Because the potential difference across each bulb in a parallel arrangement equals the terminal voltage ($\Delta V = \Delta V_1 = \Delta V_2$), you can divide each side of the equation by ΔV to get the following equation.

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2}$$

An extension of this analysis shows that the equivalent resistance of two or more resistors connected in parallel can be calculated using the following equation.

RESISTORS IN PARALLEL

$$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$$

The equivalent resistance of resistors in parallel can be calculated using a reciprocal relationship.

Notice that this equation does not give the value of the equivalent resistance directly. You must take the reciprocal of your answer to obtain the value of the equivalent resistance.

Because of the reciprocal relationship, *the equivalent resistance for a parallel arrangement of resistors must always be less than the smallest resistance in the group of resistors.*

The conclusions made about both series and parallel circuits are summarized in **Table 2.**

Why it Matters

Conceptual Challenge

1. Car Headlights

How can you tell that the headlights on a car are wired in parallel rather than in series? How would the brightness of the bulbs differ if they were wired in series across the same 12 V battery instead of in parallel?

2. Simple Circuits

Sketch as many different circuits as you can using three light bulbs—each of which has the same resistance—and a battery.

Table 2 Resistors in Series or in Parallel

	Series	Parallel
schematic diagram		
current	$I = I_1 = I_2 = I_3 \ldots$ = same for each resistor	$I = I_1 + I_2 + I_3 \ldots$ = sum of currents
potential difference	$\Delta V = \Delta V_1 + \Delta V_2 + \Delta V_3 \ldots$ = sum of potential differences	$\Delta V = \Delta V_1 = \Delta V_2 = \Delta V_3 \ldots$ = same for each resistor
equivalent resistance	$R_{eq} = R_1 + R_2 + R_3 \ldots$ = sum of individual resistances	$\frac{1}{R_{eq}} = \frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} \ldots$ = reciprocal sum of resistances