Supporting Document for Curriculum Guide
1st Quarter
The first quarter is filled with material that students have already learned in the 8th grade. The instruction may go faster than implied on the pacing guide. However, there was no time built in for normal 1st week orientation so everything may balance out. Students struggled with the one-dimensional kinematics in 8th grade, so this may take additional time.
PSCI.PS2.1
1. speed formula: s=d/t
2. Speed is simply the distance an object travels over a specified time frame. There are different types of speed that can be calculate such as instantaneous speed or average speed. Velocity is speed with direction. Velocity can be changed without changing speed by a force causing the object to change direction.
3. Force is required to change the motion of an object.
4. There are three one dimensional kinematics addressed in this standard: position v time, distance v time, and velocity v time. The ability to convert between the graphs illustrates the relationship among the factors that make up each kinematic.

PSCI.PS2.2
1. Selecting appropriate units of measurement relates to the scale of the system being represented. The movement of small insects may be measured in centimeters per second, whereas a jet's flight would be more appropriately measured in kilometers per hour.
2. Imperial or metric units can be used depending on the situation being represented.
3. $V=d/t$, $a=(v_f - v_i)/t$

*DOK 4 learning outcome is an extension of the requirements sought by the standard and not required. Performing multistep problems from situational phenomena requires extended thinking and multiple skills to find a solution.

PSCI.PS2.3
1. The length of an arrow represents the magnitude of the force and the direction of the arrow represents the direction of the force.
2. types of forces:
    a. applied force: F_{app}
       force applied from an outside person or object
    b. gravity force: F_{grav}
       force of attraction between two masses
    c. normal force: F_{norm}
       force exerted upon an object when in contact with a stable object (i.e. book on table)
    d. friction force: F_{frict}
       force exerted by a surface that usually opposes the motion of the object (sliding and static)
    e. air resistance force: F_{air}
       type of friction that is exerted on an object traveling through the air

   f. tension force: F_{tens}
      force transmitted through a string, rope, or cable on when it is pulled tight by forces acting in opposite directions
   g. spring force: F_{spring}
      force induced on a spring as it compresses or stretches when an object is attached to it in an effort to get to its resting position
3. The acceleration of gravity is 9.8m/s^2 at sea level. The force of gravity is dependent on the mass of the object that it is attracting. Greater force is applied to an object with greater mass to achieve the same acceleration.
4. Free-body diagrams are used by engineers as they design various objects that will be put into motion. They do this in order to anticipate and calculate forces acting on the object to ensure that it can withstand stresses and have enough power to perform their function.

*DOK 3 learning outcome is meant to extend the use of free-body diagrams to PSCI.PS2.4 and PSCI.PS2.6. The idea behind free-body diagrams is to visualize all the forces and thus perform accurate calculations.

PSCI.PS2.4

1. force formula: F=ma, the unit for force is newtons (kg x m/s^2)
2. Newton's 1st Law (law of inertia):
   An object remains at rest or in uniform motion in a straight line unless acted upon by an outside force.
3. Newton's 2nd Law (F=ma):
   The acceleration of an object as produced by a net force is directly proportional to the magnitude of the net force and inversely proportional to the mass of the object.
4. Newton's 3rd Law:
   For every action, there is an opposite and equal reaction.

PSCI.PS2.5

1. Momentum formula: p=mv, the unit is kg x m/s
2. Calculating momentum in elastic collisions requires multi-step work and perseverance. For example, a student may be given the initial velocity and mass of one ball before colliding with another. Then the velocities of both balls are given after the collision. With that information, students could solve the mass of the second ball if the momentum of the 1st ball is solved for before the collision, the momentum of the 1st ball after the collision, subtract to find momentum transferred to the 2nd ball, and then plug the momentum and velocity to find the mass of the 2nd ball.
3. The Law of Conservation of Momentum seems to have flaws in the everyday world. An object in motion will stop moving if additional force is not applied, and two objects that collide will not continue indefinitely in opposite directions. Students should be able to identify friction forces as the cause of these "losses" of momentum. However, by taking measurements of momentum of an object in motion and calculating the deceleration of that object, students can calculate the actual force of friction on the object. They can

find the friction forces of various surfaces. This also ties into the Law of Conservation of Energy.

PSCI.PS2.6

1. This is all about application of Newton's Laws addressed in the previous 5 standards.

PSCI.PS2.7

1. Electricity produces a magnetic field. Placing a compass next to a current bearing wire will deflect towards the wire. Changing the direction of the current will cause the compass to change directions as well.
2. An electromagnet is created by wrapping conductive wire (usually copper) with an electric current around a metal rod (usually iron). Students should develop this through experimenting with various materials and without specific directions.
3. Properties of the Materials in an Electromagnet
    a. Conductive wire: electrons in metals are able to move between atoms (this is why they are shiny), an electric current can move through the wire because the electrons are able to flow between atoms in the wire
    b. Metal rod: atoms inside the metal rod have north and south domains that are randomly arranged; when a magnetic field is introduced near a metal, the domains align and the magnetic field of the electric current is magnified; when the magnetic field is removed the domains return to their previous position (depending on metal used)
    c. Electricity: electricity produces a magnetic field which aligns the domains of metal
4. Ways to change the strength of the magnetic field of an electromagnet include: altering the amount of electricity moving through wire, varying the number of coils in the wire, and changing the type of material of the rod or the thickness of the rod (or removing the metal altogether).
5. When designing an electromagnet, the easiest way to manipulate the strength is to change the number of loops. However, students need to also learn that the amount of electricity and the rod material has an impact on the strength.

* Caution: The batteries will overheat and explode. Use goggles. Also, by requiring students to use their bare hands in connecting the wire, the students will notice when the wire and battery get too hot and break the circuit and limit the likelihood that the battery explodes. Batteries also lose their strength very quickly when creating electromagnets.