# Using Deductive Reasoning

## Objectives

1. Recognize the hypothesis and the conclusion of an if-then statement.
2. State the converse of an if-then statement.
3. Use a counterexample to disprove an if-then statement.
4. Understand the meaning of *if and only if*.
5. Use properties from algebra and properties of congruence in proofs.
6. Use the Midpoint Theorem and the Angle Bisector Theorem.
7. Know the kinds of reasons that can be used in proofs.

## 2-1 *If-Then Statements; Converses*

Your friend says, "If it rains after school, then I will give you a ride home."

A geometry student reads, "If B is between A and C, then $AB + BC = AC$."

These are examples of **if-then statements,** which are also called **conditional statements** or simply **conditionals.**

To represent an if-then statement symbolically, let $p$ represent the **hypothesis,** shown in red, and let $q$ represent the **conclusion,** shown in blue. Then we have the basic form of an if-then statement shown below:

If $p$, then $q$.

↑ ↑

**$p$: hypothesis** **$q$: conclusion**

The **converse** of a conditional is formed by interchanging the hypothesis and the conclusion.

Statement: If $p$, then $q$. Converse: If $q$, then $p$.

A statement and its converse say different things. In fact, some true statements have false converses.

Statement: If Ed lives in Texas, then he lives south of Canada.
False Converse: If Ed lives south of Canada, then he lives in Texas.

An if-then statement is false if an example can be found for which the hypothesis is true and the conclusion is false. Such an example is called a **counterexample.** It takes only one counterexample to disprove a statement. We know the converse above is false because we can find a counterexample: Ed could live in Kansas City, which *is* south of Canada and *is not* in Texas.

Some true statements have true converses.

Statement: If $4x = 20$, then $x = 5$.
True Converse: If $x = 5$, then $4x = 20$.