Lecture Outline Chapter 4- Part 2: The Carbohydrates

I Types of Carbohydrates

If someone told you "My carbohydrate intake is too high", what would you assume about what they're eating? _____

A. **SIMPLE CARBOHYDRATES: Monosaccharides-** single sugars.

1. Examples- **glucose**  **(<u>fruits, vegetables, honey & High Fructose Corn Syrup (HFCS)</u>))**

   When it's making glucose, where does the plant put the sun's energy?

   Why does a plant need to make glucose?

   What is glucose so important to us?

2. **Fructose**  **(<u>fruits, vegetables, honey & High Fructose Corn Syrup (HFCS)</u>))**

   Why does a plant need to make it?

   What does our liver do with fructose?

3. **galactose**  **(<u>not in food alone</u>)**

   Why don't plants need to make it?

   What does our liver do with galactose?

   What does our digestive system need to do to the monosaccharides in food before anything gets into our blood?

   Is organic cane sugar more nutritious than High Fructose Corn Syrup?

B. SIMPLE CARBOHYDRATES: Disaccharides- double sugars

1. Maltose- 1 glucose bonded to 1 glucose **(grains that have sprouted)**

Draw what it would look like**,** based on how the monosaccharides are drawn in this outline above.

After enzymatic digestion of maltose what is absorbed?

2. Sucrose- 1 glucose bonded to 1 fructose **(table sugar, fruits & vegetables)**

Draw what it would look like

After enzymatic digestion of sucrose what is absorbed?

Why does a plant need to make it?

3. **Lactose-** 1 glucose bonded to 1 galactose **(milk sugar)**

Draw what it would look like

After enzymatic digestion of lactose what is absorbed?

What do the structures of all 3 disaccharides have in common? _____

What does our digestive system need to do to the disaccharides in food before anything gets into our blood? _____

Why is it good for us to eat foods with sugar? _____

What foods are the most nutritious foods to eat to get sugar?

_____

C. **COMPLEX CARBOHYDRATES: Polysaccharides**

1. **Starch** (also called **amylose**) **(in any food that is or is made from a seed)**
   a. What is starch composed of?

   b. Draw what it would look like.

   c. Why does a plant need to make starch?

   d. Why is it good for us to eat foods with starch?

   e. What foods are the most nutritious foods to eat to get starch?

   f. Do most fruits have much starch? _____ Why?

   g. What does the human body need to do to the starch in food before anything gets into our blood? _____ (Name of enzyme: _____)

2. **Glycogen** (stored animal starch). **(NOT in food)**

   a. Branched chains of many _____ molecules

   b. Draw what it would look like.

   c. made & stored in the liver and muscles of humans & other animals. Why don't you get glycogen when you eat meat?
   _____

   d. Why is glycogen so important to you? _____

   e. Body makes it after eating foods rich in _____ & _____.

   f. Can make a MAXIMUM of about 1 pound of glycogen in your body. Only store enough to last 4-12 hours of not eating carbohydrate.

   g. Muscle glycogen can be broken down to provide glucose for that muscle only

h. Liver glycogen can be broken down to glucose that can travel in the blood, thereby increasing blood glucose.

i. How is glycogen different than starch in structure?

3. **Fibers**. Indigestible by Small Intestine enzymes. Types- _____ & _____

a. *Water **In**soluble Fibers*- In ALL whole plant foods

Cellulose is example. Purpose in plant: _____

What is the building block of cellulose? _____ bonded differently than in starch.

Draw what it would look like.

Does anything happen to cellulose so something can get into our blood?

Why is it good for us to eat foods with insoluble fiber?

b. *Viscous Fibers (Water Soluble)*- In SOME whole plant foods like oats & cooked dried beans (legumes)

Gums & **Pectins** are examples. Purpose in plant: _____

What are the building blocks of pectins and gums?_____

Does anything happen to pectin & gums so something can get into our blood?

Why is it good for us to eat foods with soluble fiber?

What foods are the most nutritious foods to eat to get fiber?

II Processing of Foods With Carbohydrate

A **WHOLE FOOD** or a **mostly** WHOLE FOOD has most of its edible parts there. These include foods like whole wheat bread (it's made from wheat berries), brown rice, refried beans and dehydrated whole foods like dehydrated onions and peeled foods like a peeled apple. For this class we will call all of those foods WHOLE FOODS.
A **PARTITIONED FOOD** has had a **major** part of it removed. Some partitioned foods are still nutritious, like juice, which still contains a big part of the original food. Juice, though, has lost most of its _____.
A **REFINED** food is partitioned into only a **small** part of the original food.

A. Based on this explanation, label what each of the following foods are:

Whole wheat flour _____

Wheat flour _____

Orange _____

Orange juice _____

High fructose corn syrup _____

Dehydrated Apricots _____

Refried beans _____

Peeled & mashed potatoes _____

Brown rice _____

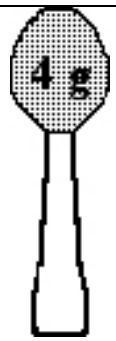
White rice _____

Soybean oil _____ (refined germ. ONLY the **fat** of the soybean)

B. Consuming lots of **refined** foods can change carbohydrate intake in 2 important ways:
sugar _____ fiber _____

C. **Added sugar in foods.**
What are some examples of foods that have sugar that's naturally there?
_____

1 teaspoon sugar weighs 4 grams. (Memorize this.)



12 oz. **soft drink**. Name of drink _____
Sugar, g _____. Teaspoons of sugar that's equal to _____

Slim Fast 12 oz. can _____
Sugar, g _____. Teaspoons of sugar that's equal to _____

# of sugar cubes in a Big Gulp _____

When looking at the sugar on a label, this includes both NATURAL and ADDED sugar. To know if there are added sugars in a product you must look at the _____.

D. **Enrichment**. Enriched vs. Whole Wheat Bread

1. **Enriched**- requires the following nutrients to be added to white flour & its products as well as to white rice- *thiamin, riboflavin, niacin, folic acid, iron*
2. Which is more nutritious, enriched bread or whole wheat bread? _____

Why? _____

3. If a bread is called "Wheat Bread", what is probably its first ingredient? _____

4. How do you know if a bread is truly Whole Wheat?

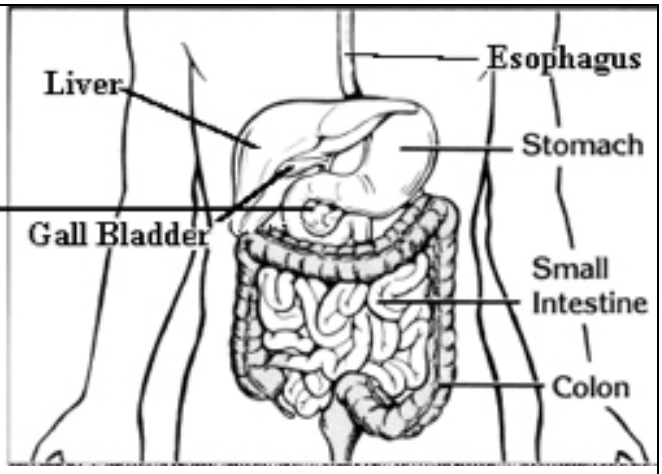
Why are processed foods often much cheaper than whole foods?

III Digestion and Absorption of Carbohydrates (see text p. 77)

A. REVIEW- After eating, what needs to happen in the digestive tract to the:
   1. Monosaccharides in food _____
   2. Disaccharides in food _____
   3. Starch in food _____
   4. Fiber in food _____

B. While enjoying a snack of an apple, what carbohydrates must be enzymatically digested? (See notes above and, MISC INFO, Food Sources Carbohydrates, Lipids, Proteins- posted in moodle)

C. After digestive enzymes have done their thing, what is absorbed into the villi?



D. Locations in body where **bacterial** digestion of carbohydrates can be a problem

1. ***Mouth***: **Sucrose**

   What happens in the mouth after eating foods with sugar? *Plaque bacteria eat sucrose and break the sugar down* ***anaerobically*** *to get energy from it.*

   What is left as a result of this breakdown? _____ _____.

   This acid destroys _____ of teeth. Result? _____

   Ways to decrease risk of cavities: _____

   _____ _____

   _____

2. ***Colon*****: Lactose**

   What happens if Lactose Intolerant? *Bacteria in LARGE INTESTINE eat the lactose and make _____ as a by-product.*

   Resulting symptoms:

   Getting enough calcium if lactose intolerant:

   Drink 1/2 cup milk WITH meals OR drink milk w/ _____ added.

   Yogurt without added _____.

   Aged, hard cheese, like _____ because bacteria ate most of the _____ during aging.

   Dairy alternatives to get calcium:

IV In the Body: Glucose As Fuel

A. What happens to make **BS Rise.** After eating foods with carbohydrate, these carbohydrates are digested by enzymes down to _____ and these monosaccharides are absorbed into the blood. Then the fructose & galactose are changed to _____ in liver.

1. Sugar (glucose) leaves bloodstream and enters cells.
   Role of insulin (a hormone made by the pancreas and secreted into the blood)

2. **IF ENERGY IS NEEDED**
   Split apart glucose in **body's cells** to release the energy & make $C0_2$ & H_20

3. If energy **NOT** needed
   a. glucose stored as _____ or
   b. changed to _____

B. Body's Response when **BS fall**s

1. You receive messages from your brain & nervous system to _____

2. If you don't eat, what is your body's first way of getting glucose?
   _____

   Hormones that send messages for this to happen- **glucagon** (made by pancreas) & **epinephrine** (the major stress hormone)

   What do **insulin & glucagon** have in common?

   How are **insulin & glucagon** different?

3. If you have already used up your liver's glycogen, what is the next way your body has of getting glucose? ***rearrange _____ in muscles into***

   _____
   WHAT ARE MUSCLES MADE OF?
   a. Protein
   b. _____
   c. _____ and
   d. water

   When your blood sugar falls & liver glycogen is gone, what in muscles can be used to raise your blood sugar?
   _____

List the 3 ways your body can raise your blood sugar.

Can fat be used to raise your blood sugar?

C. **Excesses** of Glucose. What happens to it?

Why does eating lots of sugar or starch usually not lead to sustained high blood sugar levels?

_____

D. **Deficiencies** of Glucose

1. **Ketosis**- buildup of ketones in blood

   a. What causes it?

   b. List 3 situations that can lead to less glucose being in cells and therefore ketosis.

   c. Symptoms- decreased appetite, increased thirst & urination
   Why decreased appetite?

   Why increased thirst & urination?

   d. Short-term ketosis itself might not be dangerous, except if **<u>diabetic</u>** or **<u>pregnant</u>**. But if your body is in ketosis, what does this also mean is happening in the body? _____
   _____
   (Hint- If you're in ketosis, it means your cells aren't getting enough glucose. So how will your body make sure your brain gets some glucose?)

2. **Hypoglycemia** (*hypo*- low, *glyc*- sugar, *emia*- blood)

   a. Symptoms: weakness, headache, confusion
   b. Some people have symptoms but normal blood sugar. May be caused by frequently changing from a low carb. diet to lots of sugar.
   c. Cause of **<u>true</u>** hypoglycemia- tumor of pancreas or hepatitis of liver or other disorder.
   d. DIAGNOSIS of Hypoglycemia (& diabetes)- Glucose Tolerance Test.

E. **Diabetes**- not enough insulin or ineffective insulin

1. **Type I-** don't make enough insulin, so must take by injection. Why can't insulin be taken in pill form?

   Problems come from long term _____ blood sugar and _____ cell glucose: capillaries destroyed so tissues die from lack of _____, so **kidney & eye disease, heart attacks**

2. **Type II**- make enough insulin, but ineffective. Sometimes given a pill that stimulates the pancreas to make even more insulin.

   Treatment- diet, weight management, exercise, stress management

   Diet- high in vitamins, minerals & complex carbohydrates (_____ **&** _____) moderate in protein, low in _____ and _____ fat and moderately low in _____ sugars.

   Exercise: helps maintain desirable _____ & improves cell's sensitivity to _____

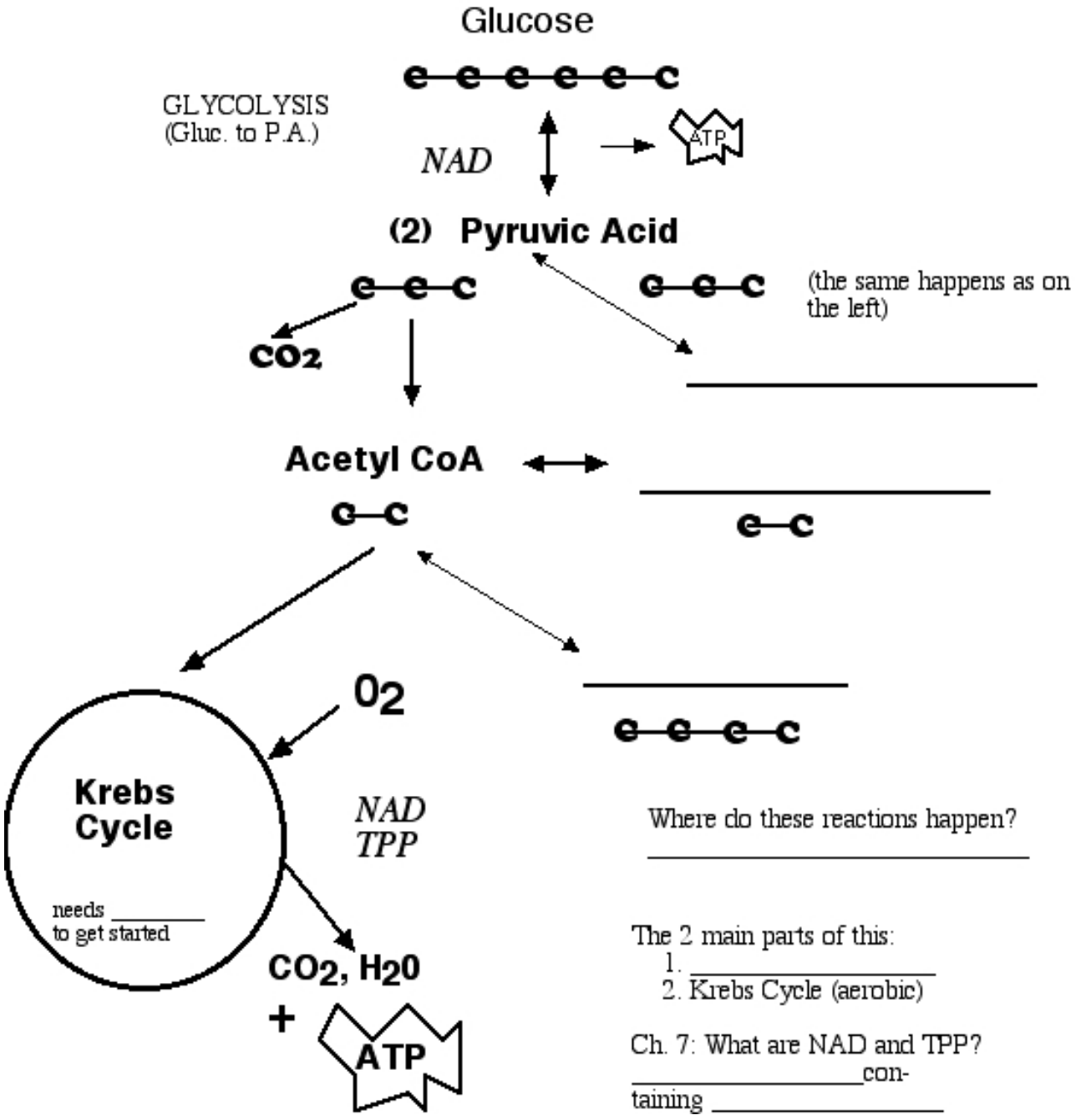
   Is this different than recommendations for non-diabetics?

   Why are rates of diabetes now exploding world-wide?

C = _____

Cellular Respiration (Energy Metabolism; "Step 5")

This is actually step ____ of Wilbur. Glucose combines with _____. This breaks apart the glucose, releasing _____ as ATP & producing _____ & _____.



Where do these reactions happen?

_____

The 2 main parts of this:
1. _____
2. Krebs Cycle (aerobic)

Ch. 7: What are NAD and TPP?
_____con-
taining _____