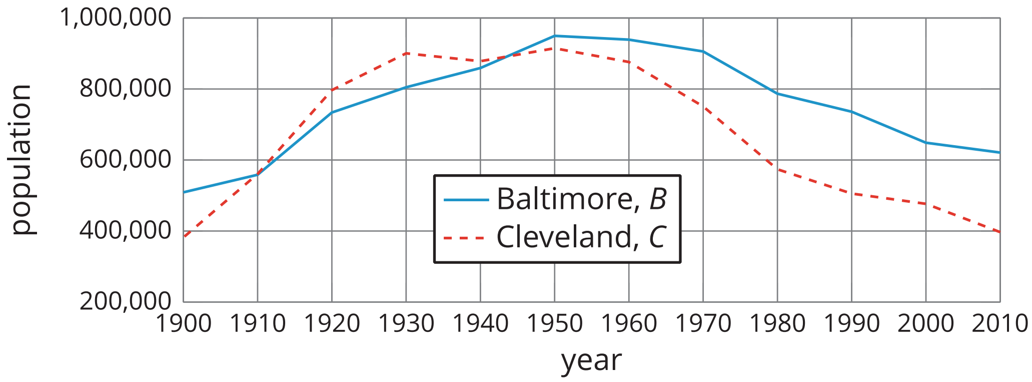
Lesson 9: Comparing Graphs

- Let’s compare graphs of functions to learn about the situations they represent.

9.1: Population Growth

This graph shows the populations of Baltimore and Cleveland in the 20th century. $B(t)$ is the population of Baltimore in year t. $C(t)$ is the population of Cleveland in year t.



1. Estimate $B(1930)$ and explain what it means in this situation.

2. Here are pairs of statements about the two populations. In each pair, which statement is true? Be prepared to explain how you know.

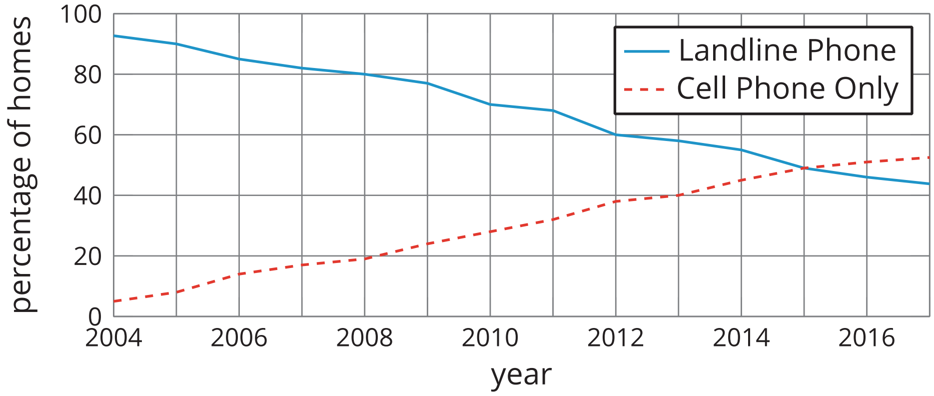
   a. $B(2000) > C(2000)$ or $B(2000) < C(2000)$

   b. $B(1900) = C(1900)$ or $B(1900) > C(1900)$

3. Were the two cities’ populations ever the same? If so, when?

9.2: Wired or Wireless?

$H(t)$ is the percentage of homes in the United States that have a landline phone in year t. $C(t)$ is the percentage of homes with *only* a cell phone. Here are the graphs of H and C.



1. Estimate $H(2006)$ and $C(2006)$. Explain what each value tells us about the phones.

2. What is the approximate solution to $C(t) = 20$? Explain what the solution means in this situation.

3. Determine if each equation is true. Be prepared to explain how you know.

   a. $C(2011) = H(2011)$

   b. $C(2015) = H(2015)$

4. Between 2004 and 2015, did the percentage of homes with landlines decrease at the same rate at which the percentage of cell-phones-only homes increased? Explain or show your reasoning.

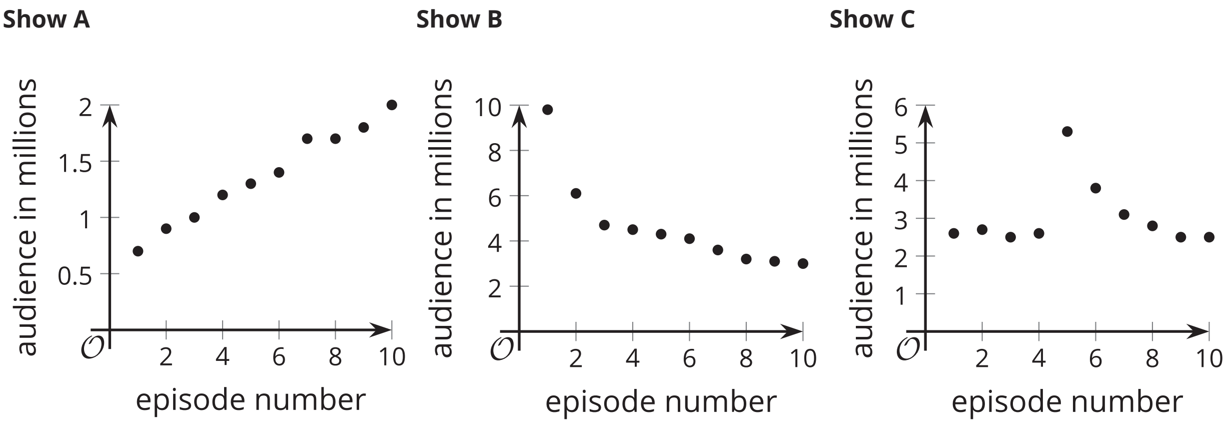
Are you ready for more?

1. Explain why the statement $C(t) + H(t) \leq 100$ is true in this situation.

2. What value does $C(t) + H(t)$ appear to take between 2004 and 2017? How much does this value vary in that interval?

9.3: Audience of TV Shows

The number of people who watched a TV episode is a function of that show's episode number. Here are three graphs of three functions—A, B, and C—representing three different TV shows.



1. Match each description with a graph that could represent the situation described. One of the descriptions has no corresponding graph.

    a. This show has a good core audience. They had a guest star in the fifth episode that brought in some new viewers, but most of them stopped watching after that.

    b. This show is one of the most popular shows, and its audience keeps increasing.

    c. This show has a small audience, but it's improving, so more people are noticing.

    d. This show started out huge. Even though it feels like it crashed, it still has more viewers than another show.

2. Which is greatest, $A(7)$, $B(7)$, or $C(7)$? Explain what the answer tells us about the shows.

3. Sketch a graph of the viewership of the fourth TV show that did not have a matching graph.

9.4: Functions f and g

1. Here are graphs that represent two functions, f and g.

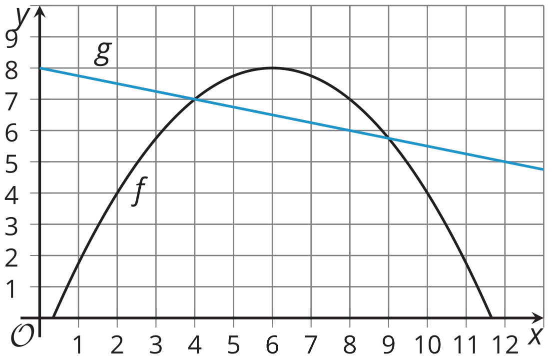
   Decide which function value is greater for each given input. Be prepared to explain your reasoning.

   a. $f(2)$ or $g(2)$

   b. $f(4)$ or $g(4)$

   c. $f(6)$ or $g(6)$

   d. $f(8)$ or $g(8)$

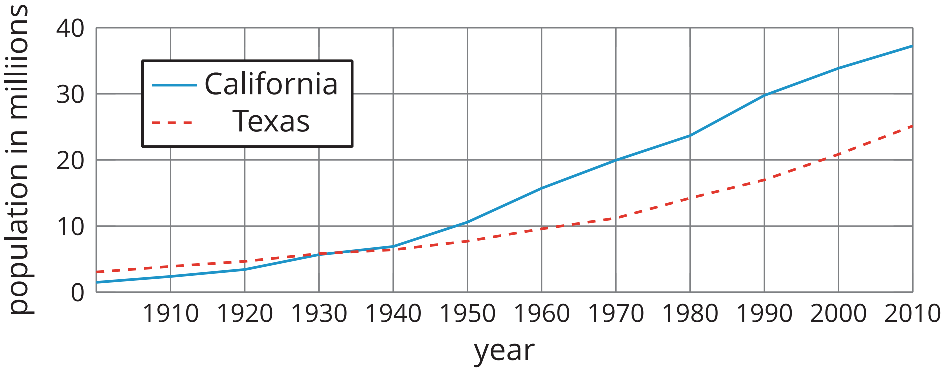


2. Is there a value of x at which the equation $f(x) = g(x)$ is true? Explain your reasoning.

3. Identify at least two values of x at which the inequality $f(x) < g(x)$ is true.

Lesson 9 Summary

Graphs are very useful for comparing two or more functions. Here are graphs of functions C and T, which give the populations (in millions) of California and Texas in year x.



What can we tell about the populations?	How can we tell?	How can we convey this with function notation?
In the early 1900s, California had a smaller population than Texas.	The graph of C is below the graph of T when x is 1900.	$C(1900) < T(1900)$
Around 1935, the two states had the same population of about 5 million people.	The graphs intersect at about $(1935, 5)$.	$C(1935) = 5$ and $T(1935) = 5$, and $C(1935) = T(1935)$
After 1935, California has had more people than Texas.	When x is greater than 1935, the graph of $C(x)$ is above that of $T(x)$.	$C(x) > T(x)$ for $x > 1935$
Both populations have increased over time, with no periods of decline.	Both graphs slant upward from left to right.	
From 1900 to 2010, the population of California has risen faster than that of Texas. California had a greater average rate of change.	If we draw a line to connect the points for 1900 and 2010 on each graph, the line for C has a greater slope than that for T.	$\frac{C(2010) - C(1900)}{2010 - 1900} > \frac{T(2010) - T(1900)}{2010 - 1900}$