# Bosma 9th Grade Science Midterm Study Guide

## Unit 1: Scientific Inquiry

**Science:**

- A system of knowledge and the methods used to acquire that knowledge
- Based on **empiricism**- a search for knowledge based on experimentation and observation

**Technology:**

- The use of scientific knowledge to solve practical problems to improve the lives of people

Science and technology are interdependent- advances in one lead to advances in the other.

**Scientific Process:**

1. **Observation**: Information gathered using the five senses- touch, taste, smell, sight, and hearing; there are two types of observations: **qualitative**- describes an object using the senses (ex. color) and **quantitative**- measures an object with a measuring tool (ex. length, mass)
2. **Hypothesis**: A possible explanation for a set of observations, often expressed as an "If…, then…" statements; can't be proven to be absolutely correct, but become stronger as more supporting data is collected
3. **Experiment**: The test of a hypothesis
4. **Theory**: The most logical explanation for events that occur in nature (ex. Einstein's Theory of Relativity); is never proved, but can be disproved, changed, replaced, or discarded
5. **Scientific law**: A rule of nature (ex. Newton's Laws of Motion); describes but does not explain a pattern in nature

**Scientific Skills:**

- **Inferences**
  - A logical conclusion based on observation
- **Predictions**
  - A forecast of what might happen in the future
  - Based on past observations or available data

**Variables:** Factors, conditions, or relationships that can change or be changed in an event

A good experiment has…

- An **independent variable**, also called the **manipulated variable**- the factor that is intentionally changed by the experimenter (MNEMONIC: *I* choose, *I* change, *I* control)
- A **dependent variable**, also called the **responding variable**- the factor that changes due to a change in the independent variable
- **Control variables**- factors that do not change during an experiment; if they change, the experiment becomes invalid

Unit 2: Graphing

**Line Graphs:** Used to graph **continuous** data- variables that are associated with a measurement involving a standard scale with equal intervals

- MNEMONIC
  **D**ependent
  **R**esponding
  **Y**-axis

  **M**anipulated
  **I**ndependent
  **X**-axis

**Bar Graphs:** Used to graph **discrete** or **categorical** data- variables that don't have intervals with meaning (ex. color, gender, days of the week)

**Predictions Based on Graphs:**

- **Interpolation:** A prediction of an unknown variable made between data points
- **Extrapolation:** A prediction of an unknown variable made outside or beyond the range of the known data points

The accuracies of these methods are better when the relationship between the two variables is linear.

Unit 3: Motion

**Frame of reference:** A system of objects that are not moving with respect to one another

**Relative motion:** Movement in relation to frame of reference

**Distance:** The length of a path between two points (d=st)

**Displacement:** Describes both distance and direction

**Vector:** A quantity that has both magnitude and direction

**Resultant vector:** The vector sum of two or more vectors

**Speed:** The ratio of the distance an object moves to the amount of time it moves (s=d/t) (measured in m/s) (represented by the slope of a line in a distance-time graph)

**Average speed:** Computed for the entire duration of a trip

**Instantaneous speed:** Measured at a particular instant; the rate at which an object is moving at a given moment in time

**Velocity:** A description of both speed and direction

**Acceleration:** The rate at which velocity changes (measured in $m/s^2$) ($a= (v_f+v_i)/t$)

**Instantaneous acceleration:** The measure of how fast a velocity is changing at a specific moment in time

**Free fall:** The movement of an object toward Earth solely because of gravity; objects in free fall accelerate constantly at $9.8m/s^2$

**Constant acceleration:** A steady change in velocity

Unit 4: Forces

**Force:** A push or a pull

**Newton:** A unit of force; 1N is equal to the amount of force necessary to accelerate a 1-kg mass at a rate of $1m/s^2$

**Net force:** The overall force acting on an object; all of the forces combined

**Friction:** A force that opposes the motion of objects that touch as they move past each other

4 types (in order of severity)

- **Static friction:** acts on unmoving objects to keep them stationary (prevents them from slipping)
- **Sliding friction:** opposed the direction of motion of an object as it slides over a surface
- **Rolling friction:** Friction that acts on a rolling object
- **Fluid friction:** Opposes the motion of an object in a liquid or gaseous environment
    - **Air resistance:** A special type of fluid friction; opposes gravity and reduces acceleration

**Gravity:** An attractive force that acts between any 2 masses, equal to $9.8m/s^2$

**Terminal velocity:** The constant velocity of a falling object when air resistance=gravity

**Projectile motion:** The motion of a falling object after it is given an initial forward velocity

**Inertia:** The tendency of an object to resist a change in velocity

**Mass:** The measure of inertia of an object; the amount of matter in an object

**Weight:** Mass adjusted for gravity

**Momentum:** The product of an object's mass and velocity

**Law of Conservation of Momentum:** If no net force acts on a system, then the total momentum of the system doesn't change

**Newton's Laws of Motion:**

1. **Law of Inertia:** An object at rest tends to stay at rest and an object in motion tends to stay in motion, unless acted on by an unbalanced force.
2. Force = mass x acceleration.
3. For every action, there is an equal and opposite reaction.

Unit 5: Energy

**Energy:** the ability to do work

When **work** is done on an object, energy is transferred to that object. (Work=fd, where f=force and d=stopping distance)

According to Einstein's theory, $e=mc^2$, energy and mass are equivalent and can be converted into one another. e=energy, m=mass and c=speed of light

The sun is the source of almost all of our energy, and the rest comes from the ground.

**Kinetic energy:** The energy of movement, dependent on mass and velocity ($KE=1/2mv^2$, where m=mass and v=velocity)

**Potential energy:** Energy stored as a result of position or shape

- **Gravitational potential energy:** Potential energy dependent on an object's height (GPE=mgh, where m=mass, $g=9.8m/s^2$, and h=height)
- **Elastic potential energy:** Potential energy of something that is compressed or stretched ($EPE=1/2kx^2$, where k=the amount of force needed to stretch it and x=the distance the spring stretches from equilibrium)
- **Chemical potential energy:** Potential energy found in chemical bonds
- **Electrical potential energy**

**Mechanical energy:** Energy associated with the motion and position of everyday objects; the sum of an object's kinetic and potential energy

**Thermal energy:** Total potential and kinetic energy of all the microscopic particles in an object; also known as heat energy

**Chemical energy:** Energy stored in chemical bonds

**Electrical energy:** Energy associated with electric charges

**Electromagnetic energy:** A form of energy that travels in waves

**Nuclear energy:** Energy stored in atomic nuclei

- **Nuclear fusion:** When two atoms combine
- **Nuclear fission:** When an atom splits

**Energy conversion:** Process of changing energy from one form to another

**Joule:** A unit of energy, equal to $1kg/m^2/s^2$

**Energy Resources:**

- **Nonrenewable resources:** Energy sources that exist in limited quantities and can't be replaced
    - **Fossil fuels:** Formed underground from the remains of once-living organisms; all contain carbon
        - Oil
        - Natural gas
        - Coal
    - **Uranium**
- **Renewable resources:** Resources that can be replaced in a relatively short period of time; will never run out
    - **Solar:** Sunlight converted into usable energy
        - **Active solar system:** Direct heating
        - **Passive solar system:** Indirect; heats buildings without the use of any machinery
        - **Photovoltaic solar system:** The use of solar cells to convert sunlight into electricity
    - **Hydroelectric:** Energy obtained from flowing water
    - **Wind:** Wind converted into usable energy
    - **Geothermal:** Thermal energy generated by the Earth's core; found beneath the Earth's surface

- **Biomass:** Chemical energy found in living things; created by burning organic material; the only renewable resource that pollutes

**Hydrogen fuel cell:** Generates electricity by reacting hydrogen with oxygen; has a byproduct of water

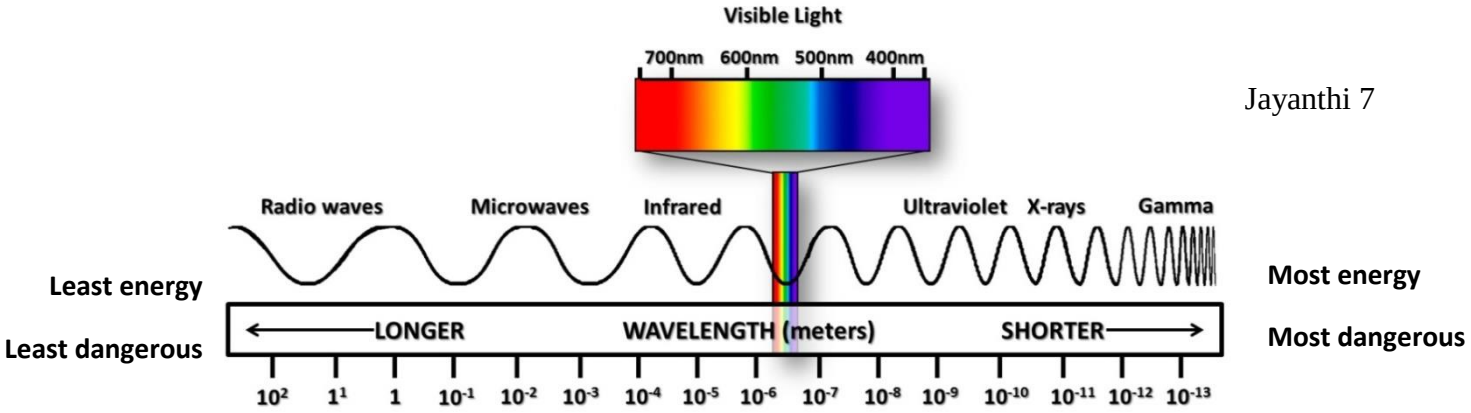
**Energy conservation:** Finding ways to use less energy or use energy more efficiently

**Law of Conservation of Energy:** Energy can be neither created nor destroyed; it can only be transformed from one form to another or transferred between objects. The total amount of energy never changes.

Unit 6: Electromagnetic Spectrum

**Electromagnetic spectrum:** The full range of frequencies of electromagnetic radiation

- **Radio waves:** The longest wavelength, with the lowest frequency and lowest energy, can be used to learn what certain things such as stars are made out of, and are found in TV, microwaves, and radar
- **Infrared rays:** Emitted by our bodies, which allow Night Vision goggles to detect our bodies in the dark; the way that remote controls work; a source of heat that can be used to detect human beings
- **Visible Light Spectrum:** The only part of the EM spectrum that the human eye can see
    - Composed of red, orange, yellow, green, blue, indigo, and violet
    - White light is composed of all these colors
    - In a vacuum, light travels at $3x10^8$ m/sec
    - Something that appears to be a certain color absorbs all the colors and reflects one color, making it appear a certain way.
        - Ex. A red stop sign absorbs orange, yellow, green, blue, indigo, and violet, but reflects red
- **Ultraviolet rays:** The heat emitted by the sun, that causes skin to burn; often used in health, medicine, and agriculture
- **X-Rays:** Can be used by doctors to see bones and teeth; they have high energy so they can penetrate solids and can be used to look inside them
- **Gamma rays:** The shortest wavelength, with the highest frequency and the highest energy (turned Bruce Banner into the Hulk!); used to kill cancer cells and create images of the brain
- Wavelength and frequency are inverse; a longer wavelength implies a lower frequency and vice versa.




**Electromagnetic waves:** Transverse waves consisting of changing electric fields and changing magnetic fields

**Electric field:** An area that exerts electric forces on charged particles

**Magnetic field:** An area that produces magnetic forces

**Electromagnetic radiation:** The transfer of energy by electromagnetic waves traveling through matter or across space

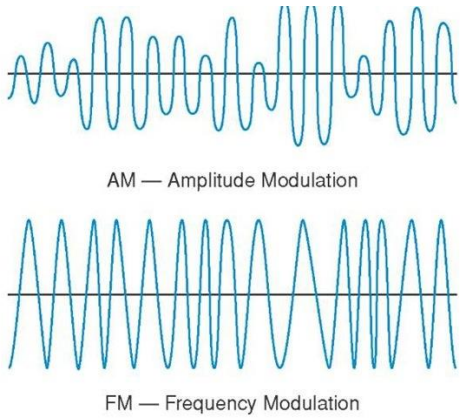
**Photoelectric effect:** The emission of electrons from a metal caused by light striking the metal

**Photons:** Packets of electromagnetic energy, which have energy proportional to the frequency of the light

**Intensity:** The rate at which a wave's energy flows through a given unit of area

**Amplitude modulation:** When the amplitude of the wave is varied, but the frequency stays the same (AM radio waves)

**Frequency modulation:** When the frequency of the wave is varied, but the amplitude stays the same (FM radio waves)




**Thermograms:** Color-coded pictures that show variations in temperature

**Parts of a (Transverse) Wave:**