**APES Ch. 2 Reading Q’s :Science, Systems, Matter, and Energy**

**Miller:  *Living in the Environment***

**The Nature of Science**

A. Define a theory. How is a theory different from a hypothesis?

B. What is a scientific/natural law?

C. Describe a controlled experiment.

1. Compare/contrast the experimental and control groups.

D. Why is there always a degree of uncertainty in science?

E. When would a paradigm shift occur?

F. What is junk science?

**Models and Behavior of Systems**

A. Scientists project the behavior of complex systems by developing a model of its inputs, throughputs (flows), and outputs of matter, energy, and information.

1. What do mathematical models use to describe the behavior of a system?

2. When are models useful?

3. What type of questions do models answer?

B. Feedback loops

1 What is positive feedback?

2.What is negative feedback?

C. Prolonged time delays in a complex system may cause a weakening or failure of the feedback mechanisms.

**Types and Structure of Matter**

1. Matter
2. What is matter?
3. What is an element?

B. The building blocks

1. Define an atom.

2. What is an ion?

3. What is a molecule?

C. Structure of an atom.

1. Describe the basic structure of an atom. What the subatomic particles and their charges?

2. Why is an atom neutral?

3. What determines an element’s atomic number?

4. What gives the atom mass? How is mass number determined?

5. Define an isotope.

D. Ions

1. Define concentration.

2. What is pH? How is it measured? Give pH ranges and examples of each below:

a. Acid

b. Neutral

c. Base

E. Chemical formulas

1. How are the elements of a compound represented? Provide examples hydrogen, nitrogen, carbon, and oxygen.

F. Define organic compounds. What is unique about the organic compound methane?

1. What is a hydrocarbon? Give an example.

2. What are chlorinated hydrocarbons?

3. What are simple carbohydrates made of?

G. Polymers are larger and more complex organic compounds which have molecular units, linked by chemical bonds

1. What are complex carbohydrates made of?

2. What are the building blocks of proteins?

3. What are the building blocks of nucleic acids?

4. In simple terms, what is a gene?

5. What is a chromosomes?

6. What is a species genome?

H. Define inorganic compounds. Provide 2 common examples.

I. All living things are composed of cells.

1. What 3 structures are common in ALL cells of eukaryotic organisms?

2. Describe the cells of prokaryotic organisms.

3. What are the building blocks of life?

J. What are the 4 states of matter?

1. What 3 states of matter can water be found in? What factor determines the state of water?

2. Define plasma. Where is it found in the universe? Where is it found (natural or artificial) on Earth?

**Changes in Matter**

A. What happen when matter has a physical change? Provide an example.

B. What happens when matter has a chemical change? Provide an example.

C. What does the Law of conservation of matter state regarding matter and energy?

1. Complete this statement: Atoms are re-arranged into \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

2. Complete this statement: Atoms can have \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ or \_\_\_\_\_\_\_\_\_\_\_\_ changes but they are never \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

**Energy**

A. Define energy.

1. Kinetic energy has…. Provide an example.

2. Potential energy is….. Provide an example.

3. Potential energy can be….. Provide an example.

**Energy Laws: Two Rules We Cannot Break**

A. State the the First Law of Thermodynamics.

B. State the Second Law of Thermodynamics.

1. In changing forms of energy, there is a loss in energy \_\_\_\_\_\_; \_\_\_\_\_ is often produced and lost.

2. Why does changing forms of energy produce a small percentage of useful energy?

3. In living systems what happens to solar energy? Ultimately \_\_\_\_ quality energy is \_\_\_\_\_ to \_\_\_quality energy.

4. Can high-quality energy be recycled/reused?

5. What does energy efficiency/productivity measure?

a. Overall, energy efficiency is very \_\_\_\_—about \_\_\_% of the energy produces useful work.

6. \_\_\_% is unavoidable waste energy, \_\_\_% is unnecessarily wasted energy.

a. How can we further reduce this waste?

**Sustainability and Matter and Energy Laws**

A. What does resource use automatically add to the environment?

B. Advanced industrialized countries have high-throughput (high waste) economies. Give two reasons:

C. What is the benefit of recycling and reusing?

D. Waste heat is added to environment even with recycling/reuse. What positive impact does recycling/reuse have on waste?