Name:_____ Date:_____ Band:_____
Geometry

Unit 2: Reasoning and Proof Project

ANALYZING A CALENDAR PATTERN

You can choose a set of four numbers from a page of a monthly calendar by drawing a 2-by-2 square around four dates, as shown below. The four numbers form a 2-by-2 *calendar square.*

MARCH						
SUN	**MON**	**TUE**	**WED**	**THU**	**FRI**	**SAT**
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

Task: Use inductive reasoning to make a conjecture about the numbers on the diagonals of a 2-by-2 calendar square. Then use deductive reasoning to prove your conjecture.

Part 1: Apply What You've Learned

A. Use the 2-by-2 calendar square outlined in red on the March calendar. Find a relationship between the pairs of numbers on the diagonals of the calendar square.

B. Repeat Part A for several other 2-by-2 calendar squares on the March calendar. Make a conjecture based on your results.

C. Test your conjecture using other calendar months. Can you find a counterexample to your conjecture?

Part 2: Apply What You've Learned

In Part 1, you made a conjecture based on patterns you observed in the numbers on the calendar. Your conjecture may have been similar to the one below.

Conjecture: The sums of the numbers on the diagonals of a 2-by-2 calendar square are equal.

You can express this conjecture with symbols by using a, b, c, and d to represent any four distinct numbers from a monthly calendar page. Assume the list a, b, c, and d gives the numbers in order from least to greatest.

A. Which of the following conditional statements represents the conjecture? What is the hypothesis of the conditional? What is the conclusion?

I. If $a + d = b + c$, then a, b, c, and d form a 2-by-2 calendar square.

II. If a, b, c, and d form a 2-by-2 calendar square, then $a + d = b + c$.

B. Identify the other statement in Part A as the *converse, inverse,* or *contrapositive* of the conjecture. Then write the other two of these (converse, inverse, or contrapositive) in if-then form.

C. You now have four conditional statements about distinct numbers a, b, c, and d from a monthly calendar page. For which of these statements can you find counterexamples? If possible, give at least two counterexamples.

Part 3: Apply What You've Learned

Choose from the following words and expressions to complete the sentences below.

1 more than	7 more than	$a-1$	$a-7$	$d-7$
1 less than	7 less than	$a+1$	$a+7$	$d-1$
Syllogism	Detachment	$c+1$	$c-1$	$b+7$

A. Fact 1: A date in a monthly calendar is _____ a date directly to the left of it.

B. Fact 2: A date in a monthly calendar is _____ a date directly to the above it.

Let a, b, c, and d represent the numbers in a 2-by-2 calendar square, with a, b, c, and d listed from least to greatest.

C. You can use Fact 1 above to conclude that b is equivalent to _____.

D. You can use Fact 2 above to conclude that c is equivalent to _____.

E. You can use Fact 1 above to conclude that d is equivalent to _____.

F. Each of these conditions is an example of using the Law of _____.

Part 4: Completing the Performance Task

Look back at your results from Parts 1-3. Use the work you did to solve the Task by using deductive reasoning to prove your conjecture. Show all your work and explain each step of your solution.

Part 5: On Your Own

You can choose a 3-by-3 calendar square on a page of a monthly calendar by drawing a 3-by-3 square around nine dates, as shown below.

MARCH						
SUN	MON	TUE	WED	THU	FRI	SAT
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

A. Use inductive reasoning to make a conjecture about the relationship between the center number of a 3-by-3 calendar square and the three calendar-square numbers that lie on any row, column, or diagonal containing the center number.

B. Use deductive reasoning to prove your conjecture.