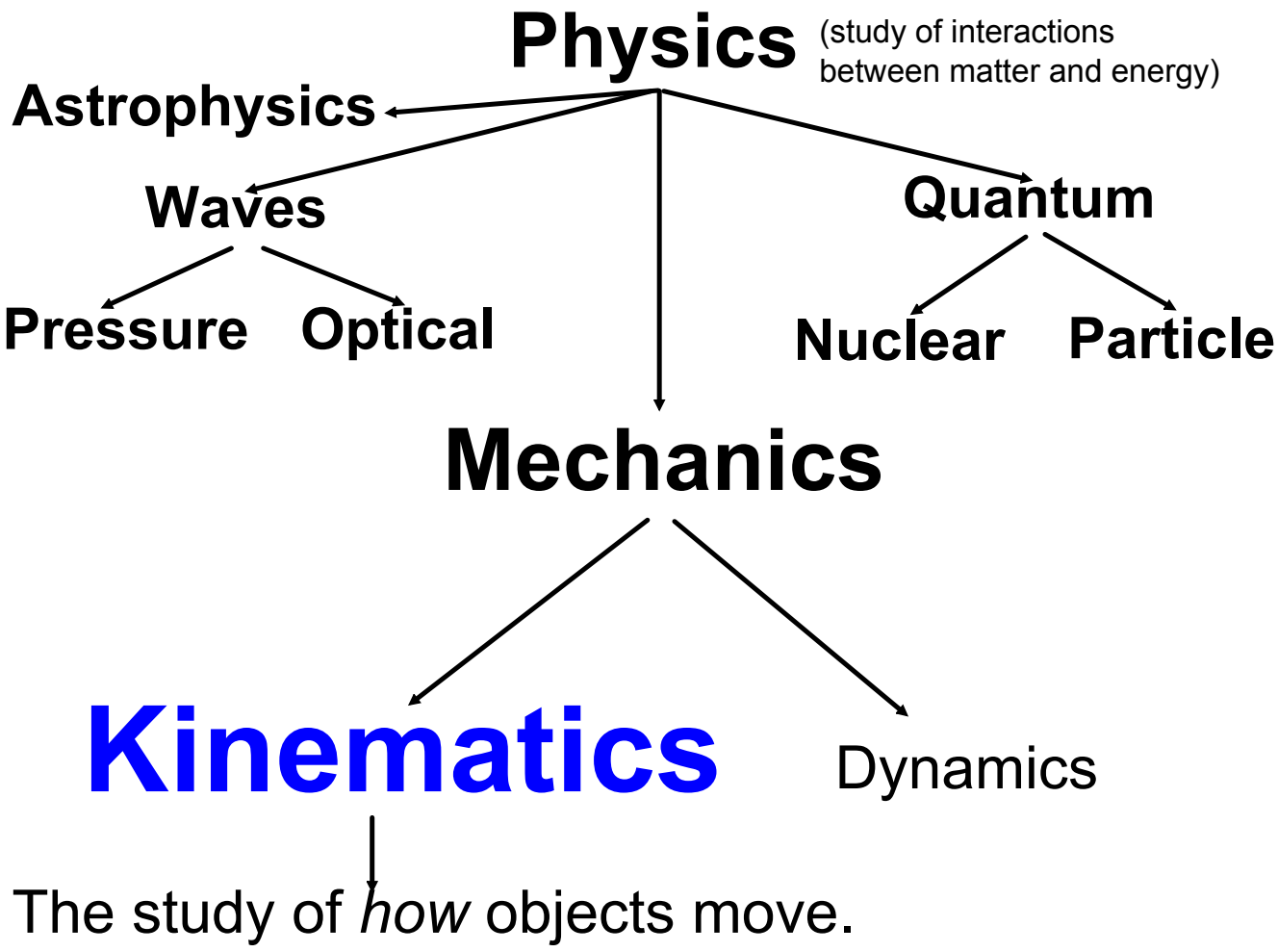


The study of *how* objects move.

Motion Project

- Slow motion video analysis
- Edgertronic Camera
- More info to follow.

How fast am I moving?

4.1 Motion

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

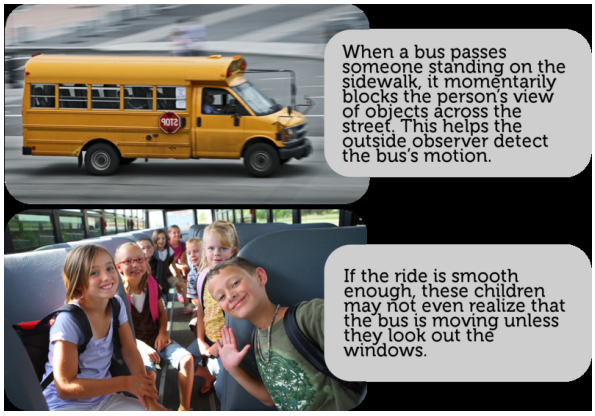
Defining Motion

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

Frame of Reference

Example with object in room and hot wheels®

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.

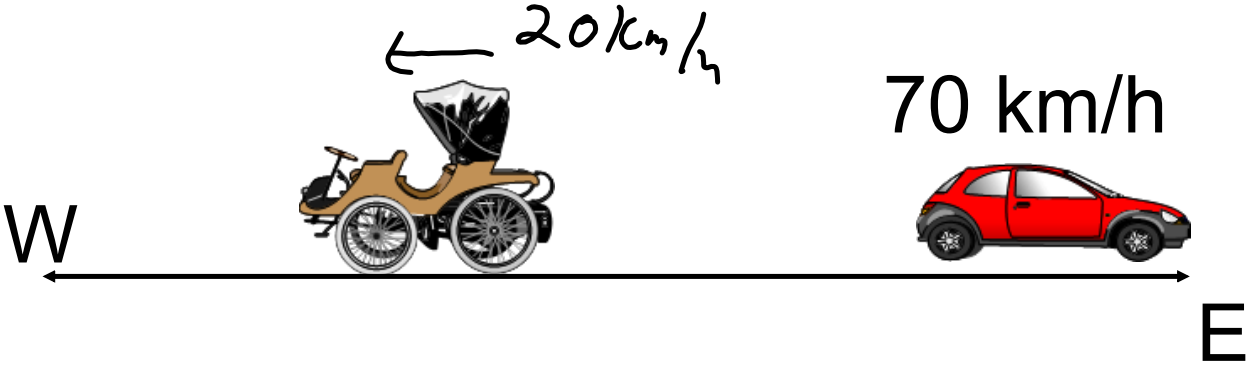
Choice of frame of reference is very important. A different frame of reference will yield different measurements!

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.

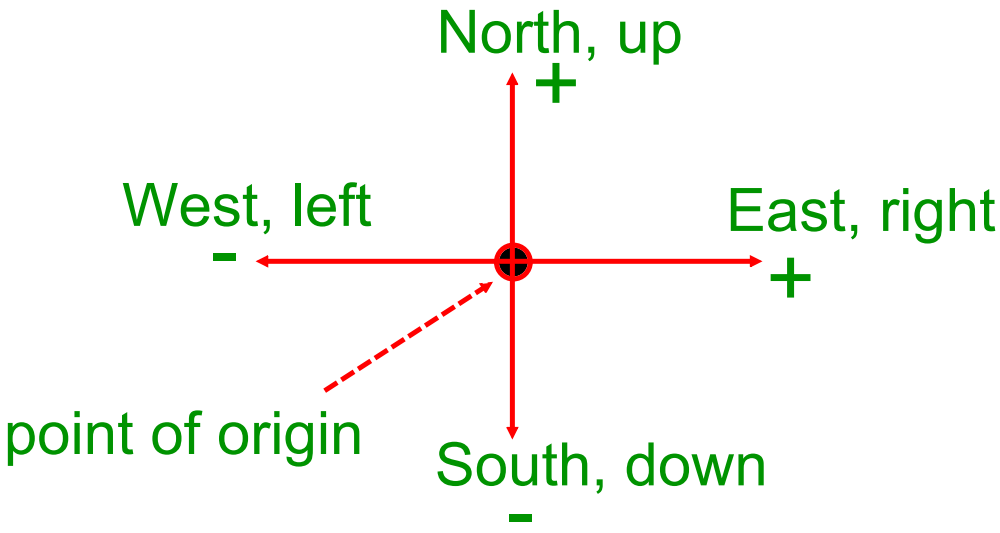
Suppose you are in a car traveling 70 km/h East; the velocities list below are relative to an observer watching traffic from the road. Relative to you in the car, what is the velocity of the cars in the following situations:

1. A car in front of you traveling 70 km/h [E].
2. A car behind you is driving 40 km/h [E].
3. A car approaches driving 60 km/h [W].
4. A car driving away at 20 km/h [W].



Coordinate System

In physics all measurements must be made relative to a point of origin. From that we apply the frame of reference to be able to do calculations.



Calculations can only happen if all quantities are measured relative to the same direction. This is very similar to adding numbers with the same units.

If you travel 20 m [E] and then 20 m [W] your final position is zero - which you can only calculate if one of the measurements is negative.

In physics, a negative quantity communicates its direction.

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. X ?!?
4. The movie starts at 2:30 pm west. X
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]. X
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

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

Key Motion Terms

Use the glossary to find the definitions of the following:

Position; Distance, Displacement, Speed, Velocity, Acceleration & Time.