Nutrition

A. – a substance in food that is used by the body to promote normal

 growth, maintenance, and repair

 1. – those which must be consumed in relatively large

 quantities

 A) Include

 2. – those which are required in small quantities

 A) Include

 3. – any nutrient that cannot be made by the body and

 must be provided by the diet

 A) include

B. Summary of Macronutrients

 1.

 A) Sources

 1) Complex carbohydrates (starches) –

 2) Simple carbohydrates (sugars) –

 3) Both complex and simple –

 B) Uses in the body

 1)

 2) Used to synthesize nucleic acids, glycolipids, glycoproteins, ATP, cAMP

 and many cell surface receptors

 C) Locations in the body

 1) Adults generally have about

 a)

 b)

 c)

 i) Blood glucose is usually measured in mg/dl with normal levels in the low

 to mid 100’s

 D) Problems

 1) Excess – obesity, cavities & upset stomach

 2) Deficits – tissue wasting & metabolic acidosis

 2.

 A) Sources

 1) Saturated fatty acids –

 2) Unsaturated fatty acids –

 3) Essential fatty acids –

 4) Cholesterol –

 B) Uses in the body

 1)

 2)

 3)

 4) Stabilize cell membranes

 5) Precursor for bile salts, steroid hormones, and vitamin D

 6) Necessary for fat-soluble vitamin absorption

 7) Thromboplastin (blood clotting factor), prostaglandins and eicosanoids are all

 derived from lipids

 C) Serum lipoproteins

 1) Tiny droplets with a core of cholesterol and triglycerides surrounded by a protein

 and phospholipid coating

 2) Allows lipids to be transported in the blood to be recognized by the body’s cells

 3) 4 categories

 a)

 i) Absorbed in the digestive system and ultimately stored in adipocytes as

 triglycerides

 b)

 i) Formation primarily occurs in the

 ii) Act as a vehicle to remove excess cholesterol from the body

 c)

 i) Mostly

 ii) Transport cholesterol to cells that require it

 d)

 i) Produced in the

 ii) Transport lipids around the body for use or storage

 iii) Converted to

 4) Desirable Cholesterol Levels

 a) Total cholesterol =

 b) HDL =

 c) LDL =

 D) Problems

 1) Excess – obesity, cardiovascular disease, & Type 2 diabetes

 2) Deficits – weight loss, poor growth, skin lesions, increased risk of strokes,

 & slower metabolic rate

 3.

 A) Sources

 1) Complete proteins –

 2) Incomplete proteins –

 B) Uses in the body

 1) Structural proteins such as

 2) Functional proteins such as

 C) Problems

 1) Excess – obesity and kidney & liver problems

 2) Deficits – weight loss and tissue wasting, growth retardation, anemia, edema,

 premature birth & miscarriage

 4. Vitamins

 A) Fat soluble vitamins

 1)

 a) ; required for skin & mucus structure and normal bone

 development

 b) Found in green leafy vegetables, egg yolk, liver, and fortified milk &

 margarine

 2)

 a) Increases blood

 b) Produced in the skin exposed to UV light, also found in

 3)

 a) Antioxidant that prevents oxidation of fatty acids preventing damage to cell

 membranes by free radicals

 b) Found in vegetable oils, nuts, whole grains, and dark leafy vegetables

 4)

 a) Essential in

 b) Found in green leafy vegetables, broccoli, cabbage, cauliflower, and pork

 liver

 c) Is also produced by bacteria normally present in the large intestine

 B) Water soluble vitamins

 1)

 a) , necessary for the formation of most connective

 tissues and the conversion of cholesterol to bile salts, aids iron absorption

 b) Found in

 2) B-complex Vitamins

 a) (B1) – helps convert pyruvic acid to acetyl CoA and is necessary

 for the synthesis of ACh; found in lean meats, eggs, and green leafy vegetables

 b) (B2) – acts as FAD; found in egg whites, fish, and milk

 c) (B3) – acts as NAD; found in poultry, fish, and meat

 d) – necessary for amino acid metabolism and the formation of

 antibodies and hormones; found in meat, poultry, fish, whole grains, and

 bananas

 e) (B9) – essential for RBC formation and embryonic neural

 tube development; found in liver, orange juice, deep-green vegetables, lean

 beef, eggs, and whole grains

 f) – necessary for RBC production and proper metabolism in the GI

 tract, nervous system, and bone marrow; found in liver, meat, poultry, and

 eggs

 5. Minerals

 A) Major minerals

 1) – necessary for bone density, impulse conduction, and muscle

 contraction

 2) – required for the production of nucleic acids, proteins, and

 ATP

 3) – necessary for impulse conduction and muscle contraction

 4) – a component of some amino acids & vitamins; vital for

 tertiary protein structure

 5) – necessary for maintaining osmotic pressure, impulse

 conduction, muscle contraction, and acid-base balance

 6) – required for CO2 transport and HCl production

 7) – coenzyme (NAD & FAD) component

 B) Trace minerals

 1) – component of hemoglobin

 2) – required for the synthesis of fatty acids, cholesterol,

 urea, and hemoglobin

 3) – required for the production of hemoglobin, melanin, and

 myelin

 4) – required for the formation of thyroid hormones

 5) – enzyme/protein component, required for normal growth, wound

 healing, taste, smell, and sperm production

C. Food Intake Regulation

 1.

 A) Releases a number of chemicals

 1) Orexins –

 2) Neuropeptide Y – increases cravings for

 3) Galanin – increases cravings for

 4) Serotonin – promotes feeling of

 B) Also binds to chemicals

 1)

 a) Released from

 b) Inhibits

 2)

 a) Released from cells in the

 b) Stimulates hunger

Metabolism

A. – sum of all the chemical processes in the body

B. Types of Metabolic Reactions

 1. reactions – energy-requiring reactions that build organic

 compounds

 2. reactions – energy-releasing reactions that break organic

 compounds and often generate ATP

 3. reaction – any reaction where a molecule gains oxygen or loses

 a hydrogen

 4. reaction – any reaction where a molecule loses oxygen or gains

 a hydrogen

 A) Oxidation and Reduction (Redox) reactions are always coupled

C. Carbohydrate Metabolism

 1. Glucose catabolism is the breakdown of CHO to release energy (cellular respiration)

 A) It is accomplished in four steps:

 2. – “sugar splitting” occurs in the cytoplasm of the cell and does not

 require oxygen

 A) 1 glucose molecule is broken down into

 B) 4 ATP are produced during the process. However, 2 ATP are used during the

 process. Therefore, the net result is only

 C) 2 H atoms are removed (oxidation) and are picked up by 2 NAD+ to form 2

 molecules of NADH (reduction)

 D) The fate of pyruvic acid depends on the oxygen availability

 1) No oxygen present –

 a) The H from NADH is transferred to pyruvic acid resulting in lactic acid

 2) Oxygen present –

 3.

 A) As each pyruvic acid enters the mitochondria, a C and H are removed and

 coenzyme A is added resulting in molecules of acetyl CoA

 B) The 2 carbon atoms that were removed bind with O2 forming 2 molecules of CO2

 C) The 2 H atoms that were removed bind with NAD+ forming 2 molecules of NADH

 D) No ATP are formed during this step

4. Krebs Cycle – occurs in the

 A) Acetyl CoA enters the Krebs cycle where it combines with

 to create

 B) As the cycle moves around, citric acid is rearranged to produce different

 intermediate molecules called

 C) At the end of the cycle, the resulting molecule is oxaloacetic acid, which is now

 available to attach to another acetyl CoA

 D) Totals for the Krebs cycle

 1) 4 C atoms are removed and combine with O2 forming 4 molecules of CO2

 2) 10 H atoms are removed and added to NAD+ (6) or FAD (4) resulting in 6

 NADH and 2 FADH2

 3) 2 molecules of ATP are synthesized per cycle

 E) All NADH (10; 2 from glycolysis, 2 from pre-Krebs, 6 from Krebs) & FADH2 (2

 from Krebs) produced up to this point will enter the electron transport chain

 5. Electron Transport Chain (ETC) – occurs on the

 A) Involves membrane proteins acting as H+ pumps that will release energy as an

 electron is transferred from one to another

 B) NADH and FADH2 drop off their hydrogen atoms to the chain of electron

 acceptors (pumps)

 C) As the H are dropped off they lose their electrons which travel “down the chain”

 (from one pump to the next)

 D) The energy from the electrons is used to pump H+ into the intramenbranous space,

 creating a H+ gradient

 1) The electrons ultimately end up forming the bond between O and H resulting in

 the eventual formation of H2O

 a) is considered the final electron acceptor for cellular (aerobic)

 respiration

 F) Intramembranous H+ then moves through ATPsynthase creating the energy to

 combine ADP + P resulting in ATP

 1) Each NADH stores enough energy to create

 2) Each FADH2 stores enough energy to create

 G) Results in the production of ATP; therefore the entire process from glycolysis

 thru ETC yields a net of ATP

 6. Carbohydrate Anabolism

 A) When cellular ATP reserves are high or when glucose is in excess, glucose has to

 be stored

 1) Glucose catabolism is inhibited

 2) Glucose conversion to glycogen (glycogenesis) or to fat (lipogenesis) is

 stimulated

 B) When ATP or glucose levels drop the body can then convert glycogen back to

 glucose

 1) – production of glucose from glycogen

 2) – formation of glucose from non-carbohydrate

 molecules (such as fat and protein)

 3) Both processes occur in the

D. Lipid Metabolism

 1. The end products of lipid digestion (lipolysis) and cholesterol digestion are transported

 in the blood as

 2. The glycerol is converted to glucose (which enters into glycolysis) or G3P

 (which eventually enters the Krebs cycle)

 3. The fatty acids are broken down into fragments which bind to coenzyme A creating

 which enter the Krebs cycle

 4. Dietary fats not needed for energy or structural materials are stored in

 5. When carbohydrates are scarce, the breakdown of fats for energy results in the

 formation of (ketones) which can be deadly in high amounts because they

 lower the blood pH resulting in a condition known as ketoacidosis.

E. Protein Metabolism

 1. To be used for energy, amino acids are converted into pyruvic acid or keto-acids that

 can then enter into Krebs

 A) This process involves the following events:

 1) One of any number of amino acids transfers their amine group to -ketoglutaric

 acid resulting in the formation of

 a) This process is known as

 2) In the liver, the amine group from glutamic acid is removed in the form of

 ammonia (NH3) and combined with CO2 to form

 a) This process is known as

 b) The urea is then excreted into the blood where it is filtered out by the kidneys

 and released in urine

 c) Deaminated amino acids may also be converted to

 2. Protein anabolism requires essential amino acids

 A) If any of them are lacking, amino acids are used as

F. Role of the Liver in Metabolism

 1. The liver is the body’s main metabolic organ and it plays a crucial role in processing or

 storing virtually every nutrient group

 2. The liver has several metabolic functions:

 A) Packages fatty acids to forms that can be stored or transported

 B)

 C) Forms non-essential amino acids and converts ammonia to urea

 D) Stores glucose as glycogen and regulates blood sugar homeostasis

 E)

 F) Conserves Fe+3 from phagocytized RBC

 G)

 H) Detoxifies drugs, alcohol, & other substances

Metabolic Rate and Body Heat Production

A. Body temperature reflects the balance between heat production and heat loss and is

 normally 96-100oF (37oC) which is optimal for physiological activities

B. At rest, most body heat is produced by the

 1. Activation of causes dramatic increases in body heat

 production (

 2. The body core generally has the highest temperature whereas the shell (the skin) has the

 lowest temp

 3. serves as the major heat-exchange agent between the core and the shell

 A) When blood is deep in the organs, heat loss is

 B) When blood is in the skin capillaries, heat loss is at its

 4. Heat-exchange mechanisms include:

 A) – the transfer of heat from a warmer object to a cooler object

 (not in direct contact) in the form of “heat waves”

 1) Accounts for about

 2) Examples include your skin warming while sunbathing or a room warming as it

 fills with people

 B) – the transfer of heat from a warmer object to a cooler object

 that is in direct contact with the warmer one (including the air in direct contact with

 your skin)

 1) Examples include the seat beneath you warming as you sit in it or your skin

 warming as a heating pad sits on it

 C) – the transfer of heat energy by air currents

 1) Warm air rises away from the body and cool air replaces it therefore increasing

 conduction

 2) fans and wind can speed up convection therefore making us feel cooler

 D) – heat is absorbed by water molecules that become so energized

 that they escape as water vapor taking heat with it

 1) Sweating is the best example but there is a small amount of water loss that

 occurs without sweating at all times, even in cold weather

 5. Heat-promoting mechanisms

 A)

 B)

 C)

 D)

 6. Body’s Thermostat

 A) The acts as the body’s thermostat

 1) Its heat-promoting and heat-loss centers receive input from peripheral and

 central thermoreceptors

 2) It then integrates these inputs and initiate responses leading to homeostasis