Bellwork:

Rewrite the biconditional statement as a conditional statement and its converse.

conv: if it is sunny, then we will go to the beach.

1. We will go to the beach if and only if it is sunny.

cond: h

if we go to the beach, then it is sunny.

Give a counterexample that demonstrates that the statement is false.

2. If a polygon has four equal sides, then it is a square.

a rhombus

3. If a vehicle has wheels, then it is a car.

bus, scooter, airplane,

Determine whether the statement can be combined with its converse to form a true biconditional.

4. If $2x > 8$, then $x = 5$.

can't be done.

2.3 **Deductive Reasoning**

Goals today: to learn symbolic notation for conditional statements AND to learn the two laws of logic.

If it is raining, then it is cloudy.

p q

p = hypothesis $\longrightarrow$ = then

q = conclusion ~ = not

<table>
<tr><td>conditional (original)
$p \longrightarrow q$
if it is raining then it is cloudy.</td><td>converse (switched)
$q \longrightarrow p$
if it is cloudy, then it is raining.</td></tr>
<tr><td>inverse (negated)
$\sim p \longrightarrow \sim q$
if it is not raining then it is not cloudy.</td><td>contrapositive (switched & negated)
$\sim q \longrightarrow \sim p$
if it is not cloudy, then it is not raining.</td></tr>
<tr><td colspan="2">biconditional (forwards and backwards)
conditional + converse (if and only if)
$p \longleftrightarrow q$
it is raining if and only if it is cloudy. $\longleftrightarrow$</td></tr>
</table>

*The same colors always have the same truth values.

Example:

Let p be "today is Monday" and q be "there is school."

$\sim p$: today is NOT Monday. $\sim q$: there is NO school

a. Write $p \rightarrow q$. If today is Monday, then there is school.

b. Write the converse of $p \rightarrow q$. $q \rightarrow p$ If there is school then today is Monday.

c. Write the contrapositive of $p \rightarrow q$. $\sim q \rightarrow \sim p$
If there is no school, then today is not Monday

d. Write the inverse of $p \rightarrow q$. $\sim p \rightarrow \sim q$
If today is not Monday, then there is no school

Two types of Reasoning

Inductive Reasoning vs. Deductive Reasoning

Inductive reasoning:	Deductive reasoning:
Patterns	Facts
Specific Examples	Rules
Prediction	Definitions
Conjecture	Logical Argument

Example: (Inductive or Deductive?)

inductive

A. Josh knows that Dell computers cost less than Mac computers. All other brands that Josh knows of cost less than Dell. Josh reasons that Mac costs more than all other brands.

B. Josh knows that Dell computers cost less than Mac computers. He also knows that Mac computers cost less than Micron. Josh reasons that Dell costs less than Micron.

deductive

Two Laws of Logic (Law of Detachment and Law of Syllogism):

When you have **one** conditional statement ($p \longrightarrow q$) and it is **true**...

you can "detach" the p and if the condition is met, you can draw the conclusion. It's called the **Law of Detachment**.

Example 1:

If x is a number divisible by 5, then x must end in a 0 or a 5.
x = 25

25 ends in a 5.

Example 2:

If today is Labor day, then there is no school.
Today is Labor day. there is no school

It only works when "p" is the part that is detached!

can't detach the q

When you have **two** conditional statements ($p \longrightarrow q$ and $q \longrightarrow r$) and they are **both true**...

as long as the conclusion of the first statement is the same as the hypothesis for the second statement you can leap from p to r ($p \longrightarrow r$) and it is true. It's called the **Law of Syllogism**. (with logic)

Example:

If $\underbrace{\text{you attend Olympia High School}}_{p}$, then $\underbrace{\text{you live in Orlando}}_{q}$.

If $\underbrace{\text{you live in Orlando}}_{q}$, then $\underbrace{\text{you live in Florida}}_{r}$.

so you can conclude:

If $\underbrace{\text{you attend Olympia High School}}_{p}$, then $\underbrace{\text{you live in Florida}}_{r}$.

Example:

Heather is going to the mall. Can you conclude that she will buy a pair of shoes?

If Heather shops for shoes, she will buy a pair. If Heather goes to the mall she will shop for shoes.

switch the two sentences and yes, she will buy shoes!