodating Differences in Literacy Learners

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Part I: The Unit of Study

I will be focusing on the logic unit in tenth grade geometry class. Typically, this tends to be the most challenging unit in geometry. I break logic into two units—basic logic and geometric proof writing. I am hoping to develop my basic logic unit to in turn develop strong vocabulary and also retain the vocabulary for future units, especially geometric proof writing.

The basic logic unit lasts a little over three weeks. The topics covered are: inductive reasoning, making conjectures, truth tables, conditional statements, and deductive reasoning. The High School content expectations that are covered are represented in the following table:

Code:	Michigan High School Content Expectation:
L.3.1.1.	Distinguish between deductive and inductive reasoning, identifying and providing examples of each.
L.3.1.3	Define and explain the roles of axioms (postulates), definitions, theorems, counter-examples, and proofs in the logical structure of mathematics. Identify and give examples of each.
L.3.2.1	Know and use the terms of basic logic.
L.3.2.2	Use the connectives “not,” “and,” “or,” and “if-then” in mathematical and everyday settings. Know the truth table of each connective and how to logically negate statements involving these connectives.
L.3.2.3	Use the quantifiers “there exists” and “all” in mathematical and everyday settings and know how to logically negate statements involving them.
L.3.2.4	Write the converse, inverse, and contrapositive of an “If..., then...” statement. Use the fact, in mathematical and everyday settings, that the contrapositive is logically equivalent to the original while the inverse and converse are not.
L.3.3.1	Know the basic structure for the proof of an “If..., then...” statement (assuming the hypothesis and ending with the conclusion) and that proving the contrapositive is equivalent.
L.3.3.2	Construct proofs by contradiction. Use counter-examples, when appropriate, to disprove a statement.

The general lesson plans are for seventy minute periods and are represented in the following table:

	Topic:	Vocabulary Words: (definitions can be found in the Zip Around Game)	Description of class activities:	Artifacts for data:
Day 1:	Inductive Reasoning / Conjectures	Inductive Reasoning Conjecture	• KWL (in Think-Pair-Share as a group) • Lesson • Add to word wall (if necessary)	KWL Homework
Day 2:	Counterexamples	Counterexample	• Warm-up: Making conjectures • Lesson • Add to word wall (if necessary)	Homework
Day 3:	Counterexamples		• Counterexamples group work • Add to word wall (if necessary)	Group Work Presentation
Day 4:	Statements	Statement Negation Truth Value	• Add to word wall (if necessary) • Quiz on 2.1 • Lesson	Quiz Homework
Day 5:	Conjunction/ Disjunction	Compound Statement Conjunction Disjunction	• Zip Around Activity in small groups of 5-6 • Add to word wall (if necessary) • Compound Statements Activity	Compound Statements Activity
Day 6:	Truth Tables	Truth Table	• Zip Around Activity • Add to word wall (if necessary) • 2-2 Part Two Fill in Notes	Truth table ticket out the door
Day 7:	Truth Tables		• Zip Around Activity • Add to word wall (if necessary) • Truth Tables #1 Partner Work	Truth Tables Work

Day 8:	Conditional Statements	If-Then Statement Hypothesis Conclusion Conditional Statement	• Add to word wall (if necessary) • 2-3 Fill in Notes Part 1	Homework
Day 9:	Related Conditionals	Converse Inverse Contrapositive	• Add to word wall (if necessary) • 2-3 Fill in Notes Part 2 • Model LINCS Strategy with vocabulary words • Model Self-test	2-3 Worksheet #1
Day 10:	Related Conditionals	Logically Equivalent	• LINCS Self-Test in Cooperative Groups • Create LINCS Table for new vocabulary words • Lesson • Add to word wall (if necessary) • Introduce Hand Symbols Dance	On Day 8 HW and 2-3 Worksheet #1 we will analyze which statements are logically equivalent
Day 11:	Deductive Reasoning	Deductive Reasoning Law of Detachment Law of Syllogism	• Zip Around Activity • Hand Symbols Dance Warm-Up • Create LINCS Table for new vocabulary words • Assign Logic Project: Pass out rubric and draw p,q,r's • Lesson with laws activity • Add to word wall (if necessary)	In Class "laws" activity as a class
Day 12:	Postulates and Basic Proof	Postulate/Axiom Theorem Proof Informal Proof	• LINCS Self-Test in Cooperative Groups • Add to word wall (if necessary) • Lesson	Homework

Day 13:	Logic Project	Vocabulary of Entire Logic Unit	• Zip Around Activity • Hand Symbols Dance Warm-Up • Work on Logic Project • Add to word wall (if necessary)	
Day 14:	Logic Project	Vocabulary of Entire Logic Unit	• LINCS Self-Test in Cooperative Groups • Hand Symbols Dance Warm-Up • Work on Logic Project Due at the end of the hour • Add to word wall (if necessary)	Logic Project
Day 15:	Review	Vocabulary of Entire Logic Unit	• Zip Around Activity • LINCS Self-Test in Cooperative • Add to word wall (if necessary)Groups • Discuss “trouble words” • Hand Symbols Dance Warm-Up • Review Assignment	Zip Around Activity LINCS Self-Test Report on Trouble Words (each group reports 3 most troubling words)
Day 16:	Review	Vocabulary of Entire Logic Unit	• Stations Review • Add to word wall (if necessary)	7 Stations Review Sheets
Day 17:	Assessment	Vocabulary of Entire Logic Unit	• Basic Logic Test	Basic Logic Test Scores

Part II: Literacy Requirements and Challenges

The literacy requirements for this unit are more than in most geometry units. Students will be reading text, and developing phrases and sentences to represent mathematical logic. Students will be analyzing statements representing geometric situations and have to decide whether statements are true or false. This skill relies on a student's ability in indentifying and correctly decoding words such as *sometimes, always,* or *never.* A student's understanding of these key words is fundamental to their understanding of mathematics! By reading a situation, can the student depict and draw a visual representation of the problems? Students will also be manipulating statements to form multiple related statements.

Because of the amount of vocabulary and its importance in future units, I decided to focus on vocabulary acquisition as well as multiple representations and methods to manipulate the related conditionals. The related conditionals are the most confusing vocabulary to keep straight and utilize correctly in this unit. It is important that students develop a deep understanding of topics so that there is vocabulary retention, not just memorization for that specific unit. "Traditionally, vocabulary instruction has been conducted by having children look words up in dictionaries and memorize the definitions, under the assumption that, having learned the definition, they have learned the word. This assumption is untrue for a number of reasons." (Stahl, 2003, p. 244). Math vocabulary continues to build, which is why we cannot continue "traditional" vocabulary instruction.

Part III: Intervention Plan

In order to address attaining vocabulary and develop meaningful definitions, I am going to incorporate the LINCS strategy (Ellis, 2000). The zip around game (Curriculum Project Inc., 1999) will also be an intervention to assist with the same vocabulary issues.

In order to help my mathematics students develop a deeper meaning, students need to be introduced and working with the vocabulary in various ways. The Hand Dance Game is incorporated to give visual learners a way to visualize the concepts and well as help brain activity by its kinesthetic nature. "'Current research shows that children who learn through movement retain more and perform better in school', notes Lengel. 'Kinesthetic learners, for example, do well in things like chemistry class where they are participating in experiments, or in athletics where they are playing a sport, or in music class where they are singing or playing an instrument. They remember things by connecting a physical activity to a subject.' "(PR Newswire, 2010, p.1).

In order to address analyzing text, students will be expected to identify and mark key descriptor and connector words including: always, sometimes, never, all, some, none, every, and, or, etc." on our word wall. "Which words do good readers skip as they read along at a good pace? Almost none. " (Moats, 1999, p. 21) Key words "always, sometimes, and never" play large role in mathematics concepts. I need to start and identification process for such key words. "Prior information, or background knowledge, serves as a filter through which new information passes. Readers interact with new material, trying to match what they read to what they already know to construct meaning. "(Ehren, 2005, p. 2). In order to improve my instruction, I need to give my kids a chance at decoding their text. I want to add that element

into my classroom. By developing this skill I will help create prior knowledge for them to use outside of my classroom and in their math courses ahead.

When planning interventions, it is important not to single students out. I feel that my interventions are great because they fit right into my everyday lesson plans for each and every one of my students. There is not a time where I am separating my students to intervene. The interventions do not just benefit students who need the assistance; these strategies are research based and benefit all students in some way. "Developing a strong vocabulary not only promotes reading comprehension but also enables us to actively participate in our society." (Blanchowicz & Fisher, 2004 p. 1).

LINCS Strategy for Vocabulary:

In order for success with the LINCS strategy, I must model this in class first. I am going to "think aloud" as I walk through the process of creating my LINCS Table (Ellis, E.S., 2000).

List the parts of the story. (Ellis, E.S.,2000).

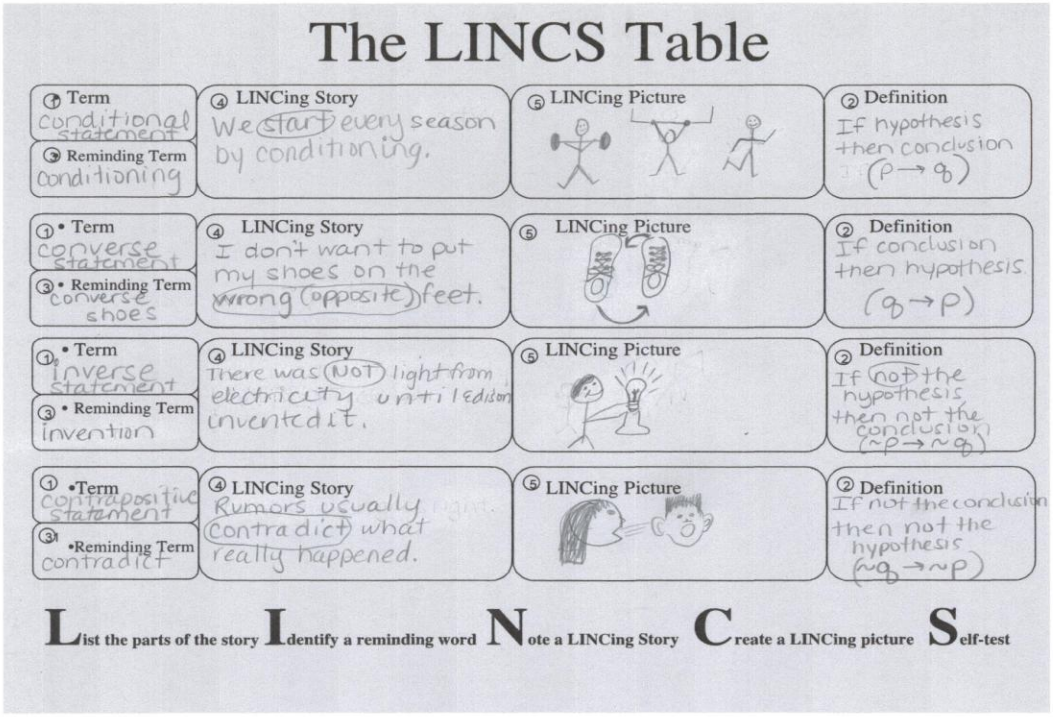
Conditional Statement

Converse Statement

Inverse Statement

Contrapositive Statement

Identify a reminding word, note a LINCing story, and create a LINCing picture. (Ellis, E.S.,2000).



Conditional Statement: The reminding word for conditional is conditioning. The story is that the football team begins each season by conditioning. The picture is of team mates lifting weights, doing pull-ups, and running. This relates to the real definition of the word because it is our initial, or beginning, if-then statements, just like the athletes start a season with conditioning.

Converse Statement: The reminding word for converse is converse shoes. The story is that my little brother puts her shoes on the wrong feet! The picture is of shoes with arrows to switch them. This relates to the real definition of converse (as a geometry term) because you switch the hypothesis and conclusion in the converse statement.

Inverse Statement: The reminding word for inverse is invention. The story is that there was not light from electricity until Thomas Edison invented the light bulb. The picture is Edison

and a light bulb. This is related to the real definition because you add the word 'not' in front of the hypothesis and conclusion in the inverse statement, just like you do not have something until it is invented. I do want to note that 'inverted' seems to be a better word to use, but it is actually deceiving due to the fact changing order would be considered a converse statement in this case, not the inverse.

Contrapositive Statement: The reminding word for contrapositive is contradiction. The story is that when a gossiper spreads a rumor, it usually contradicts what really happened. The picture is of one gossiper whispering to another. This is just like a contrapositive statement because you change everything about the statement to its opposite—it's order and it's positivity.

Next, I will model the self-test. I am going to use a partner to model what they will be doing in class everyday by reviewing the LINCS vocabulary words both by the forwards and backwards methods. (Ellis, E., 2000 p. 37).

Hand Symbols Dance Activity:

This is an activity that I use to be a visual and kinesthetic method of learning the related conditional vocabulary words. Students generally have the most issues confusing these four terms. Open hands represent the given hypothesis and conclusion, respectively named "p" and "q." The left hand represents "p" and the right hand represents "q." A closed hand, or fist, represents negation. The related conditionals are easy to remember and represent in their symbolic forms. It is also a fundamental part of mathematics standards to be able to

understand mathematics vocabulary by its multiple representations—in text, figures, and symbolically.

VOCABULARY WORD:	SYMBOLIC REPRESENTATION:	DANCE MOVE:
Conditional Statement	$p \rightarrow q$ Read: "If p then q."	
Converse Statement	$q \rightarrow p$ Read: "If q then p."	
Inverse Statement	$\sim p \rightarrow \sim q$ Read: "If not p then not q."	
Contrapositive Statement	$\sim q \rightarrow \sim p$ Read: "If not q then not p."	

In class I play music where the students dance for a few seconds and I shout a statement and pause the music. Students must hit a dance pose with their hands correctly in place. Towards the end of the unit I make it a game. Anyone who is incorrect sits down and we play until we have a winner (or a few if it goes too long!).

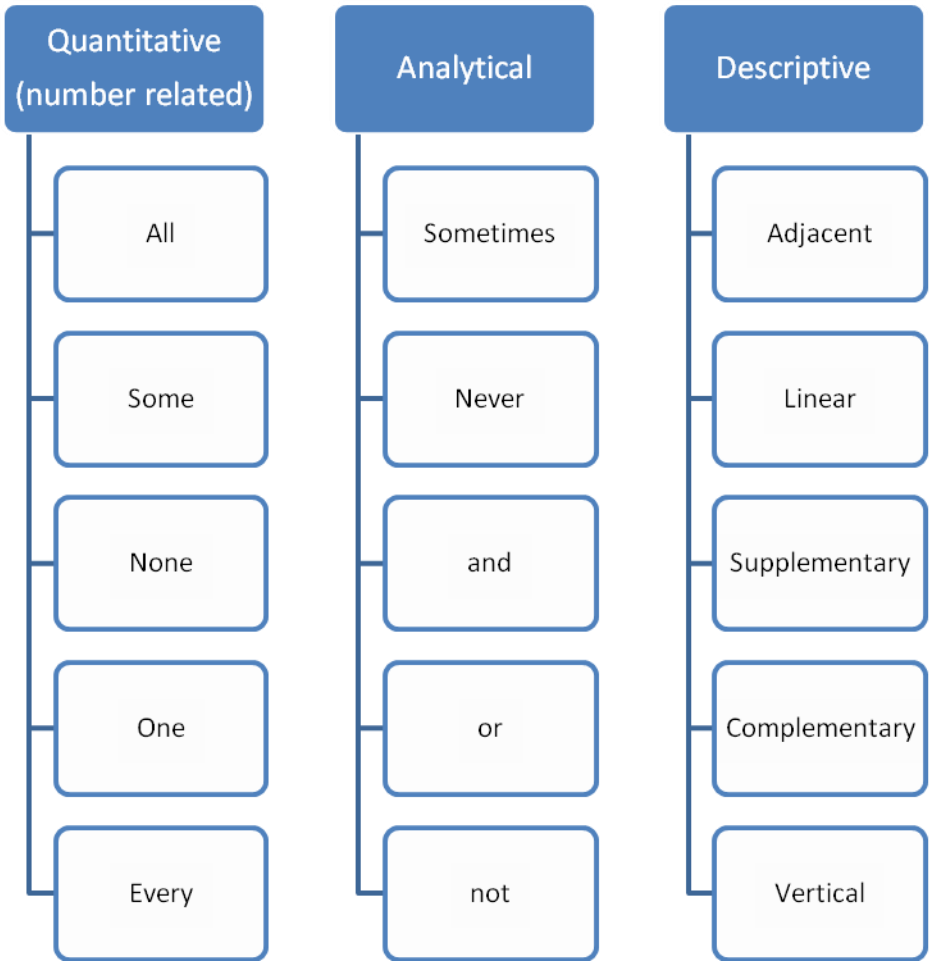
Zip Around Activity:

Another way to review vocabulary is the Zip Around game (Curriculum Project Inc., 1999). I have various versions so that the vocabulary is not always in the same order. You can continue to build onto the game as we introduce more and more vocabulary words. Each student receives a card. I choose a student to begin and read the "Who has" of their card. As we continue the students say, "I have" the particular vocabulary word and then "who has" the definition.

I have CONJECTURE. Who has a reasoning that uses specific examples to come to a generalization or prediction?	I have INDUCTIVE REASONING. Who has a false example that proves that a conjecture is not true?	I have COUNTEREXAMPLE. Who has a sentence that is either true or false?	I have STATEMENT. Who has the truth or falsity of a statement?
I have TRUTH VALUE. Who has a statement that has the opposite meaning as well as an opposite truth value?	I have NEGATION. Who has two or more joined statements?	I have COMPOUND STATEMENT. Who has a compound statement formed by two or more statements with the word "and?"	I have CONJUNTION. Who has has a compound statement formed by two or more statements with the word "or?"
I have DISJUNCTION. Who has an organizing method for truth values?	I have TRUTH TABLE. Who has a statement that can be written in the "if-then" form?	I have CONDITIONAL STATEMENT. Who has a statement written in the form "If P, then Q?"	I have IF-THEN STATEMENT. Who has the statement immediately following the word "if?"
I have HYPOTHESIS. Who has the statement immediately following	I have CONCLUSION. Who has statements that are based upon a	I have RELATED CONDITIONALS. Who has the statement	I have CONVERSE. Who has the statement that negates both the

the word “then?”	given conditional statement?	exchanging the hypothesis and conclusion of the given conditional statement?	hypothesis and conclusion of the given conditional statement?
I have INVERSE. Who has the statement that negates and exchanges both the hypothesis and conclusion of a given conditional statement?	I have CONTRAPOSITIVE. Who has statements that have the same truth value?	I have LOGICALLY EQUIVALENT. Who has the method of reasoning that uses facts, rules, definitions, or properties to reach a logical conclusion?	I have DEDUCTIVE REASONING. Who has a form of deductive reasoning that uses true conditional statements?
I have THE LAW OF DETACHMENT. Who has a form of deductive reasoning that mimics the transitive property?	I have THE LAW OF SYLLOGISM. Who has a statement that describes a fundamental relationship between the basic terms of geometry?	I have POSTULATE OR AXIOM. Who has a statement or conjecture that has been proven to be true?	I have THEOREM. Who has a logical argument in which each statement is justified by definitions, postulates, properties, or theorems?
I have PROOF. Who has a method of proof in paragraph form?	I have INFORMAL PROOF. Who has an educated guess based on known information?		

In class as we read text and story problems students will be identifying quantitative, descriptive, and connecting words important in correctly analyzing a specific mathematical situation. As we come across these words, students will add these to our word wall of "key words in problem solving." Students will continually add to this wall as we continue the year.



Assessments and Beyond:

Typically students do not come in with a lot of formal knowledge on the subject. As a pre-test I focus on the connector words and truth values. I like to see how it directly relates to the post test. Students are unfamiliar with vocabulary words and the techniques used in the logic unit.

I have two different post-assessments provided—the logic project and the formal summative test. Both of these tools provide me with a demonstration of student learning in two very different ways. The logic project gives students a real-life look at how logic is in their everyday life by looking at advertisements, assessing statements, and looking at tricky wording. It is a product of work that is very individual for each student. I like that I have time to give them feedback before their review assignments and the formal assessment. The formal test is a look at how a student may perform on standardized tests, which are also an important factor in education today with the No Child Left Behind Act of 2001 and recent legislation for Race To the Top funding. The use of standardized and common assessments in my district is a growing trend. It is very important that I am able to collaborate with the other geometry teachers and improve our instruction, share methods, analyze our assessment data, and use it to make instructional decisions, just as I do individually in my own classroom with the results from these assessments.

The assessment data will tell me what vocabulary words still need more time to develop. This will give me topics and information for warm-up activities and topics that I can work within our new material too. Looking at the data will also help me decide if this is a good distribution of vocabulary techniques. Will one method be better or is the variety working? This information can also help me target more literacy issues that I would also like to add interventions for. It is almost like action research. Identify a problem, try interventions, analyze data, and adjust as necessary! It is a learning process for the teacher too. Every group of students and individual students react differently to the interventions. I believe it will give me better experience of choosing the right interventions for the right students.

Name:_____Date:_____Hour:_____

Basic Logic Pre-Test

Write each conditional in IF-THEN form

1) All vertical angles are congruent.

2) Collinear points lie on the same line.

Write the converse of the following conditional. Then state whether it is TRUE or FALSE.

3) If two angles are right angles then two angles are congruent.

Write the inverse of the following conditional. Then state whether it is TRUE or FALSE.

4) If today is Friday, then tomorrow is Saturday.

Provide a counterexample to disprove the following statement:

5) All adjacent angles are complementary.

Fill in the blank.

6) Conditional statements are logically equivalent to the _____ statement.

7) Converse statements are logically equivalent to the _____ statement.

Fill in connector words to make the following sentences TRUE about you.

8) I have Ms. McGerty as a geometry teacher ____ I have Ms. Phillips for a geometry teacher.

9) I attend Lake Shore High School ____ I am I sophomore this year

LOGIC PROJECT

PART I: Find 2 advertisements and make them into if-then statements. Make sure you attach the original advertisements in your project. (8 points)

PART II: Make a truth table for : (12 points)

p ^ q

p v q

~p ^ r

q v ~p

(p ^ q) v r

(p v q) ^ r

PART III: (use the p, q, and r that was drawn in class). Write the following conditional statements , along with their converse, inverse, and contrapositive. After you have written the sentence, choose one color to highlight all of the hypotheses and another color for the conclusions. (Make a key). Then, write the statements truth value after the sentence. (32 points)

1). Use p→q as the conditional statement.
Conditional:
Converse:
Inverse:
Contrapositive:

2). Use p→*r* as your conditional statement.
Conditional:
Converse:
Inverse:
Contrapositive:

You will get additional points for:

-neatness (3 points)

-originality / creativity of presentation (book, poster, powerpoint, etc.) (5 points)

TOTAL POINTS: _____ out of 60 points

LOGIC PROJECT RUBRIC

PART I:
Advertisement 1 _____ 2 points Comments:

Advertisement 2 _____2 points
If-Then for Ad. 1 _____2 points
If-Then for Ad. 2_____2 points

PART II: Make a truth table for : (2 points each)

p ^ q _____ 2 points

p v q _____ 2 points

~p ^ r _____ 2 points

q v ~p _____ 2 points

(p ^ q) v r _____ 2 points

(p v q) ^ r _____ 2 points

PART III: (use the p, q, and r that was drawn in class)
(Make a key for hypothesis/conclusion)
One point each per statement
-Statement
-Hypothesis
-Conclusion
-Truth Value

1). Use p→q as the conditional statement.

Conditional: _____ 4 points
Converse: _____ 4 points
Inverse: _____ 4points
Contrapositive: _____ 4points

2). Use p→*r* as your conditional statement.

Conditional: _____ 4 points
Converse: _____ 4 points
Inverse: _____ 4 points
Contrapositive: _____ 4points

You will get additional points for:
-neatness (3 points) _____3 points
-originality of the material_____ 5 points

TOTAL POINTS _____ out of 60
Name: _____ Hour: _____ Date: _____

BASIC LOGIC TEST (2.1-2.5)

For the following questions, decide whether the conjecture is TRUE or FALSE. If False, give a COUNTEREXAMPLE. Remember to fill in the counterexamples with needed symbols and/or measures.

1. Given: DE + EF = DF
   Conjecture: DE = EF

   True or False ? If false, give a counterexample:

2. Given: Two adjacent angles
   Conjecture: Those angles are a linear pair

   True or False ? If false, give a counterexample:

3. Given: A, B and C are collinear
   Conjecture: AB + BC = AC

   True or False ? If false, give a counterexample:

4. Given: A linear pair
   Conjecture: The linear pair is supplementary

   True or False ? If false, give a counterexample:

Write the following statements as indicated and indicate their truth value
p: I have Geometry Class

r: Mrs. Roda is my geometry teacher

5. p^r True or False

6. p v r True or False

7. ~p ^r True or False

8. p v ~r True or False

9. ~r ^ p True or False

Fill in the following truth tables.

10.

p	q	p ^ q
T	T	
T	F	
F	T	
F	F	

11.

p	q	p v q
T	T	
T	F	
F	T	
F	F	

12.

p	q	~p	~p v q
T	T		
T	F		
F	T		
F	F		

13.

p	~p	q	~q	~p ^ ~q
T		T		
T		F		
F		T		
F		F		

p	q	r	p v q	(p v q) ^r
T	T	T		
T	T	F		
T	F	T		
T	F	F		
F	T	T		
F	T	F		
F	F	T		
F	F	F		

p	q	r	~r	(p ^ q)	(p ^ q) v ~r
T	T	T			
T	T	F			
T	F	T			
T	F	F			
F	T	T			
F	T	F			
F	F	T			
F	F	F			

Please do or write the following for each statement:

- Write the indicated statement (HINT: if – then form)
- Give it's truth value
- Underline the hypothesis _____
- Dashed line under the conclusion _ _ _ _ _

p: it is Wednesday
q: we have an early release day

CONDITIONAL:

True or False

CONVERSE:

True or False

INVERSE:

True or False

CONTRAPOSITIVE:

True or False

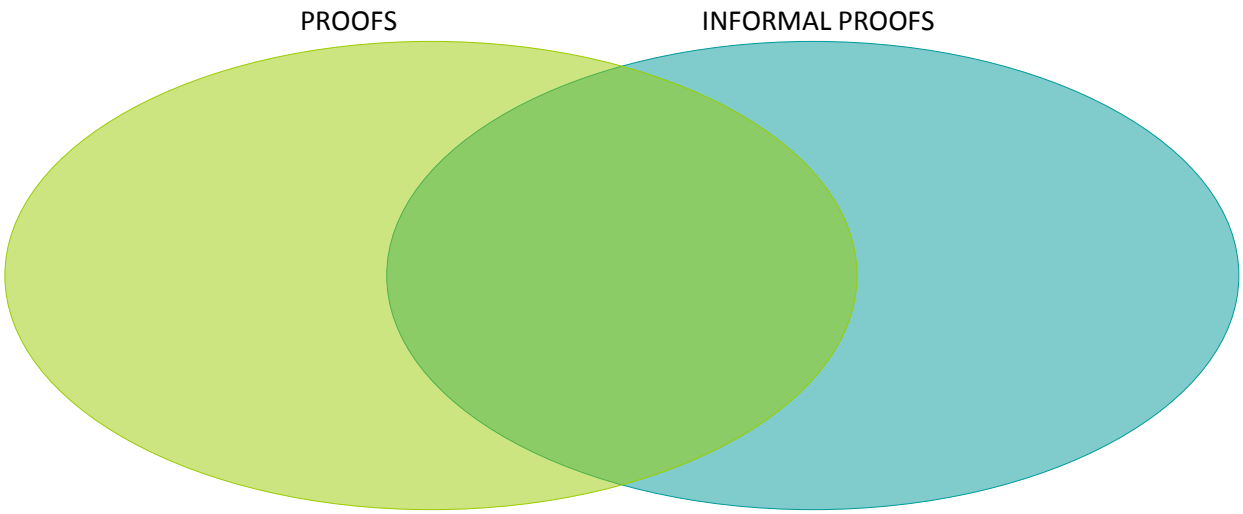
What does it mean to be logically equivalent?

Which pairs of statements always have the same truth value? (They are logically equivalent). **Answer in complete sentences.**

DEDUCTIVE REASONING:	INDUCTIVE REASONING:

Definition:	Definition:
Provide an example or skill using deductive reasoning.	Provide an example or skill using inductive reasoning.

What are the similarities and differences between Proofs and Informal Proofs? Fill in the Venn Diagram with your thoughts.



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