Name Date

Section 11.3 Summary

Measuring Distances in Space

Textbook pages 396–405

Before You Read

Looking at stars is like looking into the past. What might be the reason why? Record your thoughts on the lines below.

____

____

Mark the Text

In Your Own Words

Highlight the main idea in each paragraph. Stop after each paragraph and put what you just read into your own words.

Reading Check

1. What is a light-year?

____

____

____

How big is the universe?

Distances between most objects in space are so great that it is hard to imagine them. The unit that is commonly used to describe distances in space is the light-year. To understand this unit, think first about light. Scientists believe that light moves faster than anything else in the universe. Light moves at a speed of nearly 300 000 km/s. How fast is that? In the time it takes to snap your fingers, light can travel around the entire Earth more than seven times.

Travelling at 300 000 km/s, light from the Sun takes about 8 min to reach Earth. Light from the Sun takes about 5 h to reach Neptune, the most distant planet in our solar system. But to reach the star that is nearest to us, called Proxima Centauri, light must travel about 4.2 *years*. A **light-year** represents the distance that light travels in one year. So the distance to Proxima Centauri is 4.2 light-years. Most stars in the universe are hundreds, thousands, and even *millions* of light-years away from us. Can you imagine that? Can anyone? The universe is huge! ✔

How can distances in space be measured?

Long ago, people invented a technique for calculating distances on the ground indirectly: triangulation. **Triangulation** involves creating an imaginary triangle between an observer and the object. To use triangulation, you need to know the length of one side of the triangle, called the baseline. You also need to know the size of the two angles created when imaginary lines are drawn from each end of the baseline to the same point on the distant object.

For thousands of years people measured the distances to stars using triangulation and an effect called parallax. **Parallax** is the apparent change in position of a nearby object when it is viewed from two different points. You can see this effect by pointing at a distant object with your finger. Then, keeping your finger in view, blink first one eye and then the other. Your fingertip appears to move compared with the background because you are viewing your finger from two different points. In this case, the baseline is the distance between your eyes. ✔

To measure distances from Earth to stars, the longest possible baseline is the diameter of Earth's orbit. Sightings have to be taken six months apart. This is the time it takes Earth to move from one end of its orbital baseline to the other. If a star is close enough (up to 1000 light-years), it will appear to move in relation to the more distant stars. Then its distance can be determined using triangulation.

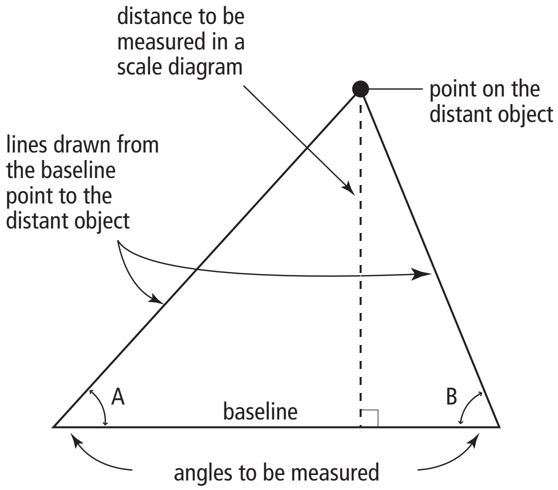
Reading Check

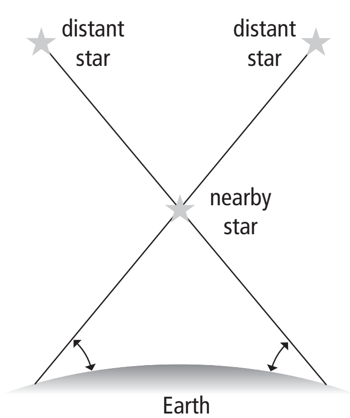
2. What is the longest possible baseline for measuring distances from Earth to stars?

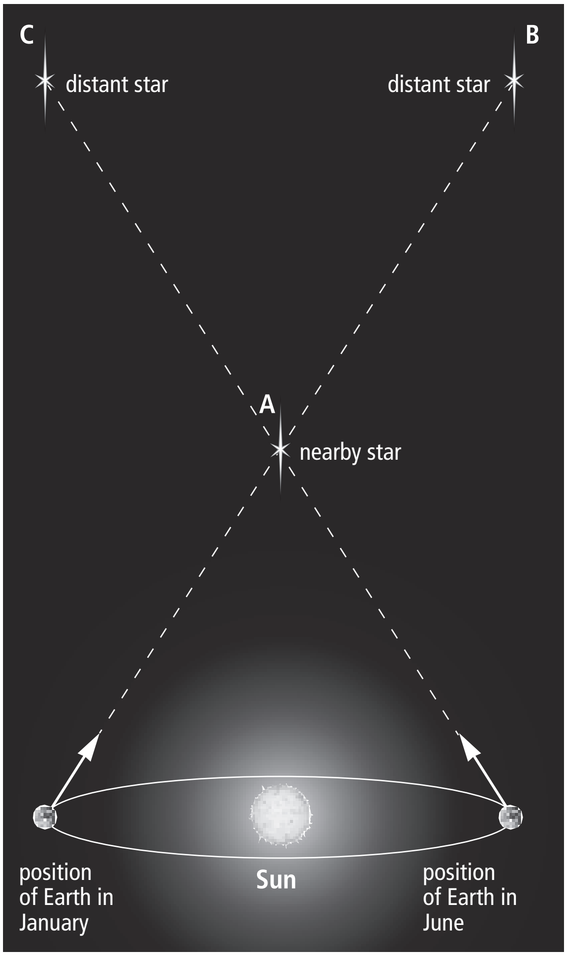
____

____

____







Name Date

Cloze Activity

Section 11.3

Use with textbook pages 396–401.

Describing distances in space

Vocabulary	
300 000 km/s	months
300 000 m/s	parallax
baseline	seconds
distance	shift
hours	triangle
light	triangulation
light-year	width
minutes	years

Use the terms in the vocabulary box to fill in the blanks. Each term can be used more than once. You will not need to use every term.

1. The unit that is commonly used to describe distances in space is the ____.

2. Light moves at a speed of nearly ____.

3. Light from the Sun takes about 4.2 ___________________ to reach the nearest star, about 5 ___________________ to reach the farthest planet in the solar system, and about 8 ___________________ to reach Earth.

4. ____ involves creating an imaginary triangle between an observer and the object.

5. An ancient technique for measuring the distances to stars involves the effect of ____.

6. ____ is the apparent change in position of a nearby object when it is viewed from two different points.

7. To measure distances from Earth to stars, the longest possible ___________________ is the diameter of Earth's orbit.

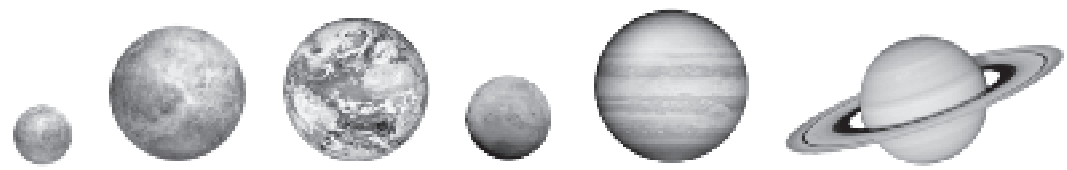
8. The time it takes Earth to move from one end of its orbital baseline to the other is 6 ___________________.

Name Date

Extension Activity
Section 11.3

Use with textbook page 401.

Parallax



You can demonstrate the principles of parallax. Set your workbook in an upright position, open to this page. Use the diagram above as your background for this activity.

1. Hold a pencil in front of your face at about one arm's length. Blink your eyes, one at a time, while looking at the pencil. How does the image of the pencil change when you do this?

2. Hold a pencil in front of your face at about one half of an arm's length. Blink your eyes, one at a time, while looking at the pencil. How does the image of the pencil change when you do this?

3. Hold a pencil in front of your face at about 5 cm from your eyes. Blink your eyes, one at a time, while looking at the pencil. How does the image of the pencil change when you do this?

4. As you moved the pencil closer, what observations were you able to make about the size of the shift of the pencil image?

5. As the distance from your eyes to the pencil increases, what do you think would happen to the size of the shift of the pencil image?

6. What vocabulary term could be used to describe this shifting?

Name Date

Extension Activity
Section 11.3

Use with textbook pages 396–397.

How big is space?

Vocabulary	
Mount Robson	human
distance from Earth to Proxima Centauri	the Moon
Earth	observable universe
~~electron~~	single-cell organism
galaxy	solar system
gray whale	the Sun

Which is bigger, Earth or an asteroid? Think about the relative size of each of the things in the vocabulary box. Figure out their order from smallest to largest. Then list them from the smallest objects (1) to the largest (12). The smallest one has been done for you.

1. electron
2. ____________________
3. ____________________
4. ____________________
5. ____________________
6. ____________________
7. ____________________
8. ____________________
9. ____________________
10. ____________________
11. ____________________
12. ____________________

Use with textbook pages 396–401.

Measuring distances in space

Match each Term on the left with the best Descriptor on the right. Each Descriptor may be used only once.	
Term	**Descriptor**
1. ______ light-year **2.** ______ parallax **3.** ______ triangulation	**A.** the apparent shift of an object against a stationary background by the change in position of the observer **B.** a technique for determining the distance to a visible object by creating an imaginary triangle between the observer and the object and then calculating the distance **C.** a measurement equal to the average distance from the Sun and Earth **D.** the distance that light travels in a year

Circle the letter of the best answer.

4. What does a light-year measure?

A. time
B. distance
C. velocity
D. diameter

5. What is the speed that light travels at?

A. 300 km/s
B. 3000 km/s
C. 30 000 km/s
D. 300 000 km/s

6. Ancient astronomers calculated distances using

A. triangulation and geometry
B. triangulation and parallax
C. geometry and probability
D. parallax and estimation

7. When observing a stationary object against a background, if you blink your eyes, one at a time, the object will appear to

A. stay in one place
B. disappear
C. shift position
D. rotate

8. The principle demonstrated in question 7 is known as

A. triangulation
B. geometry
C. Newton's law
D. parallax

9. Approximately how long does it take light from the Sun to reach Earth?

A. 8 s
B. 8 min
C. 8 h
D. 8 light-years

10. What is the longest possible baseline for measuring distances from Earth to stars?

A. the distance from Earth to the Sun
B. the distance from Earth to the Moon
C. the diameter of Earth
D. the diameter of Earth's orbit