# 4.1 Motion

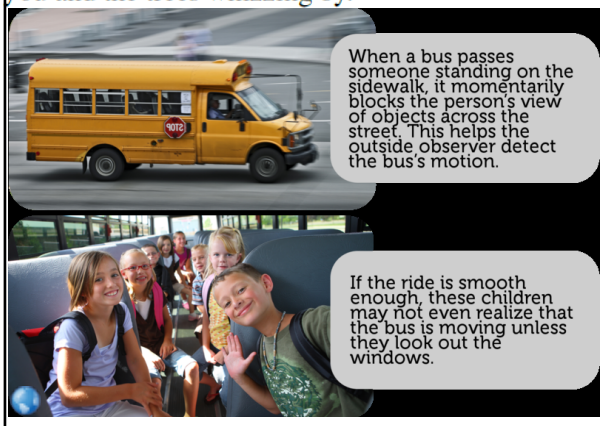
- Define motion.
- Explain how frame of reference is related to motion.

## Defining Motion

In science, **motion** is defined as a change in position. An object's position is its location.

## Frame of Reference

There's more to motion than objects simply changing position. You'll see why when you consider the following example. Assume that the school bus pictured in the **Figure** 4.2 passes by you as you stand on the sidewalk. It's obvious to you that the bus is moving, but what about to the children inside the bus? The bus isn't moving relative to them, and if they look at the other children sitting on the bus, they won't appear to be moving either. If the ride is really smooth, the children may only be able to tell that the bus is moving by looking out the window and seeing you and the trees whizzing by.




## Summary

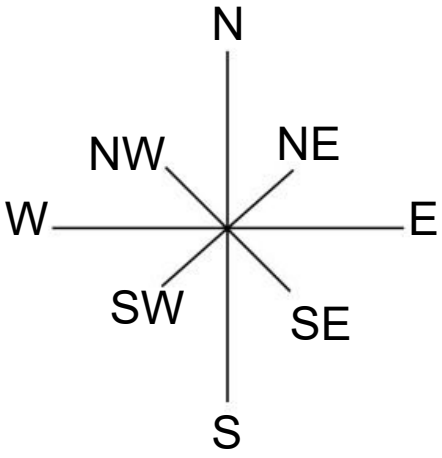
- Motion is defined as a change of position.
- How we perceive motion depends on our frame of reference. Frame of reference refers to something that is not moving with respect to an observer that can be used to detect motion.

## Vocabulary

- **frame of reference**: Something that is not moving with respect to an observer that can be used to detect motion.
- **motion**: Change in position.

# Frame of Reference

Can be thought of as any spot your doing your measurement from as long as it is not accelerating. This is called an inertial frame of reference. How you perceive movement may be perceived differently by another person. This is totally dependent upon our frame of reference.




moving up (north) or right (east) represents moving in the positive direction (+)

moving down (south) or left (west) represents moving in the negative direction (-)

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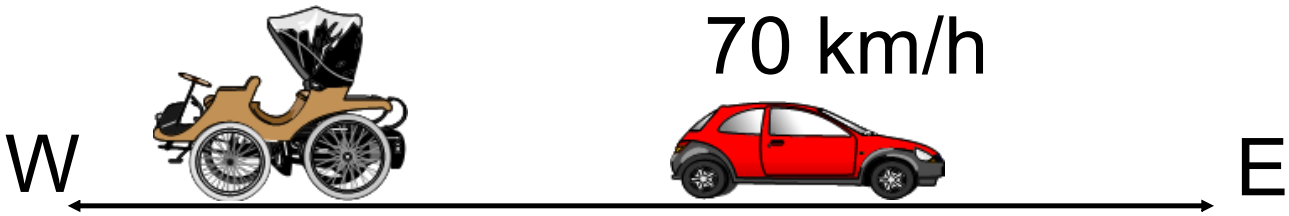
# Frame of Reference Practice

Suppose you are in a car traveling 70 km/h East; the velocities listed below are relative to an observer watching traffic from the road. Relative to you in the car, what is the velocity of the cars in the following situations:

1. A car in front of you traveling 70 km/h [E]. 0 km/s
2. A car behind you is driving 40 km/h [E]. 30 km/h [W]
3. A car approaches driving 60 km/h [W]. 130 km/h [W]

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# Types of Measurement Quantities: Scalar and Vector

You are already familiar with them from your everyday lives, you are just missing the terminology. In pairs, which of the following would you say in a conversation:

1. It will take you 3 hours to drive to Fredericton. ✓
2. My speed is 65 km/h. ✓
3. The mass of the car is 125 kg north. ✗
4. The movie starts at 2:30 pm west. ✗
5. The velocity of the plane is 200 m/s east. ✓
6. Gravity pulls me down with 195 lbs of force. ✓
7. The flight lasts 7 hours [E25°S]. ✗
8. Today I drove 50 km. ✓
9. Today I drove 50 km south. ✓

- **Scalars** are measurements that are independent of direction.
- Time
- Mass
- Distance
- Speed
- **Vectors** are measurements that require a direction (it is relative to a coordinate system within a frame of reference).
- Position
- Displacement
- Velocity
- Acceleration
- Force

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## Important Examples of the Differences Between Scalars and Vectors (measurements or calculations).

**Scalar**

1. Walked 25 m. distance
2. Drove 62 km. distance
3. Flew 150 m/s. speed
4. Ran 15 km/h. speed

**Vectors**

1. Walked 25 m [E]. displacement
2. Drove 62 km [N]. displacement
3. Flew 150 m/s [W]. velocity
4. Ran 15 km/h [S]. velocity

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