

Intellectual Inquiry – Natural/Physical/Mathematical Science

1. Describe methods of inquiry that lead to scientific knowledge and distinguish scientific fact from pseudoscience.
2. Explain fundamental principles in a branch of science.
3. Apply fundamental principles to interpret and make predictions in a branch of science.
4. Demonstrate an understanding of at least one scientific discovery that changed the way scientists understand the world.
5. Give examples of how science interacts with society.
6. Conduct a hands-on project using scientific methods to include design, data collection, analysis, summary of the results, conclusions, alternative approaches, and future studies.
7. Recognize when information is needed and demonstrate the ability to find, evaluate and use effectively sources of scientific information.

Section Unit 1 General and Inorganic Chemistry

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| Intro ch 1 | Define chemistry. |
| Intro ch 1 | Define matter. |
| 3.1 | Define atoms. |
| 3.2 | Define atomic number. |
| 3.4 | Define mass number. |
| 3.4 | Define isotopes. |
| 3.4 | Provide the isotope symbol and charge if given the number of protons, neutrons and electrons. |
| 3.4 | Calculate the number of protons, neutrons and electrons in an atom or ion given the isotope symbol and charge. |
| 3.2 | Identify the location of metals, nonmetals and metalloids on the periodic table. |
| 1.2, 1.6 | Provide the properties of metals, nonmetals and metalloids. |
| Class | Know the element names and symbols for the select elements provided in class. |
| 1.6 | Define compound. |
| Class | Recognize a compound if provided a formula. |
| 1.1, 1.2, 1.6 | Classify pure substances as elements or compounds. |
| 1.7-1.9 | Define homogeneous, heterogeneous and colloids. |
| 1.7-1.9 | Classify mixtures as homogeneous, heterogeneous and colloids. |
| 1.14 | Define molecules. |
| 3.5-3.6 | Given a main group element, provide the number of valence electrons. |
| 3.1 | Identify the elements that belong to the groups: alkali metals, alkaline earth metals, halogens and noble gases. |
| 3.7 - 3.8 | State the octet rule. |
| 3.8 | Relate the number of valence electrons of noble gases to their stability. |
| 3.9 | Explain what occurs with electrons to allow noble gases to generate light. |
| 2.2, 2.8 | Define chemical properties. |
| 3.12 | Define covalent bonds. |
| 3.13-3.15 | Explain how and why covalent bonds form. |
| 3.15-3.17 | Recognize appropriate and wrong Lewis structures for compounds. |

3.15 - 3.17	Determine the number of covalent bonds all nonmetals should form to obey the octet rule.
End of Quiz 1 material	
3.19	Define ions, cations and anions.
3.19 - 3.20	Define ionic compounds.
3.19 - 3.20	Define ionic bonds.
3.19 - 3.20	Recognize that ionic bonds form between metals and nonmetals.
3.19 - 3.20	Predict the common charge of the main group elements based upon their group number.
3.30	Define polyatomic ions.
3.20	Predict the formula of an ionic compound given the charges of the ions.
3.12	Define covalent bonds.
3.12	Define covalent compounds.
Class	Classify compounds as ionic or covalent
Class	Give formulas of a compound (ionic and covalent) given the name.
Class	Give the name of a compound (ionic and covalent) given the formula.
1.10 with intro p 15	Define the properties of the three states of matter in terms of shape and volume.
1.10	Define condensed state.
1.11, 1.12	Explain the properties of a solid, liquid and gas based upon what occurs on the molecular level.
1.13	Define pressure and relate what occurs on the atomic level to produce pressure of a gas.
2.1, 2.2	Define physical change.
2.2	State the name of the phase change between each state of matter.
2.3	Define dissolving.
2.4	Define evaporation and condensation.
2.6	Explain the equilibrium between evaporation and condensation that leads to vapor pressure
2.6	State the relationship between temperature and vapor pressure of a liquid.
2.7	Define boiling and boiling point.
2.8	Define chemical change.
Lecture video	Recognize the five indicators that a chemical reaction has occurred.
2.10	Balance a chemical reaction.
2.12 - 2.16	Define combustion reaction.
2.12-2.16	Recognize the products of a combustion reaction for complete combustion and incomplete combustion.
2.11	Explain the difference between combustion and oxidation of food in the body.
2.17	Define rusting and tarnishing.
In class	Define the Haber process and its importance.
End of Exam 1 Material (Unit 1: General and Inorganic Chemistry)	
Section	Unit 2: Organic Chemistry
Intro Ch 4	Define organic chemistry.
4.1	Define hydrocarbons.

4.1	Determine the number of hydrogen atoms needed to satisfy the octet rule of each carbon in a hydrocarbon.
4.2	Recognize the 3-dimensional structure of methane.
4.3	State the properties of methane and how it is produced in nature.
4.5	Match the number of carbon atoms (1 - 10) with the prefixes for hydrocarbons.
4.13 - 4.24	State and describe the three types of fossil fuels.
4.13 - 4.24	Know advantages and disadvantages of each of the types of fossil fuels over the other types.
4.5, 4.11	Relate what the suffixes -ane and -ene mean.
4.8	Relate what the prefix cyclo- means.
4.5, 4.8, 4.11	Define alkane, alkene and cycloalkane.
4.5, 4.8, 4.11	Determine the molecular formula given the number of carbon atoms for an alkane, alkene or cycloalkane.
4.6	Define a straight chain hydrocarbon (unbranched).
Hydrocarbon Structure and formula	Translate a structural formula to its condensed structural formula and to its shorthand representation.
Hydrocarbon Structure and formula	Translate a shorthand representation to its structural formula or condensed structural formula.
4.5	Know the names of alkyl groups according to their carbon chain length.
Nomenclature and 5.1	Know the names of halogens as a group attached to a carbon chain.
Alkane	
Nomenclature Alkane	Use the systematic rules to name hydrocarbons given its structure.
Nomenclature	Use the systematic rules to draw the structure of a hydrocarbon given its name.
p 176	Define polymers.
p 176	Define addition polymers.
5.5	If given a monomer, draw the polymer containing at least 4 monomer units.
5.5	Given a polymer, determine the monomer used to synthesize it.
5.5	Know the monomers that make up PVC, HDPE, LDPE, Polystyrene, Styrofoam, Teflon and Gortex.
5.5	Know the uses and properties of PVC, HDPE, LDPE, Polystyrene, Styrofoam, Teflon and Gortex.
5.6	Explain the glass state, rubber state and glass transition temperature of plastics.
5.8	Relate the structure of rubber, how it is synthesized.
5.9	Explain the vulcanization of rubber and why it is useful.
Organic	
Functional Groups	Match the structure of functional groups to their names for alcohols, ethers, aldehydes, ketones, carboxylic acids, esters, amines and amides.
End of Quiz 2 material (Organic Content Quiz)	
6.2, 6.3	Draw or recognize the structure of methanol and ethanol.
	Recognize alcohol names end in -ol.

6.6	Define LD-50 and explain how this defines the toxicity of methanol vs ethanol.
6.7	Explain how ethanol is broken down by the body or excreted from the body.
6.10	Draw or recognize the structure of ethylene glycol and glycerol.
6.10	Relate the uses and properties of ethylene glycol and glycerol.
6.12	Draw or recognize the structure of formaldehyde, the simplest aldehyde.
6.12	State the properties and uses of formaldehyde.
6.13	Relate that aldehydes often as useful for their pleasing aromas and tastes.
6.14	Draw or recognize the structure of acetone, the simplest ketone, and its uses.
6.15	State how carboxylic acids are formed.
6.16	Rank hydrocarbons, alcohols, aldehydes, ketones, carbonic acids, esters and CO ₂ according to oxidation state.
6.15	Draw or recognize the structure of formic acid, the simplest carboxylic acid.
6.15	Draw or recognize the structure of acetic acid.
6.16	Explain how acetic acid is formed.
6.16	Explain what causes a hangover when ethanol is ingested.
6.16	Explain what causes blindness when methanol is ingested.
6.17, 6.18	State the given properties of carboxylic acids.
6.18	Define alpha-hydroxy acids.
6.18	Know structure of lactic acid and where it is commonly found.
6.19	Recognize or draw methyl formate, the simplest ester.
6.20	Know the properties and common uses of esters.
6.23	When provided a carboxylic acid and alcohol, construct the correct structure of the ester produced by the condensation reaction.
8.3	Define neurotransmitters.
8.3	Recognize that neurotransmitters have amine and amide functional groups.
8.3	State that serotonin is a neurotransmitter.
8.4	Relate that many classes of medications, especially those that affect the nervous system have amines and amides in their structure.
8.4	State the properties of nicotine and caffeine and recognize the amine and amide functional groups in their structure.
Reading, p 303 - 310	State the properties of cocaine, amphetamines, common OTC pain killers and morphine derivatives and recognize the amine and amide functional groups in their structure.
Reading, p 303 - 310	What naturally occurring substance in the body do the drugs interact with or interfere with? Note: Find these if the book discusses them.
8.5	Define half-life.
8.5	Use half-life values to explain the duration of a drug in the body.
8.5	Calculate the fraction of a drug remaining in the body after a given period of time if you know the half-life.
8.5	Determine the half-life if you know the time it takes for a given fraction of a drug to leave the body (it will be given as 1/2, 1/4, 1/8, 1/16, etc)
End of Exam 2 Material (Unit 2: Organic Chemistry)	
Section	Unit 3: Biochemistry

Intro Ch 7	Define biochemistry
Intro Ch 7	Define carbohydrates, saccharide, monosaccharide, disaccharide and polysaccharide.
Notes	Relate that the -ose suffix is used for carbohydrates.
7.1 and notes	Recognize and draw the structure of glucose.
Group Activity:	Recognize the difference between alpha-D-glucose and beta-D-glucose, both from a paper image of the structural formula and as a three-dimensional Building Glucose model.
7.1	Recognize the structure of fructose.
7.1	State the common sources of glucose and fructose in nature.
	State the difference in how glucose produces energy in the body, in plenty of oxygen and under strenuous exercise when not enough oxygen.
7.1	Explain how excess glucose is stored in the body.
7.4	Explain how we taste sweet.
	Relate how all sugars and sweeteners are related to the sweetness of table sugar (sucrose.)
7.4	Explain the similarities and differences between Insulin-dependent (type 1), non-insulin-dependent (type 2) and gestational diabetes.
7.2	Explain what disaccharides are and how they are formed.
7.2	State the common sources of sucrose.
	Relate that sucrose is formed by the condensation reaction between glucose and fructose.
7.2	Recognize the structure of sucrose.
	Define hydrolysis and how it is used to convert a disaccharide to its two monosaccharides.
7.2	State the common source of lactose
	Relate that lactose is formed by the condensation reaction between glucose and galactose.
7.5	Explain the process of digestion of lactose and what occurs if a person is lactose intolerant.
7.5	Define polysaccharides/complex carbohydrates
7.6	State the common source of polysaccharides.
7.6	Explain the difference between starch and fiber in terms of digestibility.
	Explain the difference between starch and fiber in terms of molecular structure and the linkage between glucose molecules.
7.8 and 7.9	Recognize an alpha(1-->4) or beta(1-->4) linkage and which one is associated with complex carbohydrate.
7.9 and Group Activity	State the two types of starch and what is different, on the molecular level between the structures.
7.6	Explain why dietary fiber is important.
7.	Define glycogen and its use in the body.
7.7	Relate the difference in calories between carbohydrates and fats and how this explain why fats are a more efficient way to store excess energy.
Intro to 7.11	Define fatty acids.
7.11	Relate the number of carbon atoms in a fatty acid to its melting point.
7.11	

- 7.11 Define saturated and unsaturated with regard to fatty acids.
- 7.12 Relate the degree of unsaturation in a fatty acid to its melting point.
- 7.11 Construct a triglyceride from glycerol and three fatty acids.
- 7.11 Define fats and oils.
- 7.13 Relate the natural sources of fats and oils.
- Describe the difference in healthiness of various types of oils.
- Recognize an omega-3 fatty acid, their sources and the advantage they have over other fatty acids.
- 7.15
- 7.16 Explain the role of bile in ones digestive system.
- 7.17 Explain the hydrogenation process.
- 7.17 Recognize the difference between a cis and trans fat.
- Intro to 9.12 List the common places proteins are found in a living organism.
- Recognize the features of an amino acid. Locate the alpha-carbon, the amino end and the acid end.
- 9.12
- Familiarize yourself with the different R groups and how these define the 20 amino acids.
- 9.13 Figure 9.14
- Be able to link amino acids together by way of a condensation reaction to form a peptide bond.
- 9.13
- 9.13 Locate the peptide bond in a peptide.
- 9.14 Explain what makes the primary structure of a protein
- 9.14 Explain what makes the secondary structure of a protein.
- 9.14 Recognize on paper, or as a model the alph-helix secondary structure.
- 9.14
- Recognize on paper, or as a model the beta-pleated sheet secondary structure.
- Relate that the alpha-helix makes up the birous components of alph-karatins in hair, wool, fur, nails and hooves.
- 9.15
- 9.14 Explain what the tertiary structure of a protein is.
- 9.14 Describe the four types of connectors that hold a protein in its shape.
- Recognize which R-groups form the different connectors in the tertiary structure.
- 9.14
- 9.14 Define the quaternary structure of a protein.
- 9.18 Relate the various roles of proteins in the body.

End of Exam 3 material