Chemistry of Life

Course
Anatomy & Physiology

Unit II
Chemical Processes

Essential Question
What is matter?
TEKS
130.203 (c)(1)(A-F), (2) (A-C), (3) (A-C), (4) (A-B)

Prior Student Learning
Basic Hierarchy of Organization

Estimated time
3-6 hours

Rationale
It is very important to understand the basic principles of body chemistry.

Objectives
Upon completion of this lesson, the student will be able to:

- Identify the four major elements in the body
- Describe the properties of water and how it is utilized in the human body
- Distinguish between inorganic and organic compounds
- Describe the structures and functions of carbohydrates, proteins, lipids, and nucleic acids

Engage
Pass out one sugar cube and one plastic knife for every two students. Instruct the students to divide the sugar cube into two fragments. Ask: is each half still sugar? Can they be divided further? Tell the students to divide each half into two. Ask: Can it be divided into smaller and smaller pieces forever? Are the pieces still sugar? Go ahead and try it. Is there a point at which the sugar fragments can no longer be divided and still be called sugar? What can we call these basic particles making up matter like sugar? Tell the students that in today's class they are going to study atoms and in this unit we will be looking at the chemical basis of life.

Key Points
I. Basic Chemistry Terms and Concepts

A. Matter
1. All living things consist of matter.
2. Matter is anything that occupies space and has mass.
3. Matter may be solid, liquid or gas.
4. Matter is composed of chemical building blocks called elements.
5. Examples include humans, rocks, flowers, trees.

B. Elements
1. Elements are the building blocks of matter.
2. Elements cannot be decomposed into simpler substances by ordinary chemical reactions.
3. An element is a quantity of matter composed of atoms of the same type.
4. There are currently 109 individual elements (92 occurring naturally and the rest are man-made).

5. Elements are designated by letter abbreviations derived from the first one or two letters of the Latin or English name for the element.
6. There are approximately 26 elements found in the human body.
7. Examples include carbon, hydrogen, oxygen, and nitrogen.

C. Atoms
   1. Each element is made up of units of matter called atoms.
   2. It is the smallest unit of matter that can enter into a chemical reaction.
   3. Atoms are made up of two basic components: the nucleus and the electron cloud.
      a. Nucleus
         i. Protons -- positively charged particles which contribute to the weight of an atom. The overall charge of the atom's nucleus is always positive. The number of protons determines the atom.
         ii. Neutrons -- particles that carry no charge (neutral). Help contribute to the weight of an atom.
      b. Electron Cloud
         i. Electrons are negatively charged particles orbiting (or moving around the nucleus.
         ii. The number of electrons always equals the number of protons in a neutral atom.
         iii. Since the protons in the nucleus of an atom are positively charged and the electrons of an atom are negatively charged, and the number of protons is equal to the number of electrons, an atom has no charge or is electrically neutral.
      c. Isotopes -- a variant of a specific element. Each variant will have the exact same numbers of protons and electrons but will differ in the number of neutrons.
         i. The bigger difference in neutrons in the isotope, the more unstable it becomes.
         ii. Unstable isotopes such as Radium or Barium are used in nuclear medicine for their ability to illuminate internal structures such as in radiographs or in enteroscopies.

D. Ions
   1. Ions are atoms possessing an electrical charge due to a loss or gain of electrons.
   2. Ions in solution are called electrolytes.
   3. Common electrolytes in the body include sodium, potassium, chloride and calcium.

E. The Four Major Elements in the Body comprise 96% of the mass.
   1. Carbon
   2. Hydrogen
   3. Oxygen
   4. Nitrogen

F. Compounds and Molecules
   1. Molecule -- the combination of two or more atoms held together by covalent bonds.
      a. May be two atoms of the same element such as H_2 and O_6
      b. May be two atoms of different elements such as NaCl or HCl
   2. Compound -- any substance composed of atoms of two or more different elements that are chemically combined such as water or H_2O. Most matter is in the form of compounds.
   3. A Cation and an Anion
      a. Cation -- formed when an atom loses an electron or electrons to another atom creating an overall positive charge. Ex: Na+
      b. Anion -- formed when an atom gains an electron or electrons from another atom creating an overall negative charge. Example Cl-

G. Ionic, Covalent, and Hydrogen Bonds -- when atoms combine with other atoms, they share electrons with other atoms or they gain or lose electrons. For stability all atoms will look to bond any free electrons
   1. Ionic Bonding
      a. Ionic bonding is an attraction between atoms when one atom loses an electron(s) and another atom gains a/an electron(s).
      b. The bond is formed by the attraction of two oppositely charged ions: the bond form between a cation and an anion. Example: $Na^+ + Cl^- = NaCl$
   2. Covalent Bonding
      a. Covalent bonding is the sharing of electron pairs by two or more atoms.
      b. A single covalent bond is formed by the sharing of one pair of electrons.
      c. A double covalent bond is formed by the sharing of two pairs of electrons.
      d. A triple covalent bond is formed by the sharing of three pairs of electrons.
      e. Covalent bonding is responsible for forming long carbon chains which become the backbone of the organic compounds (carbohydrates, lipids, proteins, nucleic acids).

3. Hydrogen Bonds
    a. Hydrogen bonds are created by the covalent bonding of two other atoms (usually oxygen or nitrogen) to a hydrogen atom.
    b. The bonds are very weak (only 5% as strong as normal covalent bonds).
    c. They often serve as bridges between molecules. (Example: the bridge formed between the amino acids in myoglobin)

H. pH -- the term used to describe the degree of acidity or alkalinity of a solution.
1. pH Scale -- has values ranging from 0-14. It is based upon the number of hydrogen ions in solution.
2. Classifying Solutions Based on pH
    a. An acidic solution forms hydrogen ions, H+, when in solution. On the pH scale, the numbers are below 7.0. Examples: lemons or HCl pH = 2.0; tomatoes pH = 4.0; milk pH= 5.0.
    b. A neutral solution has a pH of 7.0. The best example is distilled water.
    c. A basic (or alkaline) solution forms hydroxide ions (OH-) when in solution. The pH scale numbers are above 7.0. Example: eggs pH= 8.0; drain cleaner pH= 13.0.
3. pH Range of the Blood
    a. The neutral pH is 7.0 such as distilled water.
    b. The average pH of blood is slightly basic and ranges from 7:35-7:45.

II. Water

A. Water is the universal solvent which provides an excellent suspension medium for the transport of nutrients and wastes.
1. Solvent -- describes a liquid or gas in which some other material has been dissolved.
2. Solute -- is the atom or molecules that has been dissolved in a solvent
3. Solution -- is the combination of a solvent and a solution.

B. Water serves as a transport medium and facilitates the movement of molecules through the body (circulation).

C. Water serves as a lubricant reducing friction and holding substances together in many areas of the body. Water is a major component of mucous, saliva, bile, amniotic fluid, synovial fluid, and serous fluid.

D. Water absorbs and releases heat very slowly which makes it vital to regulate the body's temperature.

E. Water is needed in the process of digestion and the breaking apart of larger molecules into smaller ones.

F. Water is important in removing waste products from the body.

III. Inorganic and Organic Compounds

A. Inorganic Compounds

1. Generally lack carbon atoms. If the compound contains carbon, it does not contain carbon and hydrogen.
2. Vital to normal body physiological functioning.
3. Many inorganic molecules are ionic ally bonded together.
4. Examples include carbon dioxide, water, and oxygen.

B. Organic Compounds

1. Contain both carbon and hydrogen atoms
2. Almost exclusively held together by covalent bonds
3. Carbon atoms can bond together to form long chains and large molecules.
4. Examples include carbohydrates, lipids, proteins, nucleic acids, and adenosine triphosphate (ATP).

a. Carbohydrates -- also known as sugars and starches

i. Carbohydrate molecules have a 2:1 ratio of hydrogen to oxygen.
ii. The general formula for carbohydrates is (CH2O).
iii. Provide structural units in DNA and in the cell membrane structure
iv. Provide the major energy source for the body
v. Each gram of carbohydrate provides 4.5 Kcalories.
vi. Only energy source for brain and nerve cells
vii. Blood sugar is known as glucose.

b. Lipids (Fats)

i. Lipids are generally insoluble in water.
ii. Lipids do not have a 2:1 hydrogen to oxygen ratio.
iii. The most common form of lipids is the triglycerides, which are composed of two molecular sub-units: glycerol and fatty acids
iv. The most highly concentrated sources of energy providing the body with 9.2 Kcalories per gram
v. Provides the body with its second source of energy
vi. Protects body organs
vii. Provides insulation and warmth for the body
viii. Absorbs the fat-soluble vitamins: A, D, E, K

c. Proteins

i. All proteins are composed of Carbon, Hydrogen, Oxygen and Nitrogen.
ii. Many proteins also contain Sulfur and Phosphorus.
iii. Proteins are composed of building blocks known as amino acids.

iv. There are 20 amino acids which make up all known proteins.
v. Amino acids are bonded to one another by a peptide bond (nitrogen bond).
vi. Proteins are responsible for much of the structure of body tissues including cell membranes, collagen, keratin, and elastin.
vii. Proteins form enzymes which act as catalysts in chemical reactions to speed up the reaction.
viii. Proteins function as antibodies to help the body fight infection.
ix. Proteins form hormones which act as chemical regulators for growth and development.
x. Proteins in the blood help to regulate the osmotic pressure, function as antibodies, and assist in blood clotting.
xi. Proteins function as storage molecules (ferritin).
xii. Proteins function as transport molecules (hemoglobin).
xiii. Proteins function as contractile proteins such as actin and myosin.
xiv. Proteins function as neurotransmitters by helping the nerves communicate with other nerves or muscle fibers.

IV. Nucleic Acids -- structural units that make up Deoxyribonucleic Acid (DNA) and Ribonucleic Acid (RNA)
A. Structure of Nucleic Acids
1. All nucleic acids contain Carbon, Hydrogen, Oxygen, Nitrogen, and Phosphorus.
2. Nucleic acids are composed of nucleotides. A nucleotide is formed by a sugar (deoxyribose or ribose), a phosphate, and a nitrogen base.
a. DNA stores the genetic code within structures called chromosomes. They are found within the nucleus of the cell.
b. DNA and RNA assist with protein synthesis.
c. RNA is responsible for transporting the genetic code from the nucleus to the ribosomes where the needed proteins are made.
d. DNA is formed by a double helix of nucleotides.
e. Nitrogen bases are paired together (A-T) and (C-G). The sequence of the nitrogen bases determine the amino acids to be used in the forming of a new protein. The nitrogen bases form the rungs of the DNA molecule.
f. The four nitrogen bases include:
i. Adenine

ii. Thymine
iii. Cytosine
iv. Guanine

g. The sugar is deoxyribose. The nitrogen base is attached to the deoxyribose which helps to form the sides of the helices.
h. The sides of the double helix contain a phosphate group which alternates with the deoxyribose forming the sides of the helices.

B. Structure of RNA
1. RNA is formed by a single helix of nucleotides. A nucleotide is composed of a sugar, a phosphate, and a nitrogen base.
2. Nitrogen bases are paired together (A-U) and (C-G). The sequence of the nitrogen bases determine the amino acids to be used in the protein. The nitrogen bases form the rungs of the RNA molecule.
3. The four nitrogen bases included.
   a. Adenine
   b. Uracil
   c. Cytosine
   d. Guanine
4. The sugar, ribose, with a nitrogen base attached to it, is used to form the side of helix.
5. The side of the helix contains a phosphate group which alternates with the ribose forming the backbone.

C. ATP and Energy Conversion
1. Adenosine Triphosphate (ATP)
   a. Found in all living organisms
   b. ATP is a high energy compound that drives most chemical reactions.
   c. ATP is produced by body cells in a process known as cellular respiration which involves the breaking down of glucose in a series of chemical reactions. The chemical reactions occur within the cytoplasm and the mitochondria of cells.
   d. ATP is formed by an adenosine unit (adenine and a five-carbon sugar, ribose), and three phosphate groups. Note how energy is generated.

$$ATP \leftrightarrow ADP + P + energy$$

Activity

I. Perform Measuring Lactase Laboratory Investigation.
II. Perform Testing Organic Compounds Laboratory Investigation.
III. Complete the Chemistry of Life terminology.

Assessment
Successful completion of Body Chemistry Exam
Laboratory Investigation Rubric

Materials
Body Chemistry Exam Key

Regular Milk
Lactose-Free Milk
Lactase Drops
12-well plate
Glucose test strips (4 per group. Please do not waste!)
Glucose solution (diluted corn syrup)

different foods (students may bring these from home)
hot water bath
test tubes
Lugol's solution
test tube racks
Sudan IV
wax pencils
brown paper bags
Benedict's solution
distilled water
Biuret's solution
1.5% copper sulfate

Accommodations for Learning Differences
For reinforcement, the student will create a poster describing Hypolactasia and its potential hazards for lack of calcium.

For enrichment, the students will create a poster discussing any of the following holistic complementary and alternative medicinal treatments and how it relates to body's biochemistry:

- Acupuncture Chiropractic Medicine
- Energy Therapies
- Magnetic Field Therapy
- Therapeutic Touch
- Herbal Medicine
- Ayurveda

National and State Education Standards
National Healthcare Foundation Standards
HLC01.01 Academic Foundations

Health care workers will know the academic subject matter required (in addition to state high school graduation requirements) for proficiency within their area. They will use this knowledge as needed in their role.

TEKS

130.203 (c)(1)(A) identify abbreviations, acronyms, and symbols;
130.203 (c)(1)(B) identify the basic structure of medical words;
130.203 (c)(1)(C) practice word-building skills;
130.203 (c)(1)(D) research the origins of eponyms;
130.203 (c)(1)(E) recall directional terms and anatomical planes related to body structure;
130.203 (c)(1)(F) define and accurately spell occupationally specific terms such as those relating to the body systems, surgical and diagnostic procedures, diseases, and treatments.
130.203 (c)(2)(A) demonstrate appropriate verbal and written strategies such as correct pronunciation of medical terms and spelling in a variety of health science scenarios;
130.203 (c)(2)(B) employ increasingly precise language to communicate;
130.203 (c)(2)(C) translate technical material related to the health science industry.
130.203 (c)(3)(A) examine medical and dental dictionaries and multimedia resources;
130.203 (c)(3)(B) integrate resources to interpret technical materials;
130.203 (c)(3)(C) investigate electronic media such as the Internet with appropriate supervision.
130.203 (c)(4)(A) distinguish medical abbreviations used throughout the health science industry; and
130.203 (c)(4)(B) translate medical abbreviations in simulated technical material such as physician progress notes, radiological reports, and laboratory reports.

College and Career Readiness Standards

English/Language Arts
B.1 Identify new words and concepts acquired through study of their relationships to other words and concepts.
B2. Apply knowledge of roots and affixes to infer the meanings of new words.
B3. Use reference guides to confirm the meanings of new words or concepts.
Cross- Disciplinary standards-Foundational Skills
A2. Use a variety of strategies to understand the meanings of new words

Lactose Intolerance Laboratory Investigation

Purpose

In this laboratory investigation, the student will show the activity of a commercial lactase enzyme on milk and practice the use of positive and negative controls.

Background Information

Materials

Regular Milk
Lactose-Free Milk
Lactase Drops
12-well plate
Glucose test strips (4 per group. Please do not waste!)
Glucose solution (diluted corn syrup)

Procedure

1. Wash hands and put on gloves and goggles.
2. Assemble equipment and materials.
3. Prepare work area.
4. Fill one well in the plate with regular milk. Fill another with Lactose-Free milk.
5. Check the two milk types for glucose by dipping a glucose strip and comparing the coloring to the glucose chart on the package. Record the color and the estimated glucose concentration.
6. Add a few drops of Lactase to both types of milk. Shake the plate very gently and wait 5 minutes.
7. Check the two milk types for glucose by dipping a new glucose strip and comparing to the glucose chart.
8. Clean work area with surface disinfectant. Remove goggles and gloves and wash hands.

NOTE: The glucose strips are very expensive; please use them conservatively!

Data
Complete the following table.

	Regular Milk		Lactose-Free Milk	
	Color	Concentration	Color	Concentration
Before Lactase				
After Lactase				

Conclusion

1. Compare the glucose concentration before and after adding lactase to milk. What happened?

2. Compare the glucose concentration before and after adding lactase to lactose-free milk ("Lactaid"). What happened?

3. If there is glucose in the lactase solution, your experiment will be inconclusive. Why? What do you need to do in order to rule out the presence of glucose in the lactase solution?

4. What can you do to be sure the glucose strip is actually working?

5. How can lactose-intolerant patients benefit from your results?

Testing Organic Compounds Laboratory Investigation

Purpose

In this laboratory investigation, the student will become familiar with organic compounds and their components.

Background Information

Materials

different foods (students may bring these from home)
hot water bath
test tubes
Lugol's solution
test tube racks
Sudan IV
wax pencils
brown paper bags
Benedict's solution
distilled water
Biuret's solution
1.5% copper sulfate

Procedure

1. Carbohydrates
   Monosaccharides
   1. Add 2 ml of a different food substance to each of five test tubes. In the sixth test tube, you should add only distilled water. Be sure and label each tube.
   2. Add 2 ml of Benedict's solution to each of the six test tubes.
   3. Place the test tubes in a hot water bath for three to five minutes.
   4. If you observed a color change from blue to green, yellow, or red you have a positive test which indicates the presence of monosaccharides.
   5. Complete the data table located at the end of this worksheet.

   Polysaccharides
   1. Using the same five foods, place 2 ml of each different food in each of five test tubes. In the sixth test tube, you should add only distilled water. Be sure and label each tube.
   2. Add 2 ml of Lugol's solution to each of the six test tubes.
   3. If you observed a color change from a yellow-brown color to a purplish-black color, it is a positive test and indicates the presence of starch (a polysaccharide).
   4. Complete the data table located at the end of this worksheet.

2. Testing for Lipids
    1. Using the same five foods, place 2 ml of each different food in each of five test tubes. In the sixth test tube, you should add only distilled water. Be sure and label each tube.
    2. Add 2 ml of distilled water and 3 drops of Sudan IV to each of the six test tubes.
    3. If you observed a color change to red, it is a positive test for lipids.
    4. Complete the data table located at the end of this worksheet.

    Just in case — if you are having a difficult time getting this test to work properly, mix each of the foods with distilled water to form a paste. Label six spots on a brown paper bag and apply the food pastes, one to each spot. (In the sixth spot, you will place a few drops of distilled water). Wait for 15 minutes and observe whether or not you had grease (fat) spots leading away from the food stuffs. The spot will still look wet and will be translucent. (The water from the mixture will dry up). This is a positive test for fat.

3. Testing for Proteins
    1. Using the same five foods, place 2 ml of each different food in each of five test tubes. In the sixth test tube, you should add only distilled water. Be sure and label each tube.
    2. Add 2 ml to 3 ml of Biuret's solution to each test tube.
    3. If you observed a color change from a bluish color to a pinkish purplish color, it is a positive test and indicates the presence of proteins.
    4. Complete the data table located at the end of this worksheet.

Data
Complete the following table.
Use (+) for a positive test and (-) for a negative test.

Food Substance and Test Tube	**Carbohydrates Monosaccharides**	**Carbohydrates Polysaccharides**	**Lipids**	**Protein**
1. Distilled Water				
2.				
3.				
4.				
5.				
6.				

Conclusion

1. Why did you use water in all of the tests?

2. Which food(s) contain the monosaccharides?

3. Which food(s) contain the polysaccharides?

4. Which food(s) contain the lipids?

5. Which food(s) contain the proteins?

6. Did you have any foods that contained all three organic compounds? If so, list them.

7. Did you have any foods that contained none of the organic compounds? If so, list them.

NAME: _____ **DATE:** _____

Body Chemistry Exam

1. List the three states of matter.

2. Describe an atom in terms of its nucleus, valence, shell, electrons, protons, and neutrons.

3. Define the term element and identify the four major elements in the body.

4. Define the following terms:
    a. compound:
    b. molecule:
5. Define the following terms:
    a. ion:

        cation:

        anion:

6. Describe the characteristics of the following types of bonds:
    a. ionic:

    b. covalent:

    c. hydrogen:

7. Define pH.

8. Given the pH of a solution, categorize it as acidic, basic, or neutral.

    a. 7.0

    b. 14.0

    c. 5.5

    d. 1.0

    e. 7.35

9. What is the pH of blood? _____ Is this acidic, basic or neutral?

10. Describe the properties of water that make it so valuable to the human body.

11. Define the following terms:

    a. organic:

    b. inorganic:

12. Identify the functions of carbohydrates, proteins, lipids, and nucleic acids.

13. Describe the ATP → ADP + Pi + ENERGY conversion which occurs when the body needs energy and when the body stores energy.

Body Chemistry: Key

1. **List the three states of matter.**
   Matter may be solid, liquid, or gas.
2. **Describe an atom in terms of its nucleus, shell, electrons, protons, and neutrons.**
   Atoms consist of a nucleus and a surrounding electron shell. The nucleus contains both protons (positive charge) and neutrons (neutral charge). The electron shell contains electrons (negative charge).
3. **Define the term element and identify the four major elements in the body.**
   Elements are the building blocks of matter. They cannot be decomposed into simpler substances by ordinary chemical reactions. An element is a quantity of matter composed of atoms of the same type. *The four major elements in the body are: carbon, hydrogen, oxygen, and nitrogen.*
4. **Define the following terms:**
   a. compound: a substance composed of atoms of two or more different elements that are chemically combined
   b. molecule: the combination of two or more atoms held together by covalent bonds
5. **Define the following terms:**
   a. ion: charged particle
   b. cation: When an atom loses an electron or electrons to another atom, it will have an overall positive charge.
   c. anion: When an atom gains an electron or electrons from another atom. it will have an overall negative charge.
6. **Describe the characteristics of the following types of bonds:**
   a. ionic: an attraction between atoms where one atom loses and another atom gains an electron; the bond is formed by the attraction of two oppositely charged ions.
   b. covalent: the sharing of electron pairs by two or more atoms
   c. hydrogen: the bonding of two other atoms (usually oxygen or nitrogen) covalently bound to a hydrogen atom
7. **Define pH.**
   pH is the term used to describe the degree of how acidic or basic a solution is.
8. **Given the pH of a solution, categorize it as acidic, basic, or neutral.**
   a. 7.0 neutral
   b. 14.0 basic
   c. 5.5 acidic
   d. 1.0 acidic
   e. 7.35 basic
9. **What is the pH of blood?** 7.35-7.45 **Is this acidic, basic or neutral?** Basic
10. **Describe the properties of water that make it so valuable to the human body.**
    A. Water is a universal solvent providing an excellent suspension medium for the transport of nutrients and wastes.
    B. Water serves as a transport medium and facilitates movement of molecules throughout the body (circulation).
    C. Water serves as a lubricant in various regions of the body and is a major component of mucous, saliva, bile, amniotic fluid, synovial fluid, and serous fluid.
    D. Water absorbs and releases heat very slowly which makes it vital to regulate the body's temperature.

Laboratory Investigation Rubric

Student: _____

Course: _____

Date: _____

Scoring Criteria	4 Excellent	3 Good	2 Needs Some Improvement	1 Needs Much Improvement	N/A
Problem is appropriately identified.					
Problem is precise, clear and relevant.					
Association between the problem and the predicted results is direct and relevant.					
All variables are clearly operationalized.					
Demonstrates comprehension of the use of scientific concepts and vocabulary.					
All significant data is measured.					
Data is recorded effectively and efficiently.					
Data table is well designed to the task requirements.					
All graphs are appropriate.					
All data is accurately plotted.					
Graph visually compelling; Highlights conclusions of the study					
Conclusion has relevancy in the resolution of the original problem.					
Conclusion relates the study to general interest.					

CHEMISTRY OF LIFE TERMINOLOGY WORKSHEET

Anion	
Atom	
Cation	
Compounds	
Deoxyribonucleic acid	
Elements	
Inorganic	
Isotopes	
Ions	
Matter	
Molecules	
Nucleic acids	
Organic	
pH	
Ribonucleic Acid	
radioisotope	

CHEMISTRY OF LIFE TERMINOLOGY WORKSHEET- KEY

Anion	An ion that has more electrons than protons giving off a negative electrical charge
Atom	Basic unit of matter consisting of protons, electrons and neutrons
Cation	An ion that consists of more protons than electrons giving off a positive electrical charge
Compounds	A combination of two or more elements
Deoxyribonucleic acid	A type of nucleic acid that consists of all the human genetic information that coiled into chromosomes found in all nuclei of cells comprised of adenine, guanine, cytosine and thymine
Elements	Anything that has matter
Inorganic	A type of matter than does not contain carbon or hydrogen atoms found in all inanimate objects
Isotopes	A chemical variant that has the same number of protons but a differing number of neutrons making the element unstable
Ions	Atoms or molecules with electrons not equal to the number of protons giving off a positive or negative charge
Matter	Anything that occupies space
Molecules	A combination of atoms that are held together by chemical bonds
Nucleic acids	The basic foundation to all living matter such as DNA and RNA
Organic	A type of matter that contains carbon and hydrogen and is found in all biological systems that can further decompose
pH	The measurement of hydrogen ions in a solution
Ribonucleic Acid	A type of nucleic acid found in all living matter composed of adenine, cytosine, guanine, and uracil and is responsible for synthesizing proteins
radioisotope	A chemical variant with differing numbers of neutrons causing instability and radioactive emission of gamma alpha or beta particles as chemical decays. This chemical decay, also called half-life is synthesized and used in nuclear medicine and radiology.