Chapter 6 Proteins and Amino Acids

I Introduction

What is an ***element***? _____

What elements do carbohydrate, fat & protein have in common?

_____

The *element* in protein NOT found in either carbohydrate or fat- _____

II The Structure of Amino Acids and of Protein

A. What is the structure of an ***amino acid***?
   1. central carbon and one hydrogen
   2. an acid group (carbon, a oxygen and an OH) (COOH)
   3. an amino group (NH2)
   4. a side chain, which is different for each amino acid (make amino acids differ in size, shape, and electrical charge)

B. What are the building blocks of ***protein***- _____ (_____ different ones the body uses)
   1. How does the body get these amino acids?
      1. _____ protein
      2. _____ old, worn out proteins in the body
      3. _____ amino acids
   2. What is the definition of "essential amino acids"?
   3. What is the definition of "non-essential amino acids"?

      What does the **cell** use to make these non-essential amino acids?
   4. How does the body know how to put these amino acids together to make a protein it needs, like hemoglobin or insulin or muscle tissue?
   5. Name of bond joining one amino acid to another- _____ bond
   6. The protein coils and folds based on how the amino acids in the strand attract and repel one another.
   7. _____ determines function.

C. The slinky structure of ***protein***
1. What does the coiled & twisted slinky represent? _____

   What process in the body uncoils the proteins in the food you eat?

   _____
2. What did the cut up pieces of wire represent? _____

   What process in the body breaks up the uncoiled protein into amino acids?

   _____

III FUNCTIONS in the Body of Proteins

A. ***STRUCTURAL* PROTEINS-**
3. Collagen- skin, tendons, connective tissue, bones, scar tissue, hair, nails
4. Proteins making up muscles and organs

B. ***WORKING* PROTEINS (help the body FUNCTION)**
1. Hormones, examples from chapter on carbohydrate
   a. _____
   b. _____
2. Enzymes, examples
   a.
   b.
   c. Where do our digestive enzymes come from?
5. Transport proteins
   a. lipoproteins. What do these proteins transport? _____
   b. Sodium/Potassium pump (an example of a cellular pump)
   c. hemoglobin. Transports what? _____
6. Plasma proteins. How do these help regulate fluid balance in the blood and help prevent **edema** (definition- accumulation of fluid in body's tissues)? ***Large, negatively charged proteins in blood attract water back into the blood that has accumulated in tissues.*** Why has this water gone into the tissues?
7. Antibodies
8. Energy- usually use _____ & _____ before using protein

   What is the important way the muscles help provide energy for the brain?

IV Protein in the Diet- Quality

Measures of Protein **Quality** in a food: ***digestibility*** and how well the ***amino acid pattern*** of the protein supports growth.

A. **Digestibility** Animal protein is more digestible than plant protein.

B. Amino Acid **Pattern**

1. **Complete protein**
   a. Definition: a protein in food that has all the ESSENTIAL amino acids (in the needed proportions) for building protein in the **cells** of the body
   b. Food sources- (See the document, "Food Sources and Health Benefits of the Macronutrients" posted in moodle).

   c. Why does the chicken put protein in the egg? (There are equal amounts of protein in the yolk & white.)

2. **Incomplete protein**
   a. Definition- a protein in food that is missing enough of one or more of the essential amino acids needed for the building of protein in the body's **cells**
   b. Food sources- (See the document, "Food Sources and Health Benefits of the Macronutrients" posted in moodle).

   c. Why does the plant put protein in the seed?
   d. Why do kidney beans have more protein than green beans?

3. **Mutual Supplementation** Proteins- 2 **in**complete proteins that when combined form complete protein (legume + grain)
   Example:_____

Which of the following are examples of **Mutual Supplementation**?
a. bean burrito b. oatmeal & milk c. split pea soup & cornbread d. green beans & dinner roll

V Problems with Protein <u>Quantity</u>

A. Problems with **high** protein levels in your diet:

1. Amine group (the N part) of extra amino acids - pulled off by _____ & excreted by _____

   This can be hard on _____ and _____

2. Central C & H, acid groups (COOH) & side chains (mostly C, H, O)- used for _____ if you need it OR if the calories are extra, it is changed into _____
3. may accelerate adult _____ loss by causing _____ loss
4. Harmful to _____ because a high protein diet is typically high in _____ fat and _____.
5. **<u>Environmental</u>** problems of raising lots of protein-rich foods:
   a. feedlot beef and pork: *<u>animal waste leaches into soil, water & air</u>*
   b. grazed beef: *<u>loss of native plants, soil erosion, water depletion</u>*
   c. chicken farms: *<u>same as "a"</u>*
   d. free-range chicken: *<u>loss of native plants</u>*
   e. farmed fish: *<u>chemicals in feed, spread disease [changes fish nutrients]</u>*
   f. naturally-raised fish: *<u>kills non-food fish</u>*
   g. Dairy cows: *<u>growth hormones</u>*
   h. So what's a person to eat if vegan is not your choice?

B. Protein **Deficiency:** Global Hunger

1. 1st cells to suffer- those replaced most often, including RBCs, plasma proteins & inner & outer skin cells.
   So what would you expect **<u>early</u>** symptoms to be?
   _____

2. two forms of PEM (**<u>p</u>**rotein **<u>e</u>**nergy **<u>m</u>**alnutrition) also called PCM
   a. _____- protein malnutrition
   b. _____- energy (calorie) malnutrition

VI Digestion of Protein

A. Denaturation: 1st part of **chemical** digestion

1. What is denaturation? ***uncoiling or distortion of protein's natural shape***
2. What causes it? ***heat, alcohol, acids, bases, salts of heavy metals like silver or mercury***
3. Example of denaturation in the **body**-
4. Example of denaturation in **food**-
5. Examples of using denaturation for medical uses:
   - **a.** Fever-
     - [1] What cause denaturation during a fever?
     - [2] Why might this be helpful?
     - [3] Why might a too-high fever be dangerous?
   - **b.** Cleaning a **thermometer** with alcohol. Why does this cut down on spread of infections?
   - **c.** If you swallow a salt of a heavy metal like mercury or silver, why is it dangerous?

B. **Enzymatic** digestion: 2nd part of **chemical** digestion

1. After enzymatic digestion of the **protein** in a meal, what is the main thing that is absorbed into the blood?
2. places making enzymes for protein digestion- stomach, pancreas, surface of small intestinal cells
3. Where does enzymatic digestion of protein begin? _____ & end? _____
4. Where does enzymatic digestion of starch begin? _____ & end? _____
5. Where does enzymatic digestion of fructose begin & end?
6. Where does enzymatic digestion of triglycerides begin & end?
7. What is the difference between denaturation of food proteins & enzymatic digestion of food proteins?

8. Consider a breakfast of oatmeal & a little butter.
   - What, in this meal, needs to be enzymatically digested?

   - After enzymatic digestion of the oatmeal & butter, what is absorbed into villi?

VII Using Amino Acids

The Fate of an Amino Acid that was originally part of a protein in _____ once it arrives at a _____

A. if there's **NOT** enough **glucose** available to the cell, the AA will be stripped of its _____ (which is excreted in _____) and the rest of it will be
   1. rearranged into _____ for use by brain
   2. burned as fuel
B. if there **IS** enough **glucose** available to the cell, the AA will be used to:
   1. make a _____ the cell needs, like tissue proteins, muscles or enzymes
   2. make another _____ the cell needs
   3. make other small nitrogen-containing compounds such as _____.
   4. rearrange it & store it as_____
C. Carla has been following a high proteina and low carbohydrate diet. Explain what would happen to much of the protein she is eating.
D. Don has been eating a diet with plenty of foods containing carbohydrate and protein. What happens to the **protein** in his foods?
E. Which can the body use to make glucose for the brain:
   a. liver glycogen b. muscle glycogen c. muscle protein d. fat in the body