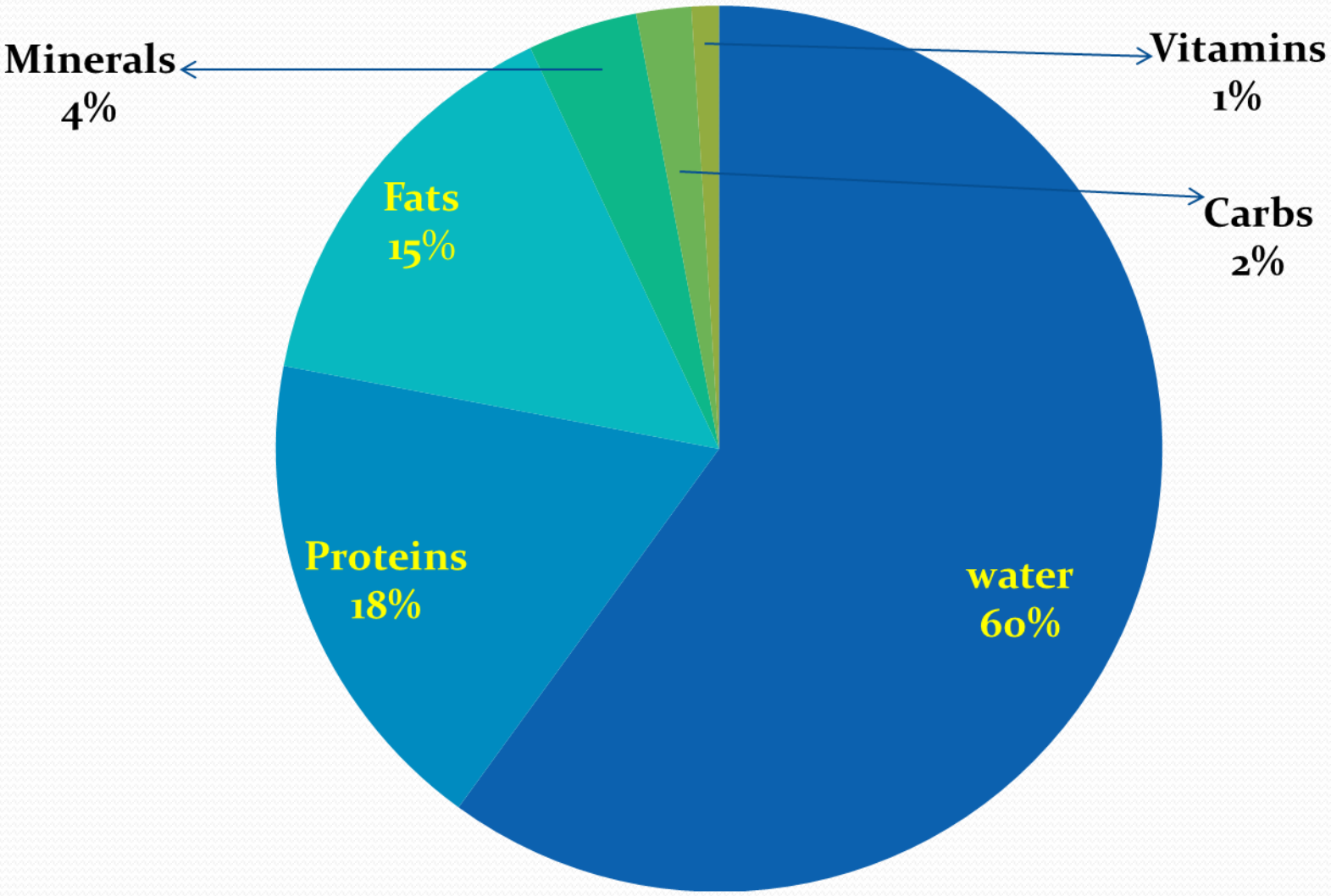
Lecture 1:

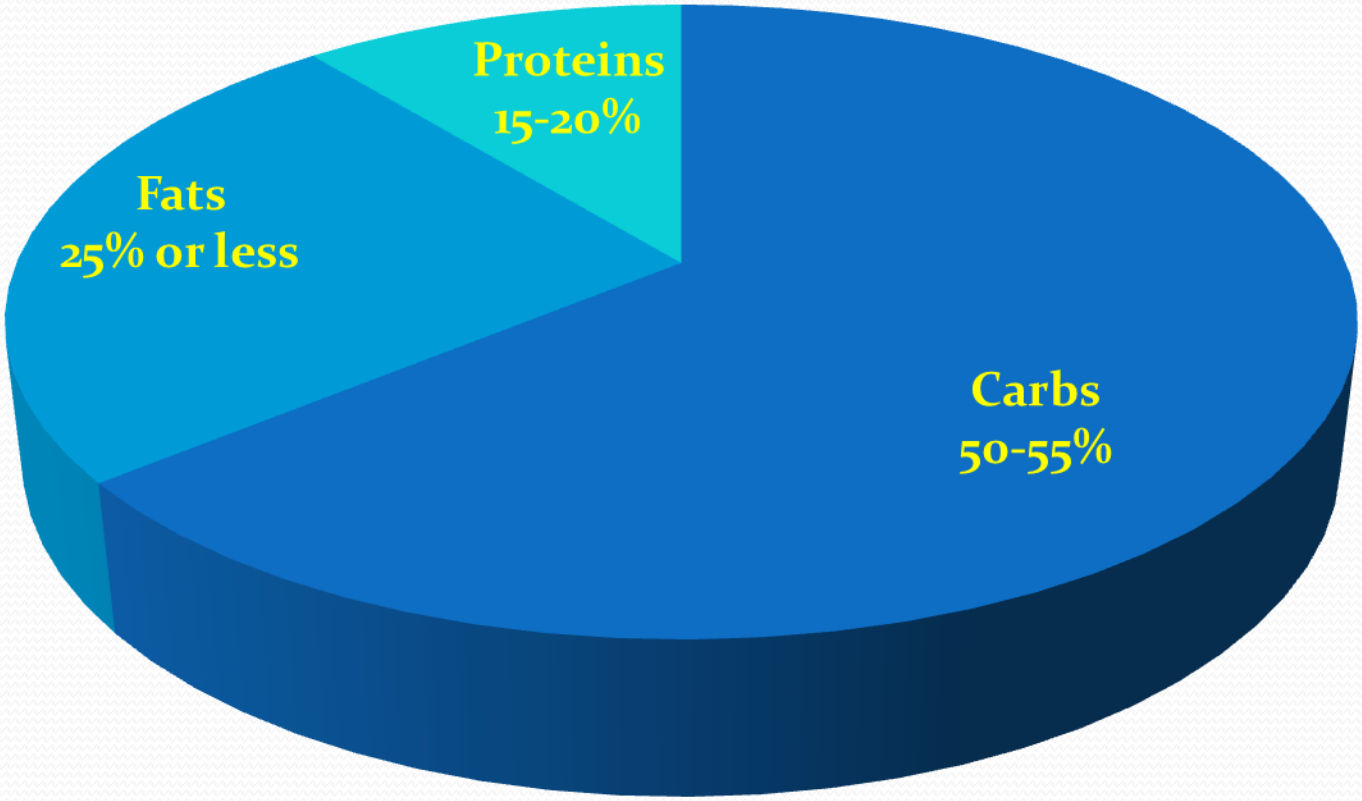
Proteins

Copyright Protection:

Body Composition:



Daily Ratios of Macronutrients:



Protein Basics:

- Protein is an essential macronutrient.
- It contains nitrogen atoms.
- About 15-20% of our daily food intake should come from protein.
- About 18% of our total body weight is protein.
- Protein gives us 4 calories per gram.
- There are over 50,000 different protein-containing compounds in the body.

What are proteins made of?

Proteins are made of amino acids. In fact, amino acids are the building blocks for proteins:

Essential: can not not be synthesized by the body.
Nonessential: can be synthesized by the body.

Essential Amino Acids:

- **Lysine**
- **Histidine** (*in infants only*)
- **Leucine**
- **Isoleucine**
- **Valine**
- **Methionine**
- **Phenylalanine**
- **Threonine**
- **Tryptophan**

Nonessential Amino Acids:

- **Glutamine**
- **Glycine**
- **Arginine**
- **Ornithine**
- **Aspartic acid**
- **Citrulline**
- **Cysteine**
- **Cystine**
- **Glutamic acid**
- **Proline**
- **Hydroxyproline**
- **Serine**
- **Tyrosine**
- **Alanine**

Types of Proteins:

Complete Protein versus Incomplete Protein:

- **If a protein contains all 9 essential amino acids, it is called "Complete Protein". This type of protein supports tissue growth and repair. All animal-based proteins are complete proteins.**

- **Proteins that lack one or more essential amino acids are called "Incomplete Proteins", and they do not support growth. All plant-based proteins are considered incomplete proteins, except "Soy" and "Spirulina" which are complete proteins.**

Functions of Proteins (Why Do We Need Proteins):

- Energy sources
- Growth and maintenance
- Hormones
- Enzymes
- Antibodies
- Acid-alkaline balance
- Fluid balance: albumin, and globulin
- Transportation: hemoglobin

Functions of Proteins:

- **1) Energy. Every one gram of protein provides 4 calories.**

During our daily activities and exercise, the primary source of energy is carbohydrates followed by fats. When the body runs out of its reservoirs of carbohydrates and fats, proteins come into play.

- **2) Hormones and enzymes are proteins, as they are made of amino acids.**

- **3) Tissue growth and maintenance.**

- **Protein serves as a constituent of all cells and tissues in the body.**
- **Even though proteins make up about 18% of the body weight, the content of protein in different cells varies.**
- **The cells require proteins for their daily constant turnover.**
- **Rapid growth in infancy and childhood need proteins.**
- **When the body is in "*catabolic states*", such as burns, after surgeries, advanced cancers, and traumatic injuries, proteins play an important role in tissue growth and healing.**

- **4) Immunity. The body produces antibodies in response to foreign bodies. Antibodies are a major part of the immune system and they are proteins.**

- **5) Acid and base balance. Proteins act as blood buffers, eliminating excess hydrogens and maintaining pH within normal limits.**

- **6) Fluid balance. Proteins, such as albumin and globulin, have a key role in maintaining fluid balance by exerting oncotic pressure, which helps keep water inside the vessels and prevent edema.**

- **7) Transportation. The carriers that transport nutrients in the blood are made of proteins. For instance, hemoglobin (which carries oxygen), lipoproteins (which carry fats), and vitamin carriers.**

How Much Protein Do We Need A Day?

- **Contrary to carbohydrates and fats, human body does not have "reservoirs" of proteins.**

- **The recommended daily allowance (RDA) for protein in adults is 0.8 gram per one kilogram of body weight.**

- **Children and adolescents need some extra amounts of proteins.**

- **During pregnancy and all months of breast feeding, the RDA increases by 25 grams per day.**

Sources of Protein.

Image: Copyright©Depositphotos.com/Ann Marosy

Problem with RDA:

- **The RDA is based on body weight, and the metabolic status of the person is not considered.**
- **At the *Canadian Academy of Sports Nutrition*, we use the terms the "right amount of protein" for the first time.**
- **The "right amount of protein" (RAP) is the daily amount of protein required by the body to maintain nitrogen balance.**

- **Nitrogen balance** occurs when nitrogen intake equals to nitrogen loss. Nitrogen is usually lost in urine, feces, and sweat.

Organic Raw Hemp Protein Powder

- **Positive nitrogen balance** is when nitrogen intake exceeds nitrogen loss. It is often seen in growing children and during **pregnancy**, **breastfeeding**, **recovery from diseases**, and **resistance training**. **A positive nitrogen balance is the optimal state for building muscles.**

- **Negative nitrogen balance** is when nitrogen loss exceeds nitrogen intake in such as **burns**, **fever, starvation**, **infections**, **dieting**, **fasting, muscle wasting diseases**, and **diabetes**.

Protein Requirements:	
Age or Conditions	Required Protein (grams/Kg of BW)
Infants:	
- 0 – 6 months	2.2
- 6 – 12 months	1.6
Children:	
- 1 -3 years old	1.2
- 4 – 6 years old	1.2
- 7 – 12 years old	1.0
Adolescents (13 – 18 years olds)	0.9
Adults:	
- Non – athletic, healthy	0.8
- Kidney failure without dialysis	0.6
- Kidney failure with dialysis	1.2
- Weight management	1.5
- Metabolic stress (eg, burns, infections, surgery, trauma, critical illness)	1.5
- Recreational exerciser	1.2
Athletes:	
- Endurance sports	1.4
- Ball sports	1.6
- Strength sports	2.0

Food Sources for Protein:

Foods	Serving Size	Protein in Grams
Spirulina	1 cup	64
Tempeh	1 cup	40
Milk	1 cup	8
Yogurt	1 cup	10
Cheese, hard cheeses	1 oz	8
Cheese, cottage	1 cup	28
Egg, whole	1	6
Egg, white	1	3
Meats, any kind	1 oz	8
Meat, luncheon	1 oz	5
Beans (legumes)	1 cup	16
Nuts	1 cup	35
Tofu, firm	1 oz	3

Sources of Protein.

Image: Copyright©Depositphotos.com/Robyn Mackenzie

how much protein do ATHLETES need?

Endurance Sports	1.4 gr/kg/day
Ball Sports	1.6 gr/kg/day
Strength Sports	2.0 gr/kg/day

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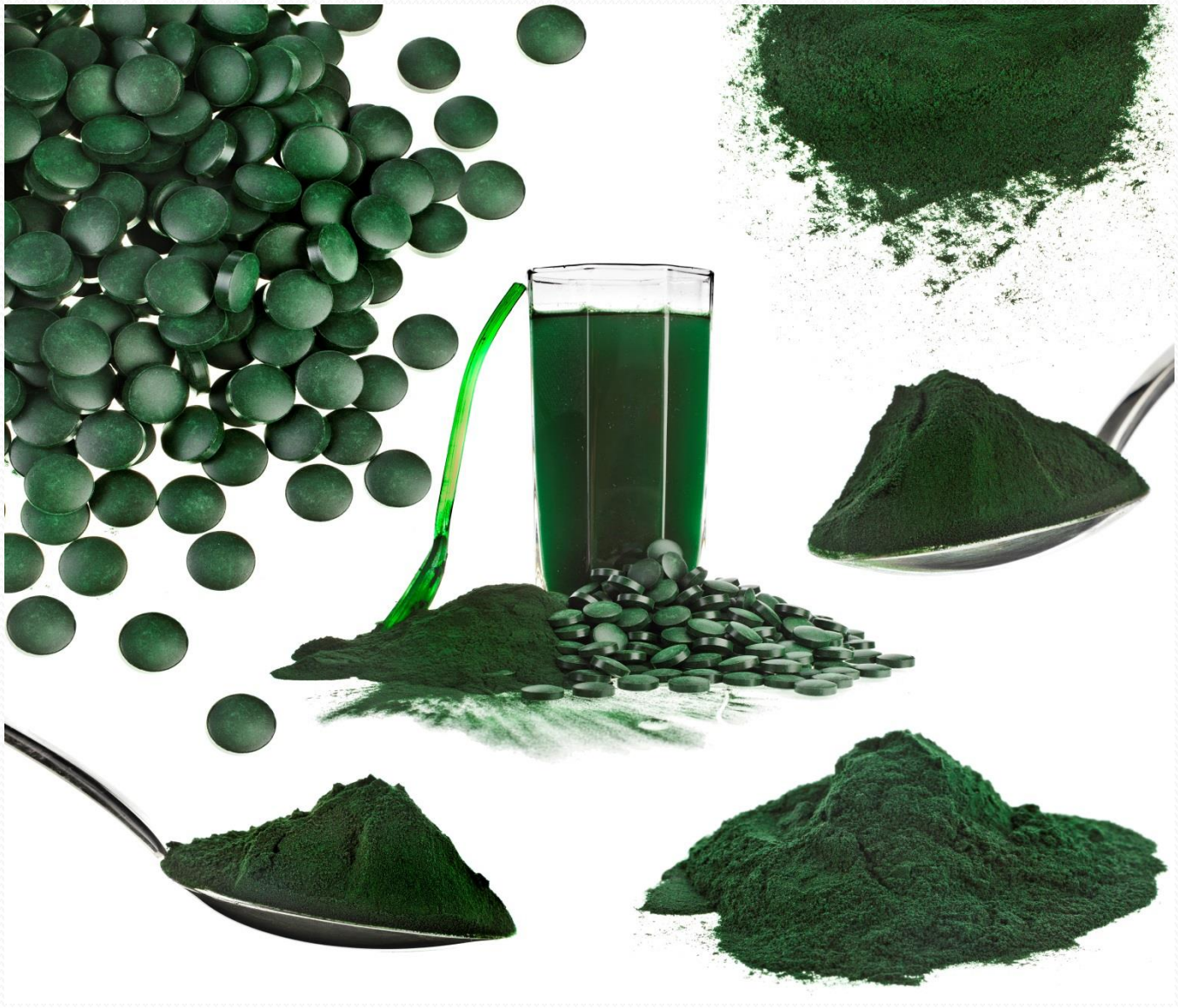
- **Spirulina is a blue-green algae (plant) that grows in warm, alkaline fresh-water bodies (The name “spirulina” is derived from the Latin word for “helix” or “spiral“).**

Spirulina



Tempeh: a fermented food made from Soybeans (most popular in Indonesia and some parts of Southeast Asia).

Tempeh is a fermented food made from Soybeans and rich in protein. *Image: Copyright©Depositphotos.com/Sergey Yechikov*

Methods for Measuring Quality of Protein:

- Protein quality refers to the ability of a specific dietary protein to support body growth and maintenance. The three most common methods for determining protein quality are:

- **Biologic Value (BV):** it measures the amount of nitrogen retained in comparison to the amount of nitrogen absorbed. BV is considered a valid method.

- **Protein Efficiency Ratio (PER):** not an ideal method.

- **Protein Digestibility-Corrected Amino Acid Score (PDCAAS).**

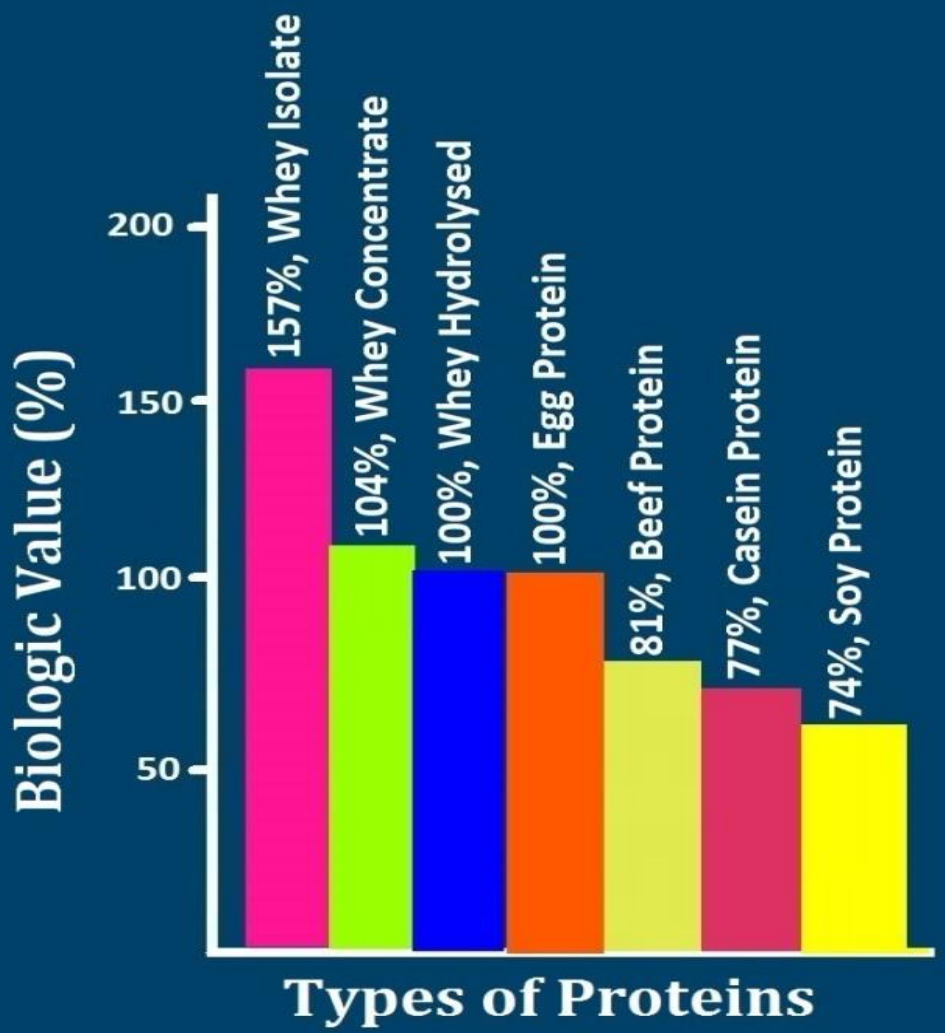
Biologic Value (BV):

- **This is considered the most valid method and it measures the amount of nitrogen retained in comparison to the amount of nitrogen absorbed.**
- **The biologic value of a whole egg is considered as a value of 100, and other proteins are compared with that of a whole egg.**
- **Proteins with higher BVs are considered "high – quality", and they come from animal sources.**

Protein Quality based on Biologic Value :

Food items	Biologic Value (BV)
Whey protein	
- Isolate	157
- Concentrate	104
- Hydrolyzed	100
Whole egg	100
Milk	91
Meats	79 - 83
Casein	77
Soy	74

Biologic Values of Proteins



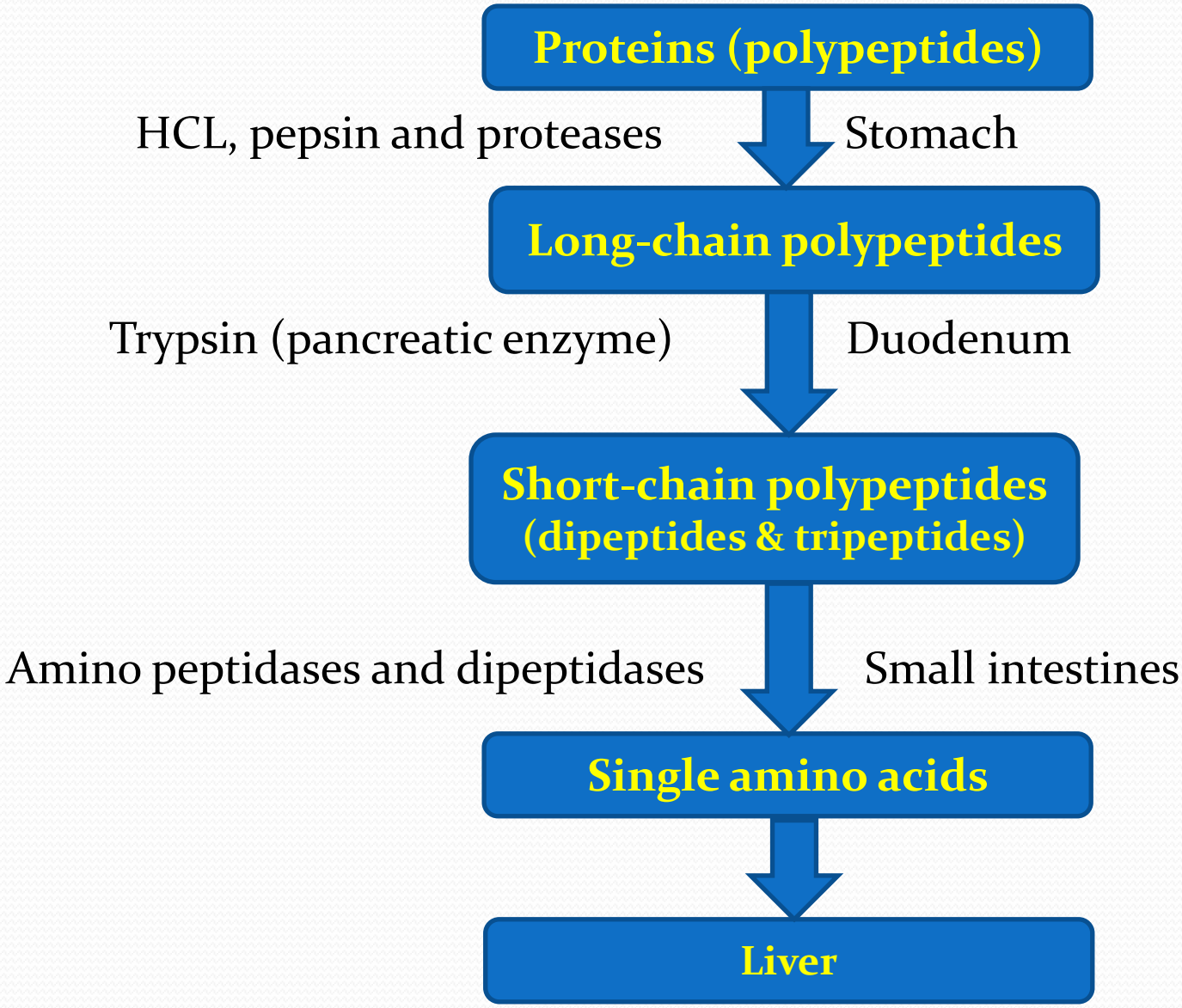
Source: Canadian Academy of Sports Nutrition

Protein Catabolism:

How Much Protein Do you Lose in Different Conditions?	
Conditions	**Daily Protein Loss**
Total Starvation for >10 days	12 - 18 gr
After Elective Surgery	30 - 60 gr
Infections	60 - 90 gr
Severe Systemic Infection	100 - 130 gr
Skeletal Trauma	100 - 130 gr
Major Burns	> 175 gr
Head Injuries	> 175 gr

Source: Canadian Academy of Sports Nutrition www.caasn.com

Digestion and Absorption:



Protein Deficiency:

- **Nearly 750 million people in the world are protein deficient.**
- ***Vegetarians*** **are at risk.**
- ***Failure To Thrive (FTT):*** **lack of proper growth during childhood.**
- ***Kwashiorkor:*** **a protein deficiency disease characterized by edema, irritability, anorexia, skin changes, and an enlarged liver with fatty infiltrates.**

Malnutrition:

- **Kwashiorkor:** **insufficient protein with sufficient calorie intake.**

- **Marasmus:** **sufficient protein with insufficient calorie intake.**

Protein Excess:

- Calcium loss
- Bone loss and Osteoporosis
- Dehydration

Homework:

- 1) Describe the functions of protein.
- 2) Describe the digestion of protein.