CHEMICAL DIGESTION WORKSHEET

Name: _____ Due Date: _____

I. Enzymatic Action in Digestion

a. Define digestion and explain the two different major processes that take place.

b. Define enzyme based on its **detailed** structure (parts to make the whole)

c. Give the function of an enzyme and two specific examples of enzymes and their specific actions.

d. Define denature and explain what is happening chemically. Can it be reversed?

e. Give the control for normal body temperature and explain the effects of temperature on enzyme function.

f. Define pH mathematically and explain the effects of pH on enzyme function.

g. What is the optimal temperature and pH for human digestive enzymes?

h. Explain hydrolysis and why it is necessary for digestive processes.

i. Define catabolism and anabolism and how they are involved in metabolism.

II. Carbohydrate Digestion

a. Give the basic chemical formula for a carbohydrate: _____
b. Where does carbohydrate digestion *begin*? _____
c. Name the enzyme(s) used in carbohydrate digestion and the source(s).
_____

Experiments

i. Starch Digestion

1. How is starch (amylose) different than glycogen?

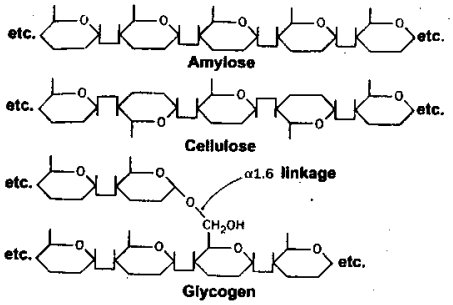
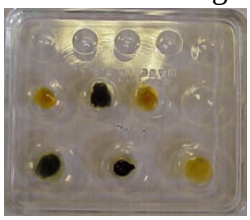


Fig. 22.5. Polysaccharides : Amylose, cellulose and glycogen. Only part of each molecule is represented.

_____
_____

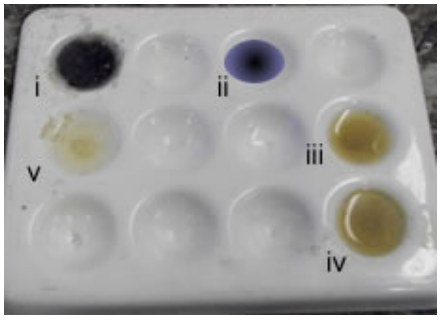
2. What enzyme is used in starch digestion? _____

3. Testing for the presence of starch:
When Lugol's Iodine (IKI) is added to starch it creates a blue/black precipitate due to the geometric interaction of the starch molecules present. If no starch is present, no geometric pattern is seen and therefore no color change will be observed.



4. Varying amounts of starch solution concentrations will also give a range of positive (+) results as pictured below

5. A spot plate is used and separate drops of starch, maltose, glucose, and water are put into each well. A drop of IKI is added to each substrate and the following results are observed



Read and record the results as (+) or (-) reaction.

i. 10% Starch _____
ii. 1% Starch _____
iii. 2% Maltose _____
iv. 2% Glucose _____
v. Water (pH 8) _____

Explain these results:

_____

_____

ii. Benedict's Test for reducing sugars

1. Define what is meant by a reducing sugar.

   _____

   _____

2. Give two examples of reducing sugars.

   _____ _____

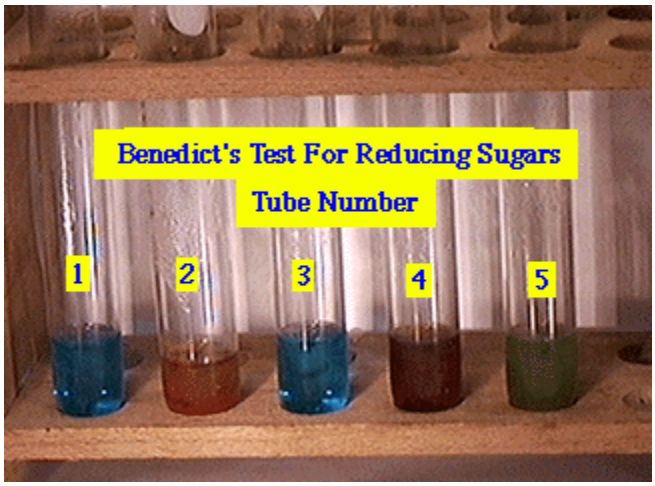
3. Reducing sugars react with Benedict's solution to form an insoluble red precipitate cuprous oxide [Cu2O]. The color change seen will vary depending on the amount of reducing sugar present.

Blue = none Green = + Yellow = ++ Orange = +++ Red = ++++	Positive Results for Benedict's Test for a Reducing Sugar  Green, Orange to Dark Brick Red

4. Test tubes are labeled, sugars and Benedicts reagents added and placed into a boiling hot water bath for 30 seconds. Why is this necessary to heat the test tubes?

   _____

5. Read and record the results from the test tube
   a. Test Tube #1 (sucrose + Benedicts) _____
   b. Test Tube #2 (maltose + Benedicts) _____
   c. Test Tube #3 (starch + Benedicts) _____
   d. Test Tube #4 (glucose + Benedicts) _____
   e. Test Tube #5 (fructose + Benedicts) _____



6. What test(s) was/were negative and why?

   _____

   _____

iii. Starch Hydrolysis

1. Starch hydrolysis will result in maltose and other short chained glucose molecules to be released. Why?

   _____

   What enzyme is necessary for starch to be hydrolyzed?

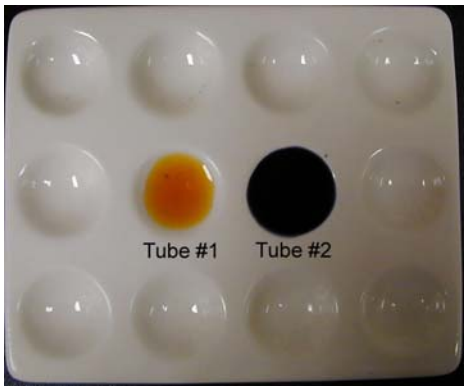
   _____

2. Two test tubes are set up and allowed to sit in a 37° water bath for 30 minutes. Why is this necessary to heat the tubes?

   _____

   a. In Test Tube #1: starch + enzyme
   b. In Test Tube #2: starch + water

3. Several drops from each test tube are put on a spot plate and Iodine is added to test for the presence of starch



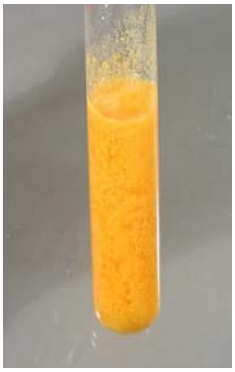
Record the results

Tube #1: _____

Tube #2: _____

Explain your results _____

4. Benedicts is added to the solution that remains in the test tubes and the tubes are then placed back in a hot water bath for 30 seconds and then removed.



Tube #1

Tube #2

Record the results

Tube #1 _____

Tube #2 _____

Explain your results _____

_____

III. Protein Digestion

a. Give the chemical structure and four functions of proteins

b. Where does protein digestion <u>begin</u> and what chemical is used?

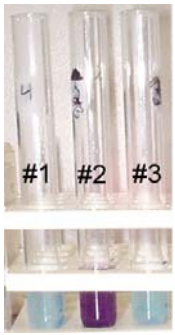
c. Name four protein enzymes present in the small intestines and give the source of these enzymes:
   1)
   2)
   3)
   4)

d. Biuret Test for Proteins

i. Biuret is a mixture of NaOH (sodium hydroxide) and CuSO4 (copper sulfate). In the presence of a protein, copper sulfate reacts with the peptide bonds causing a deep violet color change. If no protein was present or if complete digestion (no peptide bonds) has occurred, then no color change (blue) will be seen as shown in the control results below.

ii. Two test tubes are set up to determine the presence of proteins (albumin) and placed in a 37° water bath for 30 minutes.
Why is this necessary to heat the test tubes?
_____

iii. Experiment
   1. Test tube #1: water + albumin
   2. Test tube #2: water + albumin + pancreatin
   3. Test tube #3: water + starch + pancreatin



iv. Read and Explain your results
Test Tube #1: _____
Test Tube #2: _____
Test Tube #3: _____

IV. Lipid Tests

a. Where does lipid digestion BEGIN? _____

b. What enzyme is used for lipid digestion and give the source(s).

_____ _____

c. What is <u>original</u> <u>source</u> of bile? _____

d. What is the composition of bile? _____

e. Where is bile stored and why? _____

f. What hormone is involved in bile release? _____

g. What is the function of bile? _____

h. Define micelle and chylomicron by their structure and use.

i. Lipid Digestion Experiments

i. A litmus solution is used test the pH of the experimental fatty solutions such as cream. If enzymes and bile salts are present, then the fats in the cream can be hydrolyzed to create an acidic environment indicated by varying shades of pink color changes, while negative changes will be blue to purple and indicate a neutral or alkaline pH and therefore no lipid hydrolysis. Below are the color changes that indicate the pH results of lipid digestion (basic vs acidic) and the second photo shows the varying degrees of acidic pH reactions.

ii. Three test tubes are set up and put in a 37° water bath for 30 minutes. Why is this necessary to heat the tubes for this length of time?

_____

iii. Read the results for the following tubes

1. Test Tube #1: cream, water, bile, litmus solution
2. Test Tube #2: cream, pancreatin, bile, litmus solution
3. Test Tube #3: cream, pancreatin, litmus solution

iv. Explain your results

Tube #1: _____

Tube #2: _____

Tube #3: _____

j. Sudan IV Test

i. Explain what is meant by hydrophilic and hydrophobic?

_____

ii. Vegetable oil is added to a half filled test beaker of water and mixed. The results are pictured below. What happens to the oil and water?

_____

iii. Some of this solution is removed and added to a test tube. Sudan IV dye is then added to the test tube solution and mixed. The results are pictured below. Where is the dye located? _____ What is its solubility (water or fat)? _____

iv. Now several droppers of detergent water is added to the test tube above and mixed. The results are pictured below. Where is the dye?

_____

Explain what happened.

_____

V. Review Questions (Write answers on the back)

a. How is water involved with dehydration synthesis and hydrolysis?
b. How do we test for starch?
c. How do we test for reducing sugars?
d. How do we test for proteins?
e. How do we test for lipids?
f. Define emulsification.
g. What is the role of enzymes in the digestive process?