

## 2.2-2.4: CONDITIONAL STATEMENTS

- 2.2.a: Identify, write, and analyze the truth value of conditional statements.  
 2.2.b: Write the inverse, converse, and contrapositive of a conditional statement.  
 2.4: Write and analyze biconditional statements.

### Logically Equivalent Statements:

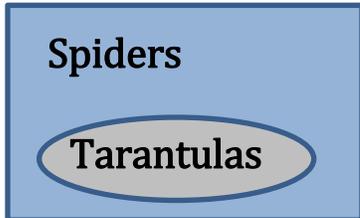
Statement	Example	Truth Value
Conditional	If $m\angle A = 95^\circ$ , then $\angle A$ is obtuse.	True
Converse	If $\angle A$ is obtuse, then $m\angle A = 95^\circ$	False
Inverse	If $m\angle A \neq 95^\circ$ , then $m\angle A$ is <u>NOT</u> obtuse.	False
Contrapositive	If $\angle A$ is <u>NOT</u> obtuse, then $m\angle A \neq 95^\circ$ .	True
Biconditional	$m\angle A = 95$ if and only if $\angle A$ is obtuse.	False

### Summary:

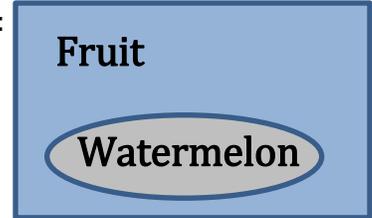
- A conditional statement is equivalent to the contrapositive statement.
- Similarly, the converse statement is equivalent to inverse statement.
- A biconditional statement is true if and only if BOTH the conditional and converse are true.

### Venn Diagrams:

Example:



Example 1:



The inner oval represents the hypothesis.

The outer oval represents the conclusion.

Conditional: If an animal is a tarantula, then  
it is a spider.

Write a conditional statement using  
 the Venn Diagram above.

If a food is a watermelon,  
 then it is a fruit.

A conditional statement has a truth value of either true (T) or false (F).

To show that a conditional statement is false:

Find ONE counterexample where the hypothesis is true and the conclusion is false.

Example 2: Determine if the conditional is true. If false, give a counterexample.

If two angles are acute, T  
 then they are congruent. T False  
 $\angle A = 30^\circ$ ,  $\angle B = 50^\circ$  } but not  $\cong$

If a dog is a human, F } Because hyp is  
 then a dog can talk. F } false, can't find  
True } a counterexample

With a Partner!



**Example 3:** Circle the hypothesis and underline the conclusion of the following statements.

- a) If two rays share a common endpoint and point in opposite directions, then they are opposite rays.
- b) An angle has a measure of  $90^\circ$ , if it is a right angle.

**Example 4:** Write the following sentences as conditional statements. Then, circle the hypothesis and underline the conclusion.

- a) The midpoint M of a segment bisects the segment.  
If M is the midpt of a segment, then it bisects the segment.
- b) Two angles that are complementary are acute.  
If 2  $\angle$ 's are complementary, then they are acute.

**Example 5:** Write the converse, inverse, and contrapositive of the following conditional statement.  
Find the truth value of each.

- T If an insect is a butterfly, then it has four wings.
- F Converse: If an insect has 4 wings, then it is a butterfly.
- F Inverse: If an insect is NOT a butterfly, then it does NOT have 4 wings.
- T Contrapositive: If an insect does NOT have 4 wings, then it is not a butterfly.
- F Bi-conditional: An insect is a butterfly iff it has 4 wings

**Example 6:** Determine if each conditional is true. If false, give a counterexample.

- a) If today is Sunday, then tomorrow is Monday. **TRUE**
- b) If an angle is obtuse, then it has a measure of  $100^\circ$ . **False**  $\uparrow 105^\circ$
- c) "If you subtract -2 from -6, then result is -4." **TRUE**  $-6 + 2 = -4$
- d) "If  $t^2 = 16$ , then  $t = 4$ ." **False**  $t = -4$

- ~~4~~ e) If an odd number is divisible by 2, then 8 is a perfect square.  
**an odd # is never divisible by 2 - so hypothesis is False**  
**8 is a perfect square - conclusion is false**  
**TRUE, since hypothesis is False, statement is true no matter what**