**Study Guide for Midterm Exam**

**Four types of Scientific Investigation:**

1. **Observations:** using their senses to gather empirical evidence.

**\*empirical evidence** is data gathered through direct observations.

**Observations are the basis of inferences and predictions**

 **Inference:** interpretation or explanation of the observation

**Prediction:** statement of what will happen in the future based on current observations.

1. **Models:** creating representations of the actual object or process.

**Helpful when:**

* an object is too small to see (an atom)
* too far away to see (the stars in distant galaxies)
* a process is too complex (photosynthesis)

**Limited by:**

* over simplifying complex processes
* the fact they can change as new evidence and information is discovered
* scale (example a solar system model does not show the true distance between planets)
1. **Experiments:** controlling all the variables except one (**independent variable**).

**Independent variable:** the one factor that is manipulated or changed in the experiment

**Dependent variable:** the responding variable that is measured

**Controlled variables:** factors that are kept the same to ensure a fair test and to prove that the independent variable alone is responsible for the change in the dependent variable.

**\*The more times the experiment is repeated the greater the validity of the answers.**

1. **Research:** studying previous data

**Scientific Answers:**

1. **Hypothesis:** a possible answer to a scientific question that is ***able to be tested***.

 The hypothesis is tested through a controlled experiment in which all factors except the independent variable are controlled (kept the same). This is to ensure that the independent variable is causing the change in the dependent variable. You **cannot prove a hypothesis** with a single experiment. Other scientists must conduct similar experiments and obtain similar results.

1. **Theory:** an explanation of a wide set of observations.
* **Atomic theory:** all matter is made of atoms.
* **Plate tectonic theory:** Earth’s crust is divided into plates that move causing earthquakes, volcanoes, and seafloor spreading. Based on evidence from identical fossils found on different continents and the shapes of the continents look as though they fit together like puzzle pieces.
* **Cell Theory:** all living things are made of cells. Based on observations of many different types of living things.
* **Big Bang Theory:** the universe has been expanding for 14 billion years.

*\*\*\* Theories can change as new evidence is discovered through scientific investigation. The new evidence must be analyzed and repeated by other scientists.*

1. **Law:** a statement or equation that reliably predicts events under very specific circumstances.

\***Limited because they DO NOT explain why**

* 1. **Law of gravity:** the gravitational force between 2 objects depend on their masses and the distance between them.
	2. **Law of motion:** an object at rest stays at rest unless acted on by an external force
	3. **Law of Conservation of Energy:** energy cannot be created or destroyed.

**The Electromagnetic Spectrum:**

1. Electromagnetic waves, also called radiation, are classified in order of decreasing wavelengths (longest to shortest).

Radio waves (longest)

Microwaves

Infrared

Visible light

Ultraviolet

X-rays

Gamma rays (shortest)

1. Wavelength affects the frequency of a wave. The longer the wave the lower the frequency. The shorter the wave the higher the frequency.
2. Waves with short frequencies have higher amounts of energy. So gamma rays have the most energy while radio waves have the least energy.
3. All EMS waves travel at the same speed. They all travel at the speed of light through a vacuum.

**Light:**

1. When light hits an object, it can be reflected, refracted, or absorbed.
2. Reflection is the bouncing off of light. This happens when light hits a smooth shiny surface.
3. Refraction is the bending of light as it travels through a transparent medium.
	* 1. Light bends because it changes speed as it travels through different mediums.
		2. Light slows down when it passes through dense materials like glass.
		3. Light speeds up when it passes through less dense materials like air.
		4. Refraction is what causes a pencil to appear broken when submerged in water.

c. Absorption occurs when the light is unable to pass all the way through. The light energy is transformed into heat (thermal) energy.

 1. Darker colored objects absorb more light than they reflect.

 2. Darker objects absorb more heat.

2. **White light** consists of all the colors Red, Orange, Yellow, Green, Blue, Indigo, and Violet (ROYGBIV).

a. An object appears green because it absorbs all the colors except for green, which is reflected to our eyes.

 b. A white object reflects all of the colors.

 c. A dark object absorbs all of the colors.

3. **Sound** also travels in waves and is produced by vibrating matter.

 a. Sound travels faster through solids than liquids or gases.

 b. Unlike light, sound CANNOT travel through a vacuum.

**Heat:**

1. Heat is the transfer of thermal energy from a **warmer object to a cooler object** until both objects are the same temperature.

Which pathway can heat travel?

1. Your hand to the air
2. The air to the coffee
3. The coffee to the table

|  |  |
| --- | --- |
| Cup of coffee | 140oF |
| Air | 74 oF |
| Table | 56 oF |
| Your Hand | 66 oF |

1. Heat can move from one object to another 3 different ways:
	1. **Conduction**: heat is transferred through the contact of particles (touch)
	2. **Convection**: heat is transferred by the circular movement of fluid as the heated fluid become less dense and moves upward, while the cooler more dense fluid moves downward.
	3. **Radiation:** transfer of heat energy through electromagnetic waves and without any particles.
2. Heat can affect matter. It can cause it to change shape as the molecules gain energy and spread out.
3. There are 3 states of matter:
	1. **Solids:** definite shape and definite volume
	2. **Liquids:** no definite shape (take the shape of the container) but do have a definite volume
	3. **Gases:** no definite shape and no definite volume.

5. Heat can change matter from one state to another.

a. **boiling:** turns a liquid to a gas

 b. **evaporation:** turns a liquid to a gas

 c. **melting:** turns a solid to a liquid

6. Removing heat can also change matter from one state to another.

 a. **freezing:** liquid to gas

 b. **condensation:** gas to liquid

**Energy Transformations:**

1. **Law of Conservation of Energy**:Energy cannot be created or destroyed but may be transformed from one form to another.

2. Some common energy transformations:

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Rollercoaster transforms potential to kinetic energy.

Some of the kinetic energy is transformed into heat energy because of friction, so the second hill is always shorter than the first.

*Give another example of potential to kinetic*: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_



A light bulb transforms electrical energy to heat energy. As the filament inside the bulb heats up, it gives off light energy.

*Give another example of electrical to light energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

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A car transforms the chemical energy of the gasoline to mechanical energy (motion).

*Give another example of chemical to mechanical: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

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A solar calculator transforms solar energy to light energy to electrical energy.

*Give another example of solar (light) energy to electrical energy: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_*

3. When energy is transformed from one form to another, it is never a 100% complete transformation. Some of the original energy is transformed to heat (thermal) energy due to friction.

|  |  |
| --- | --- |
| Type of Engine | Efficiency |
| Gasoline engine | 30% |
| Diesel engine | 40% |
| Ethanol engine | 36% |

Which of these engines converts the most chemical energy to heat energy? \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**Earth’s interior:**



1. **Crust** (lithosphere) is divided into tectonic plates which float on top of the molten material of the mantle.
	1. The movement of these plates can cause earthquakes, volcanoes, and tsunamis.
	2. When these plates move apart, magma can fill the space. This magma then cools and hardens into new crust.
	3. When these plates move together they can form mountains.
2. The **mantle** consists of molten rock which moves by convection.
	1. The rock closest to the core is heated and becomes less dense.
	2. This rock moves towards the crust where it becomes more dense as it cools.
	3. The motion of this molten rock is responsible for earthquakes, volcanoes, and new crust.
3. **Outer core** is made of molten iron and nickel.
4. **Inner core** is made of solid iron and nickel.

**Rock Cycle:**

1. Forces deep inside the Earth and at the surface produce a slow cycle that builds, destroys and changes the rocks in the crust
	1. **Rock Cycle**: A series of process that occur on Earth’s surface and in the crust and mantle that slowly change rocks from one kind to another
2. **Igneous Rock** is formed by the melting of other types of rock that return to the surface as lava and then cool to form new land (crust)
	1. The types of rocks that could melt and travel under the surface of Earth as magma are sedimentary or metamorphic rocks
	2. Once on the surface the magma becomes lava that cools as new rock
	3. Always formed by **melting**
3. **Sedimentary Rock** is formed when any type of rock goes through weathering and erosion
	1. Smaller pieces of rock (sediments) are broken off, pile on top of each other because of gravity and reform into new rock under its own weight
	2. Always created through **weathering and erosion**
	3. Can be forced up into mountains, even if sediment was from ocean/water creatures
4. **Metamorphic Rock** is formed from Sedimentary **OR** Igneous rock under extreme heat and pressure
	1. Always form through **extreme heat and pressure**