# Activily 8: Objects and Waves with Changing Speeds 

Name
Date
Class

## Key Question

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$\qquad$

## Learning the Ideas

## Calculating the Average Speed of an Object Not Moving at a Constant Speed

1. For the $10-\mathrm{s}$ simulation run, how do the average speeds of the three cars compare? Explain your answer. Hint: You don't need to do any calculations to answer this question.
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$\qquad$
2. Pick one of the three cars and calculate its average speed.

Calculate the average speeds in the examples below. In each case, you only need to know the total distance traveled and the time elapsed to answer the question.
3. Alex's family travels 200 mi . by car to reach their favorite camping spot. Alex's mother is driving and repeatedly has to change the car's speed to adjust to the changing flow of traffic. The entire trip takes four hours. What is the average speed of the family's car? Give an answer in miles per hour (mph).
4. Sofia is driving her car and needs to enter freeway traffic from an on-ramp. In five seconds and over a distance of 100 m , she speeds up from $13.0 \mathrm{~m} / \mathrm{s}$ to $30.0 \mathrm{~m} / \mathrm{s}$. What is her average speed?
5. Richard is scuba diving in the Pacific Ocean 20 m below the surface when he hears the roars of two low-flying military jets passing overhead, 100 m above the surface of the ocean. The speed of sound in air is $332 \mathrm{~m} / \mathrm{s}$ and in seawater, it is $1535 \mathrm{~m} / \mathrm{s}$. The sound waves from the jets take 0.30 s to reach Richard's ears. What is the average speed of the sound waves?
6. A seismograph detects $P$ waves from an earthquake that originates in the upper mantle 73 km directly below the seismograph.
Because the P waves move through different types of rock, their speed is different in each layer depicted in the picture. It is $8.0 \mathrm{~km} / \mathrm{s}$ in the upper mantle, $7.0 \mathrm{~km} / \mathrm{s}$ in the lower crust, and $6.0 \mathrm{~km} / \mathrm{s}$ in the upper crust. The P waves take 10 s to reach the seismograph. What is the average speed of the $P$ waves?


Distance versus Time and Speed versus Time Graphs

7. Complete the following statement:

The distance that the car travels $\qquad$ (increases, decreases, remains the same) as time increases.
8. Complete the following.

The speed of the car $\qquad$ (increases, decreases, remains the same) as time increases.

## Average Speed when Direction of Motion Changes

To find the average speed for situations in which an object's direction changes, you need to use the total distance traveled:

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\text { Average speed }=\frac{\text { Total distance traveled }}{\text { Time elapsed }}=\frac{\text { Total distance }}{\text { Time }}
$$

9. Suppose that starting from home, Alex travels along the road 9 mi. east (to the right). He then turns around and, rather than going back home, he rides to City Hall which is 3 mi . west (to the left) of his home. His total travel time is 3 h . What is his average speed?

## What We Have Learned

Remember the key question for this activity:

## How do you determine a speed for an object whose speed changes with time?

Answer the key question.

