Speed

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Materials:
Calculator
Tape measure and timer (or a watch having a seconds hand)
Flashlight
Ball
White board or other writing surface

Key Words for use by children in discussion:
Speed, distance, time, feet per second, miles per hour, relative speed

1) Ask the children, "what is speed?" Discuss how speed refers to how fast something is moving and talk about slow and fast things.
2) Have two children hold the ends of a tape measure and another child operate the timer. Roll a ball along the floor and have the children measure the time it takes the ball to travel a certain distance. Have the child at the end of the ruler call out, "stop!", when the ball crosses the set distance. Ask the children, "how do we use these numbers to calculate speed? Do we add, subtract, multiply, divide?" Eventually conclude that Distance is divided by Time and draw the fraction on the board, with the units. Calculate the speed in feet per second.
3) Have a number of students repeat the operation and describe their methods utilizing Key Words.
4) Select a student and measure his/her speed. Lay the tape measure on the ground for as long a distance as possible and, with the assistance of different children, measure the distance the student walks and the time to walk this distance. Record the speed on the dry erase board. Calculate the speed in feet per second and convert it to miles per hour. Estimate the average speed and multiply by 0.6818 to convert to miles per hour. Discuss how this compares to the speed of a fast car traveling at 100 miles per hour on the highway.
5) Ask the children how old a baby driving a car spaceship that starts on earth, moving at 100 miles per hour, will be when it gets to the sun (about 110 years). Ask the class, "how long will light from the flashlight take to get from the earth to the sun?" (about 6 minutes). Ask the class, "what is the speed of light in miles per hour?" Eventually inform the class that the speed of light is 950 million miles per hour, and record this on the board.
6) Ask the students, "who thinks they are fast?" Line up the students and have them take turns racing light from the flashlight to a wall, allowing them to get as close to the wall as they want. Stand a distance from the wall pointing the flashlight at the wall, say "ready, set, go" and turn on the flashlight. Note how fast light is. Discuss the speed of the children, in miles per hour, compared to the speed of light.
7) Have two children stand side by side, with one holding the tape measure. Tell the children when you say "go" to both start walking at the same speed. Tell the one with the ruler to yell, "stop!", when the other child reaches the end of the tape. Of course the child never reaches the end. Encourage the children to note that when the moving child measures the distance moved by the other child it is zero, which would mean the speed was zero. Repeat with another pairs of students. Note that to those sitting down , the two were definitely moving and had some speed, but to the person moving at the same speed the child had speed 0.
8) Indicate that speed is always **relative** to something. Relative to the other person moving it is zero, but relative to the children at rest it is not zero. Have the children consider the speed of a person sitting in a car traveling at the same speed (50 miles per hour) next to their car on the highway. What will they measure for the speed of the person in the car next to them? And what does a man standing on the street measure?
9) Have one student pretend to have a booster rocket on their back, allowing them to travel, almost at the speed of light, and have another student stand still. When the moving child passes the stationary child, have the stationary child turn on the flashlight in the direction of the moving child and ask, "what will each person measure for the speed of light?" Go over the experiment with relative speed and come to the conclusion that it should be zero for the child with the booster. Then explain that for everything else, like people, cars, and airplanes, that is true but for light it is not. No matter how fast you run next to a light beam, light always moves at the same speed relative to you. Encourage the children to comment on the implications of this property.
10) Provide challenge questions for relative speed, asking the students how they arrived at their answers:

- Car moving at 10 miles per hour, observer moving at 10 miles per hour in the same direction
- Light moving at 950 million miles per hour, observer moving at 950 million miles per hour in same direction
- Car moving at 10 miles per hour, scientist moving at 0 miles per hour.

Speed lesson highlights checklist

- ☐ Discuss the meaning of speed
- ☐ Measure rolling ball's speed in feet/sec
- ☐ Measure walking student's speed in feet/sec and miles/hour
- ☐ Compare time to sun for baby in a car spaceship and light
- ☐ Kids race light
- ☐ Relative speed
- ☐ Special relativity: Student moving next to light
- ☐ Relative speed challenge questions