Motion Review

Motion

1. The velocity of an object is the rate of change of its position. As a basis for understanding this concept:
   a. *Students know* position is defined in relation to some choice of a standard reference point and a set of reference directions.
   b. *Students know* that average speed is the total distance traveled divided by the total time elapsed and that the speed of an object along the path traveled can vary.
   c. *Students know* how to solve problems involving distance, time, and average speed.
   d. *Students know* the velocity of an object must be described by specifying both the direction and the speed of the object.
   e. *Students know* changes in velocity may be due to changes in speed, direction, or both.
   f. *Students know* how to interpret graphs of position versus time and graphs of speed versus time for motion in a single direction.

Notes

Read the following section highlights. Then, in your own words, write the highlights in your ScienceLog.

- An object is in motion if it changes position over time when compared with a reference point.
- The speed of a moving object depends on the distance traveled by the object and the time taken to travel that distance.
- Speed and velocity are not the same thing. Velocity is speed in a given direction.
- Acceleration is the rate at which velocity changes.
- An object can accelerate by changing speed, changing direction, or both.
- Acceleration is calculated by subtracting starting velocity from final velocity, then dividing by the time required to change velocity.

	Speed	Velocity	Acceleration
Explanation in your own words:			
Equation			

How do you know when something is in motion?

How does average speed differ from speed?

Solving *Speed* Problems

Example: What is the speed of a cheetah that travels 112.0 meters in 4.0 seconds?

Looking for: Speed of cheetah	**Solution**
Given: Distance = 112.0 meters Time = 4.0 seconds	$\text{speed} = \frac{d}{t} = \frac{112.0\ \text{m}}{4.0\ \text{s}} = \frac{28\ \text{m}}{\text{s}}$ The speed of the cheetah is 28 meters per second.
Relationship: $\text{speed} = \frac{d}{t}$	

You Try It!

1. A bicyclist travels 60.0 kilometers in 3.5 hours. What is the cyclist's average speed?

Looking for	**Solution**
Given	
Relationships	

2. What is the average speed of a car that traveled 300.0 miles in 5.5 hours?

3. How much time would it take for the sound of thunder to travel 1,500 meters if sound travels at a speed of 330 m/s?

4. Suppose you are walking home after school. The distance from school to your home is five kilometers. On foot, you can get home in 25 minutes. However, if you rode a bicycle, you could get home in 10 minutes.

   a. What is your average speed while walking?

   b. What is your average speed while bicycling?

   c. How much faster you travel on your bicycle?

Solving *Velocity* Problems

Remember: The velocity of an object is determined by measuring both the *speed* and *direction* in which an object is traveling.

- If the **speed** of an object changes, then its **velocity** also changes.
- If the **direction** in which an object is traveling changes, then its **velocity** changes.
- **A change in either speed, direction, or both causes a change in velocity.**

You can use ***v = d/t*** to solve velocity problems. **The velocity of an object in motion is equal to the distance it travels per unit of time in a given direction.**

Example 1: What is the velocity of a car that travels 100.0 meters, northeast in 4.65 seconds?

Looking for: Velocity of the car.	**Solution** $\text{velocity} = \frac{d}{t} = \frac{100.0\ \text{m}}{4.65\ \text{s}} = \frac{21.5\ \text{m}}{\text{s}}$ The velocity of the car is 21.5 meters per second, northeast.
Given: Distance = 100.0 meters Time = 4.65 seconds	
Relationship: $\text{velocity} = \frac{d}{t}$	

You Try It!

1. An airplane flies 525 kilometers north in 1.25 hours. What is the airplane's velocity?

Looking for	**Solution**
Given	
Relationship	

2. A soccer player kicks a ball 6.5 meters. How much time is needed for the ball to travel this distance if its velocity is 22 meters per second, south?

3. A bus is traveling at 79.7 kilometers per hour east, how far does the bus travel 1.45 hours?

4. A girl scout troop hiked 5.8 kilometers southeast in 1.5 hours. What was the troop's velocity?

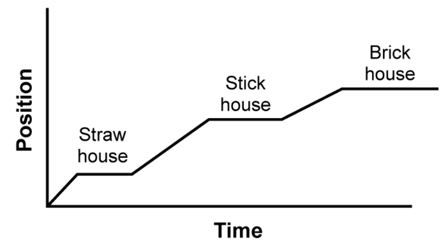
Graphing Motion

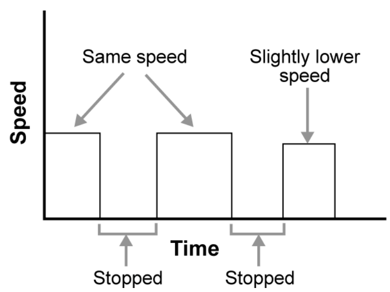
Position-time graphs

The graph at right represents the story of "The Three Little Pigs." The parts of the story are listed below.

- The wolf started from his house. The graph starts at the origin.
- Traveled to the straw house. The line moves upward.
- Stayed to blow it down and eat dinner. The line is flat because position is not changing.
- Traveled to the stick house. The line moves upward again.
- Again stayed, blew it down, and ate seconds. The line is flat.
- Traveled to the brick house. The line moves upward.
- Died in the stew pot at the brick house. The line is flat.

Position-time graph of the wolf in ***The Three Little Pigs***



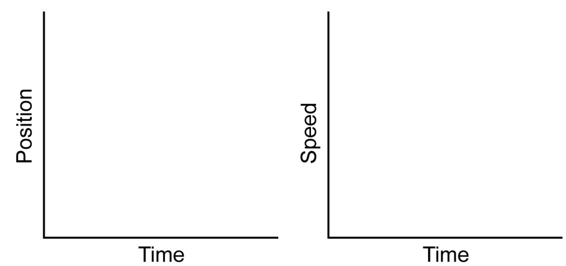


Speed-time graphs

A speed-time graph displays the speed of an object over time and is based on position-time data. Speed is the relationship between distance (position) and time, $v = d/t$. For the first part of the wolf's trip in the position versus time graph, the line rises steadily. This means the speed for this first leg is constant. If the wolf traveled this first leg faster, the slope of the line would be steeper. The wolf moved at the same speed toward his first two "visits." His third trip was slightly slower. Except for this slight difference, the wolf was either at one speed or stopped (shown by a flat line in the speed versus time graph).

You Try It!

1. Read the steps for each story. Sketch a position-time graph and a speed-time graph for each story on a **separate piece of paper.**
   - Graph Red Riding Hood's movements according to the following events listed in the order they occurred:
   - Little Red Riding Hood set out for Grandmother's cottage at a good walking pace.
   - She stopped briefly to talk to the wolf.
   - She walked a bit slower because they were talking as they walked to the wild flowers.
   - She stopped to pick flowers for quite a while.
   - Realizing she was late, Red Riding Hood ran the rest of the way to Grandmother's cottage.



2. Graph the movements of the Tortoise and the Hare. Use two lines to show the movements of each animal on each graph. The movements of each animal is listed in the order they occurred.
   - The tortoise and the hare began their race from the combined start-finish line. By the end of the race, the two will be at the same position at which they started.
   - Quickly outdistancing the tortoise, the hare ran off at a moderate speed.
   - The tortoise took off at a slow but steady speed.
   - The hare, with an enormous lead, stopped for a short nap.
   - With a startle, the hare awoke and realized that he had been sleeping for a long time.
   - The hare raced off toward the finish at top speed.
   - Before the hare could catch up, the tortoise's steady pace won the race with an hour to spare.

4. A story told from a graph: Tim, a student at Cumberland Junior High, was determined to ask Caroline for a movie date. Use these graphs of his movements from his house to Caroline's to write the story.