1. In the movie, *Field of Dreams*, a voice from the sky says, "If you build it, he will come." The movie is referring to the main character and if he builds a baseball field, then the ghost of a baseball player will come and play on it.

The quote from the movie is a conditional statement. Conditional statements use the connective, ***if…then***.

Using **p** and **q** as our statements, the compound statement **"if p then q"**, means **"p implies q"**

We write it in symbol form as $p \to q$

before *"If"* is the Antecendent or condition and *"then"* is the consequence

✱ The words after **"IF"** give a condition the makes the statement after **"THEN"** to be true. This does not mean it is a cause and effect situation. For example,

If I pass this math class, then the sun will rise the next day.

In general, **"IF"** a condition is met, **"THEN"** this statement becomes is true.

In everyday language, we speak in conditional statements all the time, however, sometimes we use *if…then* and sometimes we do not. Sometimes the connective is "hidden" in everyday expressions or statements.

EXAMPLE: Rewrite the following statements as a conditional statement using ***if…then***. Rearrange the words and add words if needed but keep the same meaning of the original statement.

1. All Marines love boot camp. If you are a Marine, then you love boot camp.
2. Big girls don't cry. If you are a big girl, then you don't cry.
3. Doing my homework will help me pass math class. If I do my homework, then it will help me pass math class.
4. Texting during class might cause me to fail math class. If I text during class then it might cause me to fail math class.
5. It's hard to study when I'm distracted. If I'm distracted, then it's hard to study.

Answers may vary

2. *If…then*

Find the truth value, ***T*** or ***F***, of compound statements using the connective, ***if…then***. Let's use ordinary language and statements to create the rules for finding truth values. Then we will write the rule in symbol form.
***If…then* (→)** is a connective that **"*implies*"**, "**IF**" a condition is met, "**THEN**" this statement is true.

For example, "If it rains then the ballgame will be cancelled." The weather is the condition for the ball game happening or not.

EXAMPLE: "If I get paid, then I will give you twenty dollars." This statement implies that you get twenty dollars depending on the condition of me getting paid.

p = If I get paid (the condition)
q = then I will give you twenty dollars (the consequence or maybe a promise)

p	q	p → q
paid?	give $	If I get paid, I give money
yes - T	yes - T	T
yes - T	no - F	F
no - F	yes - T	T
no - F	no - F	T

Truth Table RULE for **IF…THEN**

p	q	p → q
T	T	T
T	F	F
F	T	T
F	F	T

✱ If…then has "order", left to right because of the arrow pointing left to right.

EXAMPLE: If ***p* and *r* are a false** statement and ***q* is a true** statement, find the truth value for the given compound statements.

1. $\sim r \rightarrow q =$ T → T = T

2. $q \rightarrow p =$ T → F = F

3. $\sim p \rightarrow (q \wedge r) =$ T → F = F
   F

TRUTH TABLES:

1. Draw a basic table
2. *p* and *q* are the statements and go on the left side of the table.

✱ You need to know how many basic combinations of TRUE and FALSE will be in your truth table (left side/column). In other words, how many rows are in the truth table? Use the same formula from Chapter 2, when we looked for the number of subsets created from one given set: 2^n where n was the number of elements in a set. Now n will be the number of statements.

The formula: 2^n How many rows? $2^2 = 4$ (p q) $2^3 = 8$ (p q r)

3. In many mathematical problems, sometimes you have several steps to get to the final answer. Create a column for each step, the last column being your final answer.
4. We solve math problems using Order of Operations, so you must fill in truth tables in a particular order, too:
   1. Parentheses
   2. Not
   3. And, Or, If…Then
5. Refer back the basic truth table rules to follow the pattern and find your answers.

EXAMPLE: Using the four basic truth table rules, (rules for and, or, not, if…then) construct and complete a truth table for the following compound statements:

1. $\sim q \rightarrow p$

2. $(p \vee q) \rightarrow (q \vee p)$

Tautology is when the last column (final answer) in a truth table has all TRUE values

3. $(\sim p \rightarrow q) \rightarrow p$

3.3 Continued

1) $\sim q \rightarrow p$

p	q	$\sim q$	$\sim q \rightarrow p$
T	T	F	T
T	F	T	T
F	T	F	T
F	F	T	F

order does matter

$F \rightarrow T = T$
$T \rightarrow T = T$
$F \rightarrow F = T$
$T \rightarrow F = F$

2) $(p \vee q) \rightarrow (q \vee p)$

p	q	$(p \vee q)$	$(q \vee p)$	$(p \vee q) \rightarrow (q \vee p)$
T	T	T $\rightarrow$	T	= T
T	F	T $\rightarrow$	T	= T
F	T	T $\rightarrow$	T	= T
F	F	F $\rightarrow$	F	= T

final answer is a tautology (all true)

3.3 continued

3) $(\sim p \to q) \to p$

p q	$\sim p$	$(\sim p \to q)$	$(\sim p \to q) \to p$
T T	F	F → T = T	T → T = T
T F	F	F → F = T	T → T = T
F T	T	T → T = T	T → F = F
F F	T	T → F = F	F → F = T

final Answer

4) $r \to (p \wedge \sim q)$

p q r	$\sim q$	$(p \wedge \sim q)$	$r \to (p \wedge \sim q)$
T T T	F	F	T → F = F
T T F	F	F	F → F = T
T F T	T	T	T → T = T
T F F	T	T	F → T = T
F T T	F	F	T → F = F
F T F	F	F	F → F = T
F F T	T	F	T → F = F
F F F	T	F	F → F = T

final Answer