## Physical Science Chapter 10 Study Guide

Motion and Forces

1. Basics of Motion
   1. Physics—study of matter and energy and the interactions occurring between them
   2. History of physics
      1. Aristotle—ancient authority on science
      2. Galileo—discovered events that discredited Aristotle
      3. Newton—discovered laws of gravitation and laws of motion
      4. Two divisions of physics
         1. Classical physics—motion, mechanics, thermodynamics, optics, magnetism, acoustics
         2. Modern physics—quantum mechanics, relativity, particle physics
   3. Scalar vs. vector
      1. Scalar—a magnitude
      2. Vector—a magnitude and a direction
   4. Distance vs. displacement
      1. Distance-a scalar quantity—total length of a an object’s path
      2. Displacement-a vector quantity—an object’s change in position
         1. Vector addition gives us a resultant which is equal to an object’s displacement
         2. The magnitude of perpendicular vectors can be found with the Pythagorean theorem
   5. Speed—the measure of how quickly an object moves—speed = distance/time
   6. Velocity—measure of speed and direction—velocity=displacement/time
   7. Acceleration—any change in velocity
2. Newton’s Laws of Motion—Newton presented his discoveries about motion in his book ***Principia***
   1. First law of motion—the velocity of an object does not change unless the object is acted upon by an external force; this could also be called the *law of inertia* since **inertia** is the tendency of matter to resist changes in motion
   2. Second law of motion—the force required to accelerate an object at a certain rate equals the object’s mass times the desired acceleration (force=mass x acceleration)
      1. The force applied to an object is directly proportional to its acceleration
      2. Force required to accelerate an object is directly proportional to its mass
      3. Newton (N)—the SI unit for force
      4. Statics—the branch of mechanics that study objects at rest
   3. Third law of motion—when an object exerts a force on a second object, the second object exerts an equal and opposite force on the first object
3. Forces in nature
   1. Gravity—any two objects attract each other through gravitational force. Write formula:
      1. Capital G represents the gravitational constant: (6.673 x 10-11 N\*m2/kg2  )
      2. The force of gravity is inversely proportional to the square of the distance between objects—(ie. Dividing the distance in half quadruples the attraction)
      3. Acceleration of gravity (g): 9.81 m/s2 – to find the speed of a falling object, just multiply the number of seconds it has been falling times 9.81

--formula for the relationship between distance and time for a falling object: d=1/2gt2

* + 1. Terminal velocity—the point at which a falling object ceases to accelerate as a result of drag
  1. Centripetal force—causes and object to travel in a curved path rather than in a straight line
  2. Centrifugal force—describes an orbiting object’s tendency to pull against its axis and fly out in a straight line
  3. Friction—the resistance arising to an object’s motion through a fluid or across a surface; caused by two other forces: 1) attraction 2)repulsion
     1. Kinetic friction—affects objects in motion
     2. Static friction—affects stationary objects

1. Work, Power, and Momentum
   1. Work—the transfer of energy from one object to another by a force (work requires movement)
      1. Joule—the unit of work
      2. Formula for work: work=force x distance (W=Fd)
   2. Power—the rate of doing work
      1. Watt—unit for power
      2. Formula for power: power=work/time (P=W/t)
   3. Momentum—the “quantity of motion”
      1. Kg\*m/s—units for momentum
      2. Formula for momentum: momentum= mass x velocity (p=mv)
      3. Law of conservation of momentum—momentum is never lost unless acted upon by an outside force
2. Simple Machines—basic devices that multiplied muscle power to do work
   1. Machine terminology
      1. Two forces involved in simple machines
         1. Input force (Fi)—the force applied to the machine
         2. Output force (Fo)—the amount of work obtained out of the machine
      2. Fi must equal Fo  (law of conservation of energy)
      3. Mechanical advantage (MA)—the number of times a machine multiplies the input power
         1. IMA (ideal mechanical advantage)—the MA in theory
         2. AMA (actual mechanical advantage—the actual output of a machine after factoring in friction
         3. Efficiency (η)—a measure of how well a machine converts input work to output work; the more efficient a machine the less energy it loses to friction or heat; efficiency is expressed as a percentage—the higher the percentage the more efficient the machine
      4. Types of simple machines
         1. Lever—consists of input arm, output arm, and fulcrum (the place where a lever pivots)
         2. Wheel and axle
         3. Pulley
            1. Fixed pulley—doesn’t change the force required to do the work
            2. Movable pulley—divides the force in half
            3. Block and Tackle—a series of pulleys that divide the force by the number of pulleys used in the block and tackle
         4. Inclined plane
         5. Wedge
         6. Screw (the **pitch** of the screw is the distance from one thread to the next)