Michigan Curriculum Framework for Science Content

Strand IV. Using Scientific Knowledge in Physical Science

Standard IV.3—Motion of Objects
All students will describe how things around us move and explain why things move as they do; demonstrate and explain how we control the motions of objects; and relate motion to energy and energy conversions.

Benchmark 1
Describe or compare motions of common objects in terms of speed and direction.

Vocabulary
rate—amount of change in one unit of time (Science Explorer)

speed— the time rate of change of position of a body without regard to direction; Speed = Distance/Time (Academic Press)

velocity—the time rate of change of position of a body *in a particular direction* (Academic Press)

average speed—the total distance traveled divided by the total time taken to travel that distance (Academic Press)

reference point—place or object used for comparison to determine motion or to measure distance, time or speed (Science Explorer); an indicator that orients you generally (Academic Press)

Materials
- Wind-up toys (anything with wheels that winds up and moves straight)
- Measuring Tape
- Masking tape
- Paper compass rose
- Stop watch
- Conversion chart (attached)
- Vocabulary words written on index cards (additional definition card attached)
- Data worksheet (attached)

Activity

Context: Small group (6 students max)

1. Discuss vocabulary words. Ensure broad understanding of definitions.
2. Assign roles to each member: Toy Winder, Data Recorder, Toy Stopper, Timer, and at least two Mathematicians.
3. Measure a distance of 2 feet and a distance of 4 feet on a clear table and tape them off as racetracks.
4. Place compass rose on table beside tracks in any direction.
5. Team will wind one toy, time how long it takes to pass from start to finish and record the results for each track.
6. Point out the vocabulary words and emphasize how they are related to the experiment. Use questions to have the group make these connections.
7. Repeat timing with other toy on both tracks and record data.
8. Have team return to the vocabulary definitions and complete the attached worksheet.

How fast did toy #1 travel two feet? (feet per second, f.p.s.)	
How fast did toy #1 travel four feet? (feet per second, f.p.s.)	
What was the average speed of toy #2? (feet per second, f.p.s.)	
What was the average speed of toy #1 and toy #2? (feet per second, f.p.s.)	
What was the velocity of toy #1 traveling four feet?	
How could you change the velocity of the toys?	
How many miles per hour (m.p.h.) did toy #1 travel?	

1 hour	**=**	**60 minutes**
1 minute	**=**	**60 seconds**
1 mile	**=**	**5280 feet**

Assessment/Key Concepts

1. How is a reference point used to measure speed?
   To measure speed, you must have a fixed distance that will be traveled. Two reference points must be used as the beginning and end of this distance. By dividing the fixed distance by the time it takes to travel that distance, you can determine the speed of travel.

2. If your car speedometer is broken, how could you measure your speed?
   Most highways have mile markers (they're those little square green signs with a number on them.) Per their name, these signs are posted in one-mile increments so you can use two consecutive signs as reference points. Divide the distance between them (1 mile) by the time it takes to drive between them and you'll get your speed!

   If there aren't mile markers or you just want to see if they're posted exactly a mile apart, you can watch your odometer and time how long it takes you to drive a mile according to that. Do the same equation and you can measure your speed.

3. Give an example of when velocity is more critical than speed.
   Since velocity is simply speed in a given direction, it is critical for a weatherman to know which direction storms are moving. If a terrible snowstorm is moving at east at 35 m.p.h. it is critical for anyone east of the storm to take cover, but people who live west of the storm are probably not in danger. Likewise, an air traffic controller must consider velocity for every flight that s/he directs. If a plane is coming in from the North at 600 m.p.h. it could be a catastrophe for the plane in front of it that is coming in from the same direction at 250 m.p.h.!

4. Given four different speeds and distances, how do you determine an average speed? How do you determine an average velocity?
   To find the average speed of multiple speeds, you have to add all of the speeds together then divide that number by the sum of all the distances. It's the total speed divided by the total distance.

   Velocity is speed in a given direction. Speed can be averaged, but direction cannot. Therefore, you cannot have a true average velocity.

5. Speed is usually thought to mean rapid or quick. A clock has speed, however slow. How would you determine the speed at which the hour hand of a clock moves?
   Using a string, you can measure the circumference of the clock in inches. Divide the total distance by twelve (the number of hours that a clock is sectioned into) and you can tell how many inches the hand moves in one hour. You can then convert this number to feet or even miles!

References

Michigan Curriculum Framework Science Benchmarks. (June 2000 version).

Science Explorer: Motion, forces, & energy. (2002). New Jersey: Prentice-Hall

Moss, C. (Ed.). (1992). *Academic Press dictionary of science and technology*. San Diego: Academic Press