NFSC 220 MIDTERM NOTES by Sarah Kaakati

# Chapter 1

1.1: Good health: The nutrition Connection

* Nutrition is the science that links foods to health and disease. It includes the processes by which the human organism ingests, digests, absorbs, transports, and excretes food substances.
* Food provides the energy (in the form of calories) as well as the materials needed to build and maintain all body cells.
* Nutrients are the substances obtained from food that are vital for growth and maintenance of a healthy body throughout our life
* For a substance to be considered an essential nutrient, three characteristics are needed
  + First, at least one specific biological function of the nutrient in the body must be identified
  + Second, omission of the nutrient from the diet must lead to a decline in certain biological functions, such as production of blood cells
  + Third, replacing the omitted nutrient in the diet before permanent damage occurs will restore those normal biological functions
* Cancer: a condition characterized by uncontrolled growth of abnormal cells
* Cardiovascular disease: a general term that refers to any disease of the heart and circulatory system. This disease is usually characterized by the deposition of fatty material in the blood vessels
* Cholesterol: a waxy lipid found in all body cells; it has a structure containing multiple chemical rings. Cholesterol is found only in foods of animal origin
* Chronic: long standing, developing over time.
* Diabetes: a group of diseases characterized by high blood glucose.
* Hypertension: a condition in which blood pressure remains persistently elevated
* Kilocalorie: a unit that describes the energy content of food. Specifically, a kilocalorie is the heat energy needed to raise the temperature of 1000 grams of water 1 degree Celsius
* Obesity: a condition characterized by excess body fat
* Osteoporosis: decreased bone mass related to the effects of aging
* Risk factor: a term used when discussing factors contributing to the development of a disease (ex: smoking)
* Stroke: a decrease of loss in blood flow to the brain that results in the form of a blood clot

1.2 Class and sources of nutrients

1. Carbohydrates
   1. Mainly of the elements carbon, hydrogen, and oxygen
   2. Provide a major source of calories for the body, on average 4 kcal per gram
   3. Can exist as simple sugars and complex carbohydrates
   4. Simple sugars, frequently referred to as sugars, are relatively small molecules
   5. The smallest simple sugars consist of a single sugar unit and are called monosaccharides
   6. The sugar in your blood, glucose is an example of a monosaccharide
   7. 2 sugars are a disaccharide
   8. Polysaccharides are also known as complex carbohydrates, ex: starch which is made up of hundreds of repeating glucose units
   9. During digestion, complex carbohydrates are broken down into single sugar molecules and absorbed via cells lining the small intestine into the blood stream
   10. The sugar molecules in certain complex carbohydrates called **fiber** cannot be broken down by human digestive processes. Fiber passes through the small intestine undigested to provide bulk for the stool
   11. We need sugars and other carbohydrates in our diets primarily to help satisfy the calorie needs of our body cells
   12. Glucose, a simple sugar that the body can derive from most carbohydrates is a major source of calories for the most cells
   13. When not enough carbohydrate is consumed to supply sufficient glucose, the body is forced to make glucose from proteins – not a healthy change
   14. Examples of carbohydrates: cereals, fruits and vegetables
   15. 45 to 55% of intake should be from carbohydrates
2. Lipids
   1. Mostly fats and oils
   2. The basic structure of most lipids is the triglyceride. Triglycerides provided a key calorie source (ex: fatty acids) for the body and are the major form of fat in foods. They are also the main form for energy storage in the body.
   3. Fats are lipids that are solid at room temperature and oils are lipids that are liquid at room temperature
   4. Most lipids can be separated into two basic types – saturated fat and unsaturated fat.
   5. Trans fat: these fats are commonly found in processed foods, and especially deep fried foods such as doughnuts and French fries.
   6. Key unsaturated fatty acids that are body can’t produce are called essential fatty acids, and perform several important functions in the body: they help regulate blood pressure and play a role in the repair of vital cell parts
   7. We only need about four tablespoons a day of a common plant oil to supply these essential fatty acids
   8. Trans fatty acids: a form of an unsaturated fatty acid, usually a monounsaturated one when found in food (ex: margarine, shortenings, and deep fat fried foods)
   9. Fat 🡺 9 kcal per gram
   10. Examples of lipids: fats and oils
   11. 20 to 30% of calories should b from fat
3. Proteins
   1. All proteins also contain nitrogen.
   2. Proteins are the main structural material in the body. For example proteins constitute a major part of bone and muscle; they are also important components in blood, body cells, enzymes, and immune factors.
   3. They provide about 4 kcal per gram
   4. Examples of proteins: meat, fish, eggs, milk and legumes
   5. 25% of calories should be from proteins
4. Vitamins
   1. The main function of vitamins is to enable many chemical reactions to occur in the body. Some of these reactions help release the energy trapped in carbohydrates, lipids and proteins
   2. Vitamins themselves contain no usable calories for the body
   3. 13 vitamins are divided into 2 groups. Four are fat-soluble (A,D,E,K) and 9 are water soluble (the B’s and vitamin C)
   4. The two groups of vitamins have different functions and characteristics. For example, cooking destroys water-soluble vitamins much more readily than it does fat-soluble vitamins. Water-soluble vitamins are also excreted from the body much more readily than fat-soluble vitamins.
5. Minerals
   1. Minerals are structurally simple, inorganic substances, which exist as groups of one or more of the same atoms.
   2. All the nutrients discussed so far are organic compounds
   3. Inorganic substances for the most part do not contain carbon atoms
6. Water
   1. Water makes up the sixth class of nutrients.
   2. Has numerous vital functions in the body, it acts as a solvent and lubricant, as a vehicle for transporting nutrients and waste, and as a medium for temperature regulation and chemical processes
7. Definitions and ideas
   1. Some nutrients that perform important functions can be produced by the body if they are missing from the diet
   2. Macronutrient: a nutrient needed in gram quantities in a diet
   3. Fiber: substances in plant foods not digested by the processes that take place in the human stomach or small intestine. If found naturally in some foods are called dietary fibers
   4. Food: solid or liquid material used to build body tissues and supplies energy.(cal.)

# Chapter 2

2.1: a food philosophy that works

* Variety means eating many different foods
* Functional foods: foods that provide health benefits beyond those supplied by the traditional nutrients they contain. For example a tomato contains the phytochemical lycopene, so it can be called a functional food.
* There are six major food groups you should eat every day
  + 1. Grains
  + 2. Vegetables
  + 3. Fruits
  + 4. Milk
  + 5. Meat and Beans
  + 6. Oils
* Moderation refers mostly to portion size
* The nutrient density of a food is a characteristic used to determine its nutritional quality. Nutrient density of a food is determined by comparing its protein, vitamin, or mineral content with the amount of calories it provides
* A food is said to be nutrient dense if it provides a large amount of a nutrient for a relatively small amount of calories when compared to other food sources
* Energy density is a measurement that best describes the calorie content of a food, a food rich in calories but that weighs relatively little is considered energy dense (ex cookies, nuts, fat free snacks etc)
* Three general categories of nutritional stats are recognized: desirable nutrition, under nutrition and over nutrition.
* The nutritional health of a person is determined by measurements like height, weight, circumference, and etc
* Discretionary calories: the calories allowed in a diet after the person has met overall nutrition needs. This generally small amount of calories gives individuals the flexibility to consume some foods and beverages
* Recommendations within the Dietary Reference intake (DRI) (DRI: term used to encompass nutrient recommendations made by the FDA)
  + RDA: recommended dietary allowance. Use to evaluate your current intake for a specific nutrient. The further you stray above or below this value, the grater your chances of developing nutritional problems
  + AI: adequate intake. Use to evaluate your current intake of nutrients, but realize that an AI designation implies that further research is required before scientists can establish a more definitive recommendation.
  + EER: estimated energy requirement. Use to estimate calorie needs of the average person within a specific height, weight, gender, age, and physical activity pattern
  + UL: upper level. Use to evaluate the highest amount of a daily nutrient intake unlikely to cause adverse health effects in the long run in almost all people (97% to 98%) in a population. This number applies to chronic use and is set to protect even very susceptible people in the healthy general population. As intake increases above the upper level, the potential for adverse effects generally increases.
  + DV: daily value. Use as a rough guide for comparing the nutrient content of a food to approximate human needs. Typically the daily value used on food labels refers to ages four years through adulthood. It is based on a 2000 kcal diet. Some daily values also increase slightly with higher calorie intakes.

# Chapter 3

* Merely eating food won’t nourish you. You must first digest the food – break it down into usable forms of the essential nutrients that can be absorbed into the bloodstream. Once nutrients are taken up by the blood stream, they can be distributed to and used by body cells.

The Digestive System

* The foods and beverages we consume, for the most part, must undergo extensive alteration by the digestive system to provide us with usable nutrients.
* The processes of digestion and absorption take place in a long tube that is open at both ends and extends from the mouth to the anus. This tube is called the gastrointestinal (GI) tract.
* Nutrients from the food we eat must pass through the walls of the GI tract – from the inside to the outside – to be absorbed into the bloodstream. The organs that make up the GI tract, as well as some additional accessory organs located nearby, are collectively known as the digestive system.
* In the digestive system food is broken down mechanically and chemically, it is composed of six separate organs, each organ performs one or more specific jobs.

The Organs and their functions

* The Mouth and salivary glands: chew food, moistens food with saliva, releases starch digesting enzymes, initiates swallowing reflex
* Esophagus: lubricates with mucus, and moves food to stomach by swallowing
* Stomach: Store, mix, dissolve, and continues digestion of food. Dissolves food particles with secretions. Kills microorganisms with acid. Releases protein digesting enzyme.
* Liver: produces bile to aid fat digestion and absorption
* Gallbladder: store, concentrate, and later releases bile into the small intestine.
* Pancreas: secretes sodium bicarbonates and enzymes for digesting carbohydrate, fat, and proteins.
* Small Intestine: mixes and propels contents. Lubricates it with mucus. Digests and absorbs most substances using enzymes made by the pancreas and small intestine
* Large intestine: mix and propel contents. Absorbs sodium, potassium, and water. Houses bacteria. Lubricates with mucus. Synthesizes some vitamins and short chain fatty acids. Forms feces
* Rectum: holds feces and expel via the anus, which is the opening to the outside of the body.

Definitions AND functions

* Acid: is produced in the stomach. Acid promotes digestion of protein among other functions
* Bile: is produced in the liver and stored in the gallbladder. It aids fat digestion in the small intestine by suspending fat in water using bile acids, cholesterol, and lecithin.
* Bicarbonate: is produced in the pancreas and small intestine. It neutralizes stomach acid when it reaches the small intestine.
* Hormones: are produced in the stomach, small intestine, and pancreas. The stimulate production and/or release of acid, enzymes, bile and bicarbonate; help regulate peristalsis and overall GI tract flow (examples: gastrin, secretin, insulin, cholcystokinin, and glucagon).
* Saliva: produced in the mouth. It does partial starch digestion using salivary amylase, lubrication of food for swallowing.
* Mucus: produced in the mouth, stomach, small intestine, and large intestine. It protects the GI tract cells, lubricates food as it travels through the GI tract.
* Enzymes: produced in the mouth, stomach, small intestine, and pancreas. It promotes digestion of carbohydrates, fats, and proteins into forms small enough for absorption.

Digestion Problems

* Heartburn: when you have gastro esophageal reflux disease. Stomach has very little mucus in it to protect it so the acid quickly erodes the lining of the esophagus
* Ulcers: are peptic ulcers that can occur when the lining of the esophagus, stomach, or small intestine is eroded by the acid secreted by the stomach cells.
* Constipation and laxatives: difficult or infrequent evacuation of the bowel
* Hemorrhoids: are swollen veins of the rectum and anus
* Irritable bowel syndrome: a combination of cramps, gassiness, bloating, and irregular bowel function
* Diarrhea: a GI tract disease that generally lasts only a few days but is defined as increased fluidity, frequency, or amount of bowel movements compared to a person’s usual pattern
* Gallstones: are pieces of solid material that develop in the gallbladder when substances in the bile – primarily cholesterol – form crystal-like particles.

# Chapter 4

* Carbohydrates are a main fuel source for some cells, especially those in the brain, nervous system, and red blood cells. Muscles also rely on a dependable supply of carbohydrate to fuel intense physical activity
* Carbohydrates are a readily available fuel for all cells, both in the form of blood glucose and glycogen stored in the liver and muscles.
* The glycogen stored in the liver can be used to maintain blood glucose concentrations in times when you have not eaten for several hours
* Whole-grain breads and cereals have greater health benefits than refined and processed forms of carbohydrate
* Choosing the healthiest carbohydrate sources most often, while moderating intake of less healthful sources, contributes to a healthy diet
* Simple forms of carbohydrates are called sugars. Larger more complex forms are primarily called either starches or fibers, depending on their digestibility by human GI tract enzymes
* Monosaccharides and disaccharides are often referred to as simple sugars because they contain only one or two sugar units. Food labels lump all of these sugars under one category, listing them as “sugars.”
* The most common monosaccharides in foods are glucose, fructose, and galactose.
* Glucose is an important source of energy for human cells, although foods contain very little carbohydrate as this single sugar. Most glucose comes from the digestion of starches and sucrose (table sugar)
* This glucose then goes on to serve as a source of fuel for cells
* Fructose, also called fruit sugar, is another common monosaccharide. After is consumed, fructose is absorbed by the small intestine and then transported to the liver where it is quickly metabolized
* The sugar galactose has nearly the same structure as glucose. Large quantities of pure galactose do not exist in nature. Instead, galactose is usually found bonded to glucose in lactose, a sugar found in milk and other milk products.
* Disaccharides are sucrose(glucose +fructose), lactose(glucose +galactose), and maltose(glucose+glucose)
* In many foods, single-sugar units are bonded together to form a chain, known as a polysaccharide. They are also called complex carbohydrates or starch, and may contain 1000 or more glucose units and are found chiefly in grains, vegetables, and fruits.
* Cellulose (a fiber) is another complex carbohydrate in plants. Although similar to amylase, it cannot be digested by humans
* Humans and animals store glucose in the form of glycogen. Glycogen consists of a chain of glucose units with many branches, providing even more sites for enzyme action than amylopectin. Because of its branched structure that can be broken down quickly, glycogen is an ideal storage form of carbohydrate in the body.
* The liver and muscles are the major storage sites for glycogen
* Animal products are not good sources of glycogen or any other form of carbohydrate because glycogen degrades almost as soon as the animal dies
* Fiber is not a single substance but a group of substances with similar characteristics. This group is comprised of the carbohydrates cellulose, hemicelluloses, pectins, gums, and mucilages. In total, these constitute all the nonstarch polysaccharides in foods.
* Amylase is a digestible straight chain type of starch composed of glucose units
* Amylopectin is a digestible branched chain type of starch composed of glucose units
* Viscous fiber: a fiber that is readily fermented by bacteria in the large intestine
* Functional fiber: fiber added to foods that has been shown to provide health benefits
* Total fiber: combination of dietary fiber and functional fiber in a food.
* Starches contribute much of the carbohydrate in our diets. Recall that plants store glucose as polysaccharides in the form of starches. Thus, plant-based foods, such as legumes, tubers, and the grains (wheat, rye, corn, oats, barley, and rice) used to make breads, cereals, and pasta, are the best sources of starch.
* Nutritive sweeteners can provide calories for the body, for example all of the monosaccharides and disaccharides are designated nutritive sweeteners. Also there are sugar alcohols like sorbitol and xylitol which are used as nutritive sweeteners.
* Alternative sweeteners, also called artificial sweeteners include saccharin, cyclamate, aspartame, sucralose, neotame, and acesulfame-K. Unlike sugar alcohols, alternative sweeteners yield little or no calories when consumed in amounts typically used in food products.
* Food preparation can be thought of as the start of carbohydrate digestion because cooking softens tough connective structures in the fibrous parts of plants, like broccoli stems.
* All of these effects of cooking generally make carbohydrate containing foods easier to chew, swallow, and break down during digestion
* The enzymatic digestion of starch begins in the mouth, when the saliva, which contains an enzyme called salivary amylase, mixes with the starchy products during the chewing of the food. This amylase breaks down starch into many smaller units, primarily disaccharides, such as maltose. You can taste this conversion when chewing a salty cracker.
* The liver then metabolizes those sugars by transforming the monosaccharides galactose and fructose into glucose and:
  + Releasing it directly into the bloodstream for transport to organs such as the brain, muscles, kidneys, and adipose tissues
  + Producing glycogen for storage of carbohydrate
  + Producing fat (minor amount, if any)

# Chapter 5: Lipids

5.1: lipids: common properties

* In fact, the body’s need for the essential fatty acids can be met by daily consumption of about 2 to 4 table spoons of plant oil incorporated into foods and consumption of fatty fish such as salmon or tuna at least twice weekly.
* Lipids are a diverse group of chemical compounds. They share one main characteristic: they do not readily dissolve in water.

5.2 Lipids: main types

* Fatty Acids: The simplest form of lipids
  + Fatty acids are found in the main form of lipids, triglycerides. A fatty acid is basically a long chain of carbons bonded together and flanked by hydrogens
  + Fats in foods are not composed of a single type of fatty acid. Rather, each dietary fat, or triglyceride, is a complex mixture of many different fatty acids, the combination of which provides each food its unique taste and smell.
  + Fatty acids can be saturated or nonsaturated
  + Fats high in saturated fatty acids, such as animal fats, remain solid at room temperature
  + If the fatty acid contains a double bond then it is said to be unsaturated. A fatty acid with only one double bond is monounsaturated. Canola and olive oils contain a high percentage of monounsaturated fats.
  + Unsaturated fatty acids can exist in two different structural forms, the cis and Trans form.
  + Some Trans fatty acids, known as conjugated linoleic acid (CLA), occur naturally. CLA is a family of derivatives of the fatty acid linoleic acid.
  + The bacteria that live in the rumens of some animals produce trans fatty acids that eventually appear in foods such as beef, milk and butter
  + Overall, a fat or an oil is classified as saturated monounsaturated, or polyunsaturated based on the type of fatty acids present in the greatest concentration
* Triglycerides
  + Fats and oils in foods are mostly in the form of triglycerides
  + The same is true for fats found in body structures.
  + Although some fatty acids are transported in the bloodstream attached to proteins, most fatty acids are formed into triglycerides by cells in the body
* Phospholipids
  + Are another class of lipid. Like triglycerides, they are built on a backbone of glycerol. However at least one fatty acid is replaced with a compound containing phosphorus.
  + Lecithin is a common example of a phospholipid. They participate in fat digestion, absorption, and transport.
  + The body is able to produce all the phospholipids it needs, so it is not essential
* Sterols
  + The last class of lipids. The most common type is cholesterol
  + It doesn’t have a glycerol backbone or any fatty acids
  + It doesn’t readily dissolve in water so it is a lipid
  + Cholesterol is used to form certain hormones and bile acids and is incorporated into cell structures
  + The body can make all the cholesterol it needs
* Defintions
  + Cis Fatty Acid: a form of an unsaturated fatty acid that has hydrogen lying on the same side of the carbon double bond
  + Trans fatty acid: a form of an unsaturated fatty acid, usually a monounsaturated one when found in food, in which hydrogen is on both carbons forming the double bond lie on opposite sides of that bond
  + Long chain fatty acid: a fatty acid that contains 12 or more carbons
  + Omega 3 fatty acid: an unsaturated fatty acid with the first double bond on the third carbon from the methyl end
  + Omega 6 fatty acid: an unsaturated fatty acid with the first double bond on the sixth carbon from the methyl end
  + Alpha lineolic acid: an essential omega 3 fatty acid
  + Lineolic acid: an essential omega 6 fatty acid
  + Essential fatty acids: fatty acids that must be supplied by the diet to maintain health. Currently, only linoleic acid and alpha linoleic acid are classified as essential.
  + Oleic acid: an omega 9 fatty acid
  + Diglyceride: a breakdown product of a triglyceride
  + Monoglyceride: a breakdown product of a triglyceride
* Hidden Fats
  + Milk, pastries, cookies, cake, cheese, crackers…
  + “Low fat” in most cases indicates that a product contains less than 3 grams of fat per serving. Fat free means that there is less than one-half of a gram of fat per serving. And reduced fat means the product has at least 25% less fat than is usually found in that type of food.
  + Fat in foods provides some satiety, flavor, and texture

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| --- | --- | --- |
| Type and health effects | Main sources | State at room temp |
| Saturated Fatty Acids: increase blood levels of cholesterol | Lard, fat in beef, pork, and coconut oil, palm kennel. | Solid  Soft or liquid |
| Monounsaturated Fatty Acids:  Decrease blood levels of cholesterol | Olive oil, canola oil, peanut oil | Liquid |
| Polyunsaturated Fatty Acids: decrease blood levels of cholesterol | Sunflower oil, corn oil, safflower oil, fish oil | Liquid |
| Essential Fatty Acids  Omega 3: alpha-linolenic acid  Reduces inflammation responses, blood clotting | Cold water fish (salmon, tuna), walnuts, canola oil | Liquid |
| Omega 6: Linolenic acid regulates blood pressure and increases blood clotting | Beef, chicken, safflower oil, sunflower oil, corn oil | Solid to liquid |
| Transfatty acids  Increase blood cholesterol more than saturated fat | Margarine, shortening | Soft to very solid |

Absorption: The products of fat digestion in the small intestine are fatty acids and monoglycerides. These products diffuse into the absorptive cells of the small intestine. About 95% of dietary fat is absorbed in this way.

Lipoprotein serves are vehicles for transport of lipids from the small intestine and liver to the body tissues.

Lipoproteins are classified into four groups

|  |  |  |
| --- | --- | --- |
| Lipoprotein | Primary component | Key role |
| 1. Chylomicron | Triglyceride | Carries dietary fat from the small intestine to cells |
| 1. VLDL | Triglyceride | Carries lipids made and taken up by the liver to cells |
| 1. LDL | Cholesterol | Carries cholesterol made by the liver and from other sources to cells |
| 1. HDL | Protein | Contributes to cholesterol removal from cells and in turn excretion of it from the body |

The liver is also the manufacturing site for lipids and cholesterol.

The essential fatty acids

* We must obtain linoleic acid (an omega 6 fatty acid) and alpha linoleic (an omega 3 fatty acid) from foods to maintain health. Hence why they are called ESSENTIAL!
* Perform important roles in immune system function and vision, help form cell membranes, and produce hormone like compounds.
* Omega 6 and omega 3 fatty acids must be obtained through the diet because human cells lack the enzymes needed to produce these fatty acids
* Omega 9 is not essential because it can be synthesized in the body
* If humans fail to consume enough essential fatty acids, their skin becomes flaky and itchy, and diarrhea and other symptoms such as infections are often seen
* Men should have 17 and 1.6 grams of omega 6 and 3 respectively)
* Women should have 12 and 1.1 grams of omega 6 and 3 respectively

Broader roles for fatty acids and triglycerides in the body

* Providing energy
* Storing energy for later use
* Insulating and protecting the body
* Transporting fat soluble vitamins

Phospholipids in the body

* They are found in body cells, and they participate in fat digestion in the intestine.

Cholesterol in the body

* Cholesterol plays many vital roles in the body. It forms part of some important hormones such as estrogen, testosterone, and a form of the active vitamin D hormone.
* Cholesterol is also the building block of bile acids, needed for fat digestion.
* Finally, cholesterol is an essential structural component of cells and the outer layer of the lipoprotein particles that transport lipids in the blood

Recommendations for fat intake

* Total fat intake should be 20 to 35% of total calories, which equates to 44 to 78 grams per day for a person who consumes 2000 kcal daily.