



VIII.B. An object's mass is an inherent property. The mass of an object is a measure of the amount of material comprising it.

VIII. The rate of change in an object's motion is proportional to the size of the net force acting on it and inversely proportional to the object's mass.

- VIII. A. A non-zero net (unbalanced) force on an object changes the object's motion; that is, the object's speed and/or direction of motion changes.
 - VIII.A.1. A net force acting in the opposite direction as an object's motion will cause its speed to decrease.
 - VIII.A.2. A net force acting in the same direction as an object's motion will cause its speed to increase.

VII. A zero net (balanced) force does not change an object's motion.

- VII.A. Supporting objects, such as hands, tables, and shelves, exert upward forces on objects on top of them. These supporting forces exactly balance the downward pull of gravity and so these objects do not fall.
- VII.B. When an object does not move in response to a push or pull, it is because another push or pull is being applied by the environment.
- VII.C. When equal strength forces act on an object in opposite directions, they cancel each other out.

IV. The motion of an object can be changed by pushing or pulling.

- IV.A. Pushes or pulls can cause an object to start moving, or move faster.
- IV.B. Pushes or pulls can cause an object to stop moving, or move slower.
- IV.C. Pushes or pulls can change the direction of an object's motion.

III. A change in the motion of an object is a change in its speed or its direction or both.

- III.A. Changes in motion can vary in size and rate.
- III.B. The rate in change of an object's motion is acceleration.

VI. Forces can be added. The net force on an object is the sum of all the forces acting on the object.

- VI.A. There may be more than one force acting on an object at the same time.

II. An object is in motion when its position is changing

- II.A. An object's motion can be described by its speed and the direction in which it is moving.
 - II.A.1. The motion of an object can be represented using graphs of its position versus time and speed versus time.
 - II.A.2. The speed of an object is defined by how far it travels divided by the amount of time it took to travel that far.
 - II.A.2.a. The distance an object travels is the length of the actual path it takes from its starting position to its ending position.
 - II.A.2.b. Dividing the distance traveled by the time taken gives the average speed of an object, as opposed to the speed at a particular instant.
 - II.A.2.a.i. Objects may travel different distances between the same starting and ending points.
 - II.A.3. The velocity of an object is defined by its displacement divided by the amount of time required for that displacement.
 - II.A.3.a. Displacement is a straight-line measure of the difference between an object's starting and ending position.
- II.B. The description of an object's motion from one observer's view may be different from that reported from a different observer's view.
 - II.B.1. An observer's description of motion depends on the reference point chosen.
 - II.B.2. Two observers may be at different positions and/or moving relative to each other.

V. A force is a push or pull exerted on one object by another object when they interact with one another.

- V.A. Forces can vary in strength.
- V.B. Forces have direction.
- V.C. Forces are interactions. A force on an object implies that it is interacting with something else.
 - V.C.1. Some forces between objects act when the objects are in direct contact; others act when objects are not touching.
- V.D. The force of friction acts to oppose the relative motion of two objects in contact.
- V.E. Earth pulls down on all objects with a force called gravity.

I. An object's position can be described by locating the object relative to other objects or a background.

- I.A. To locate one object relative to another (reference) object, one must give the distance between them.
- I.B. One must specify the direction from the reference to the object. The direction may be given in the form of a compass heading or other terms such as up/down, left/right, forward/backward.

Key

- Student Idea from Current NC SCOS
- Student Idea from Extended Content Standards
- Teacher Idea

UP arrow: Indicates the idea FROM which arrow is pointing is pre-requisite for the idea TO which arrow is pointing.

DOWN arrow: Indicates the idea TO which arrow is pointing is a sub-idea, example, or elaboration of the idea FROM which arrow is pointing.

Dashed Line: Indicates that ideas are associated or related to one another, but not pre-requisite or elaborative.