

## Chem 108: Lab Week 16

Sign in / Pick up Papers  
and Handouts

**Lab:**  
Discussion, Experiments & Graded Assignments:

- Week #16 Powerpoint .html, .ppt, Print: .pdf (6 slides per page)
- Global Warming-Carbon Footprint Bonus DUE 8-Dec
- Carbohydrates: Word Search DUE Today
- (GQ) Viewing: Carbohydrates *Guiding Questions*
- (GQ) Viewing: How sugar affects the brain *Guiding Questions*
- (GQ) Viewing: Flatulence & Carbohydrates *Guiding Questions*

**Experimentation:**

Amino Acids & Structural Proteins:  
chemical change with or without heat in albumin

Instructions & Report Form DUE 6-Dec

Name: \_\_\_\_\_

### Sugar Wordsearch

Terry L. Heller

Department of Chemistry, SUNY College at Oswego, Oswego, NY 13020-4015; helleter@oswego.edu

This puzzle contains 29 names, terms, prefixes, and acronyms that describe sugars and their polymers. Find and highlight these terms in the matrix below. "CARBOHYDRATE" is already done for you. Then, carefully transfer them to the blanks in the description below the matrix. Use the letters remaining in the matrix to complete the sentence describing these molecules. Your answer will be e-mailed. The answers to the Sugar Wordsearch are listed below. Good hunting!

NIETORPOCYLGSU CARBOHYDRATE can be S....., a that are  
NITIHCGLUCEG nitrate A..... or K..... and an anion R.....  
KETOSSESODLA sugars. Table sugar S..... is a D.....  
EAGCHEXOSEIPER of the R..... a F..... and C..... in cyclic  
SSLSOSSIRAYSS furanose and P..... forms, respectively. L..... is  
OYTNPAMAKRON glucose linked to C...... Phos size energy in the  
TGCAHCHYDRATE....., which contains A..... and  
CAORENCLIFRCG...... The animal equivalent is G.....  
ARLCCOEYSWUO The only....., rare in them is the alpha A..... of  
LNHASELPMISRC glucose. Beta linked glucose or 1,4-glycosidic linkage makes  
AAPSEREMONAFY C..... or C....., respectively. Both are structural  
GNICDERETSEEL polymers. Complex molecules like G..... and  
EDDCCELLULOSETG P..... have sugars attached. Finally,  
phospho....., branch into R..... units in the back-  
bone of...... Converting the protein into the amino form  
produces a..... strand.

Use the remaining letters to fill in the following sentence: \_\_\_\_\_

Wordsearch Due Today

### Procedure

This procedure must be carried out in the fume hood. Acetic anhydride is an irritant and sulfuric acid is very corrosive.

Record the mass of approximately 6.0 g of salicylic acid in a clean, dry 125 mL erlenmeyer flask. In the fume hood add 8 mL of acetic anhydride to the flask and then slowly add 10 drops of concentrated sulfuric acid. Clamp the flask with a boiling chip or two to a ring stand. Heat the Erlenmeyer flask with occasional stirring for 15 minutes. If solid remains, heat it for 5 more minutes. Add about 20 mL of ice-cold deionized water to cool the flask and slowly add 20 drops of deionized water to cool the flask and slowly add 20 drops of ice-cold deionized water and cool the flask to be complete. (Hint: slow rubbing of the bottom of the flask under the solution with a stirring rod sometimes speeds up crystallization.) Assemble a Büchner funnel and filter flask and filter the crystals by vacuum filtration. (Your instructor will demonstrate how to do vacuum filtration.) If you wish to rinse the residue from the flask into the funnel, you may either use the residue (the solution in the filter flask) or a small amount of ice-cold deionized water in the hood sink.

The aspirin may be further purified by recrystallization. Dissolve the aspirin in about 20 mL of ethyl alcohol, and warm the solution in a water bath. Filter the solution in the filter flask. DO NOT GET ETHYL ALCOHOL ON YOUR SKIN OR CLOTHING. IT IS FLAMMABLE!! Stir to dissolve it completely, and then add 50 mL of warm (70°C) deionized water. Cool the mixture in an ice bath until recrystallization is complete. Vacuum filter the product and allow it to dry on the filter paper until the next lab period. The filtrate may be disposed of in the sink. When your aspirin is dry, put it in a weighed plastic vial and weigh it again. Record the mass. Calculate the percent yield.

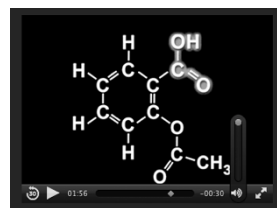
Solid aspirin should be disposed in the organic solid waste.

## Chem 108 Synthesis of Aspirin

Report Form Due Today

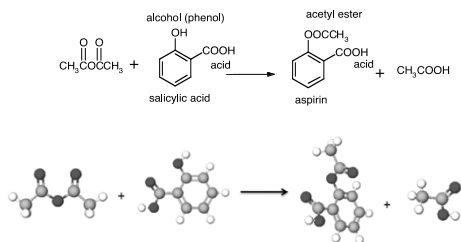
Weighing Aspirin Product & % Yield

## Representing Organic Molecules Aspirin



<http://chemconnections.org/general/movies/Representations.MOV>

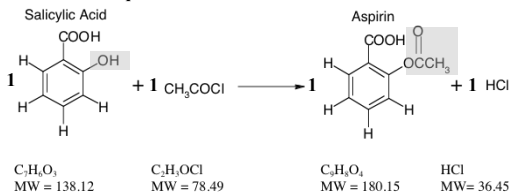
## Chem 108 Synthesis of Aspirin



## Mass Calculations: Reactants → Products

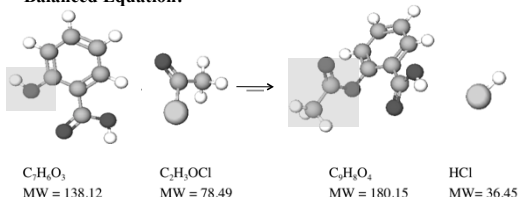
- How many grams of aspirin are theoretically produced from 6.0 g of salicylic acid with an excess of acetyl chloride, C<sub>2</sub>H<sub>3</sub>OCl?

- Balanced Equation:

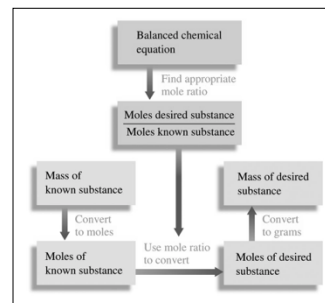


### Mass Calculations: Reactant $\rightarrow$ Product

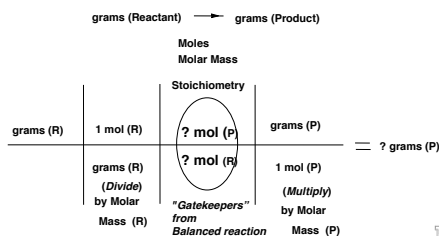
- How many grams of aspirin are theoretically produced from 6.0 g of salicylic acid with an excess of acetyl chloride,  $C_2H_3OCl$ ?
- Balanced Equation:



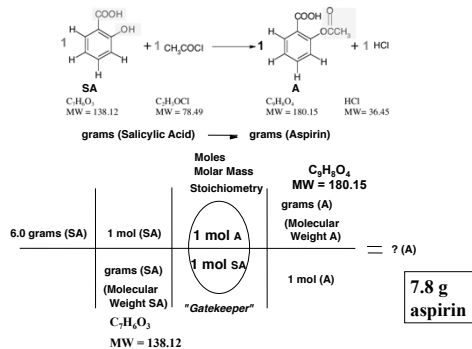
### Mass Calculations: Reactants $\leftrightarrow$ Products



### Theoretical (Yield) Mass Calculations Reactant $\rightarrow$ Product



### Mass Calculations:



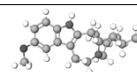
### Percent Yield

- In synthesis as in any experiment, it is very difficult and at most times impossible to be perfect. Therefore the actual yield (g) is measured and compared to the theoretical calculated yield (g). This is the percent yield:

% Yield = actual (g) / theoretical (g)  $\times$  100



### QUESTION

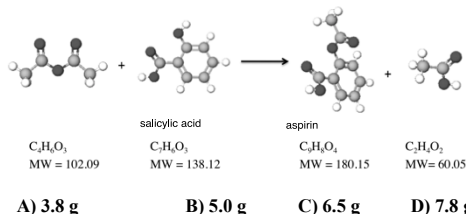


- A synthetic reaction produced 2.45g of Ibogaine,  $C_{20}H_{26}N_2O$ , a natural product with strong promise in treating heroin addiction (at least in Europe), the calculated theoretical yield was 3.05g, what is the % yield?

A) 19.7%    B) 39.4%    C) 80.3%    D) 160.6%

## QUESTION

- How many grams of aspirin are theoretically produced from 5.0 g of salicylic acid reacting with an excess of acetic anhydride,  $C_4H_6O_3$ ?
- Balanced Equation:



## QUESTION

Noelle's synthesis of aspirin,  $C_9H_8O_4$ , produced 5.90g. The calculated theoretical yield was 6.50g; what is her % yield?

- A) 47.5%      B) 80.3%      C) 90.6%      D) 110%



### Procedure

This procedure must be carried out in the fume hood. Acetic anhydride is an irritant and sulfuric acid is very corrosive.

Record the mass of approximately 125 mL of concentrated sulfuric acid. Carefully add 10 drops of concentrated sulfuric acid to a ring stand. Heat the Erlenmeyer flask for 15 minutes. If solid remains, heat the flask and slowly add 20 mL of ice-cold deionized water to cool the mixture. Rubbing the bottom of the flask with a small amount of ice-cold deionized water will help with crystallization. (Your instructor will demonstrate the proper technique.)

**Weigh filtered crude aspirin & calculate % yield. Turn in Report Form with partner's names.**

slowly add 10 drops of acetic anhydride and a boiling chip or two to the flask and slowly add 20 mL of ice-cold deionized water to cool the mixture. Rubbing the bottom of the flask with a small amount of ice-cold deionized water will help with crystallization. (Your instructor will demonstrate the proper technique.)

Name: \_\_\_\_\_

Section: \_\_\_\_\_

Report Form - Preparation of Aspirin

Mass, salicylic acid	
Mass, container + aspirin	
Mass, container	
Mass, aspirin*	
Theoretical yield*	
Percent yield*	

Show the calculations for each of the entries in the Data Table marked with \* on the calculations page.

The aspirin may be dissolved in alcohol, and warm water. Stir to dissolve it in an ice bath until the filter paper is wet. Then, pour it in a wet beaker. Solid aspirin should appear.

Is by vacuum filtration. Wash the flask and slowly add 20 mL of ice-cold deionized water to cool the mixture. Rubbing the bottom of the flask with a small amount of ice-cold deionized water will help with crystallization. (Your instructor will demonstrate the proper technique.)

at 20 mL of ethyl alcohol. DO NOT LAMMABLE!! Cool the mixture and dry it on the filter paper. The percent yield is the percent yield.

Name: \_\_\_\_\_

### Sugar Wordsearch

Terry L. Heller

Department of Chemistry, SUNY College at Oswego, Oswego, NY 13020-4016; jheller@oswego.edu

This puzzle contains 20 names, terms, entities, and acronyms that describe sugars and their properties. Find and highlight these terms in the matrix below. CARBOHYDRATE is already done for you. Then, correctly transfer them to the blanks in the description below the matrix. Use the letters remaining in the matrix to complete the sentence describing these materials. Your answers will be revealed. The answers to the Sugar Wordsearchs are found below. Good hunting!

NIETORPOCYLGUSU CARBOHYDRATE can be S... which are  
 NITIHCGLUCCOSEG either A... or K... and are therefore R...  
 KETOSESSESSODLA sugars. Table sugar, S..., is a D...  
 EAGCHEKOSSEIPEP of the H... F... and C... in cyclic  
 SLSSESOBIRAYSS isomer and F... forms, respectively. L... is  
 OUYTNPAMAKRON glucose linked to C... These two rings in the  
 TGO... The natural equivalent is C...  
 CAORENCHLIFNCG The only... more in them is the alpha A... of  
 ARLCOCOEYSWOOU glucose. Beta-linked glucose or D-glucopyranose makes  
 LNIHASELPMISRC C... or C... respectively. Both are structural  
 AAPSERENOWAEFY isomers. Complex molecules like S... and  
 GNICUDERETSEEL P... have sugars attached. Finally,  
 EDDCELULULOSETG phospholipids... back into R... into the back-  
 board of... Connecting the proteins into the dense form  
 produces... strand.

Use the remaining letters to fill in the following sentence:

Wordsearch Due Today

## Chem 108



### Lipids:

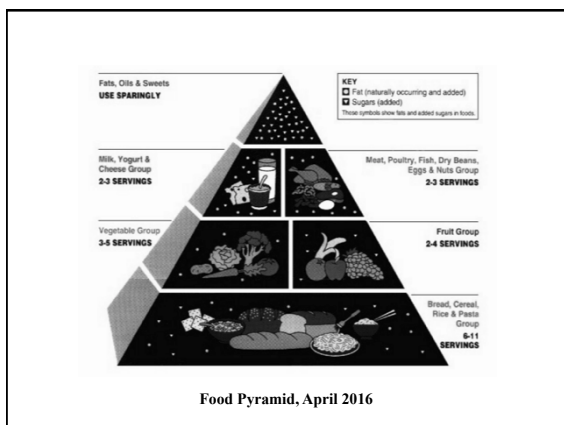
fats, oils, waxes,

terpenes ( $C_{5x}$ -carbon formulas), eg. steroids

## Lipids: Fats & Oils

Lipids are natural plant & animal products more soluble in non-polar solvents like gasoline than in water.

Combustion (burning) of one gram: of carbohydrate produces 4 to 5 Calories, protein produces 4 to 5 Calories, fat produces 9 to 10 Calories — more than twice that of either sugars or proteins.



The human body is 60-70 percent water, blood is ~90 percent, the brain and muscles are ~75 percent, and bones are ~20 percent by mass. \* A human can survive for a month or more without eating food, but only 1-2 weeks without drinking water.

How much energy is required to raise the water in your body from 25°C (average room temperature) to 37°C (average body temperature [that is, chemical - biological temperature])? Assume that there is the equivalent of 5 liters of water,  $d = 1.0 \text{ g/mL}$  in your body. The heat capacity of water is  $4.184 \text{ J/g}^\circ\text{C}$  ( $1.00 \text{ cal/g}^\circ\text{C}$ ); ( $0.001 \text{ Cal/g}^\circ\text{C}$ ); ( $0.001 \text{ kcal/g}^\circ\text{C}$ )

How many grams of fat would need to be burned? (9 Cal/g)

How much energy is required to raise the water in your body from 25°C (average room temperature) to 37°C (average body temperature [that is, chemical - biological temperature])? Assume that there is the equivalent of 5 liters of water,  $d = 1.0 \text{ g/mL}$  in your body. The heat capacity of water is  $4.184 \text{ J/g}^\circ\text{C}$  ( $1.00 \text{ cal/g}^\circ\text{C}$ ); ( $0.001 \text{ Cal/g}^\circ\text{C}$ ); ( $0.001 \text{ kcal/g}^\circ\text{C}$ )

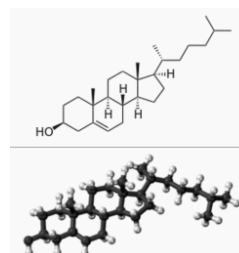
$$(37^\circ - 25^\circ\text{C}) \times 5,000 \text{ mL} \times 1.0 \text{ g/mL} \times 4.184 \text{ J/g}^\circ\text{C} = 250 \text{ kJ} = 60 \text{ Cal}$$

How many grams of fat would need to be burned? (9 Cal/g)

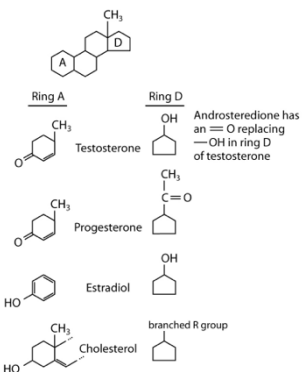
$$60 \text{ Cal} / 9 \text{ Cal/g} = 6.7 \text{ g}$$

... but how long does it last before you need more?

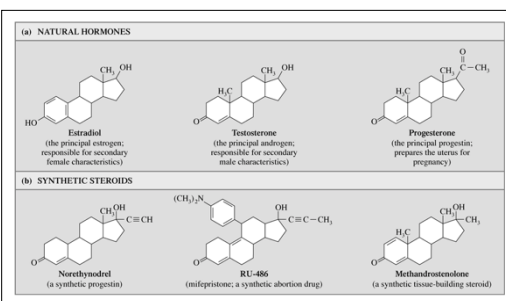
## Steroids



- What is cholesterol?
- Is there such a thing as “good” vs. “bad” cholesterol?
- How does it relate to fat?

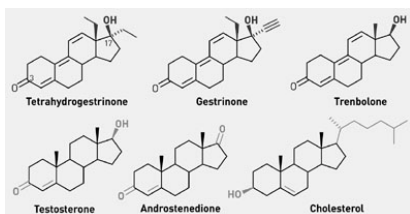


## Structures of selected steroids. (Sex hormones and synthetic compounds that have similar actions.)



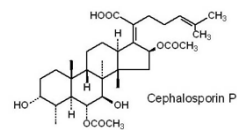
<http://www.cbsnews.com/videos/russias-dark-secret/>

### Anabolic Steroids



### Question

- The backbone structure of cephalosporin P is classified as a



- A) fatty acid.
- B) steroid.
- C) cholesterol.
- D) amino acid.

Names: \_\_\_\_\_

### Protein-Protein Interactions I Human Collagen

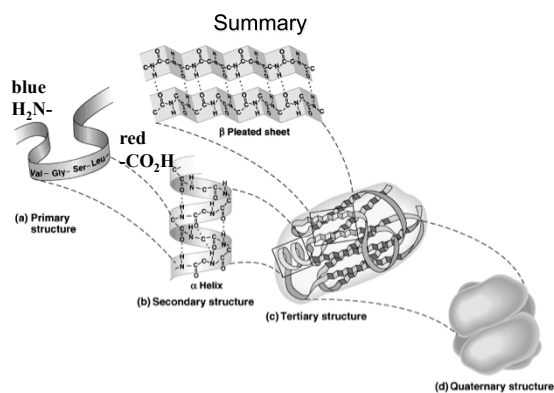
Reading: <http://chemconnections.org/general/chem106/Tech%20Prep/Protein%20Activity%201-1-2016.html>



Using the beads and string provided, assemble a string of amino acids for the following primary protein sequence of a portion of one chain of human collagen. Use one colored bead to represent each amino acid. Refer to the amino acid handout that was provided in class. There are only ten different colors of beads in the kit. If more than ten different amino acids are present, use the same color twice. Tag your string with your names and turn it in with this form. Provide the color key that you used on the back of this page.

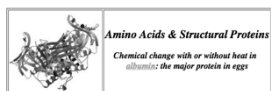
PGFTTSIQMT DLHTRDLVY SLKDYIKAREE KLRQKKRAEK LDRLTSTATKD

**Amino Acids & Proteins  
Handout  
Turn in beads & form today  
Then pick up albumin**

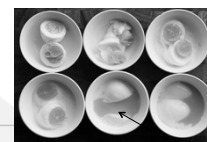


### Chem 108 Week 16

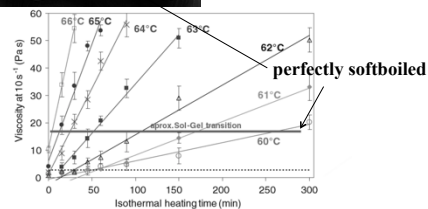
<http://chemconnections.org/general/chem108/Protein%20Activity%201-2016.html>



**Amino Acids & Proteins (egg albumin)  
Handout  
Report & Post Lab Questions Due Next Lab**



**Cooking the perfect egg:  
denaturing albumin**



<http://chemconnections.org/general/chem106/Tech%20Prep/Protein%20Activity%201-2016.html>

