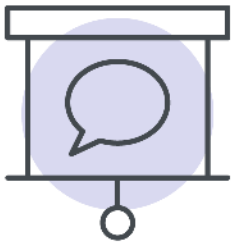
UofG

NUTR 1010
FINAL EXAM
STUDY GUIDE



Lecture Notes

What Do We Eat?

- Food
- *What does food provide us with?* Nutrients . Some nutrients are essential
- We get our essential nutrients from our food choices fortified foods, natural health products, phytochemicals and zoochemicals

Nutrients

There are 6 classes of nutrients including

- Protein
- Carbohydrates
- Fats
- Vitamins
- Minerals
- Water

Macronutrients

- Carbohydrates, fat and protein
- These give us energy
- The amount of energy they provide is measured in kilocalories (kcal)
- Carbohydrate gives you 4 kcal of energy/gram
- Fat gives you 9 kcal of energy/gram
- Protein gives you 4 kcal of energy/gram
- Alcohol gives you 7 kcal of energy/gram

Micronutrients

- Vitamins and minerals
- Vitamins are organic molecules our body needs in order to function (organic molecules = carbon containing)
- Minerals are inorganic (from the periodic table) our body needs in order to function

Functions

- Don't provide us with energy, but we need to eat them so that our body can function
- Vitamins are involved in helping your body use the energy from carbs, fats and proteins, and involved in bone growth, vision, blood clotting, oxygen transport, and tissue growth and development
- Minerals make and maintain tissues like bones and blood

Water

- Our bodies need water for everything

Provides the right environment for:

- Chemical reaction, Our cells to grow, Our muscles and nerves to function, Hormone signaling, Nutrient transport, and regulation of body temperature
- Everything

Calorie

- Unit of energy
- 1 calorie is the amount of energy it takes to warm up 1 kg of water by 1 degrees celsius
- Food energy is measured in kilocalories (kcal) but it's often just called calories

What is a Nutritious Diet?

- Nutritious diets prevent malnutrition
- Means poor of unbalanced nutrition
- Undernutrition or overnutrition(obesity)

Adequate

- Having sufficient amount of nutrients to maintain health
- Having enough

Moderate

- Watching portion sizes and frequency of consumption of foods

Balanced

- Mix and match food choices to ensure adequate nutrient intake - some nutrients only come from certain foods

Varied

- There are no super foods, need to eat a variety of foods to ensure adequate nutrient intake

Undernutrition

- Form of malnutrition caused by deficiency of energy or nutrients
- *Starvation* is the most severe form of undernutrition, it causes weight loss, poor growth, the inability to reproduce, and if severe enough death!

Overnutrition

- An excess of nutrients
- When excess of certain nutrients are consumed an adverse or toxic reaction may occur, however this is typically not caused by food

Why do people choose healthy/unhealthy foods

Based on:

- Availability and accessibility (cost, location, cooking skills)
    - Cultural and family background
    - Social acceptability
- Personal preference
    - Psychological and emotional factors
    - Health concerns
    - Media (we get lots of messages..)

Who Can I Trust?

1. Educated people with credentials:
- Registered dietitians (RD, PDt, RDt),
- Nutritional professionals with advanced degrees
2. Government: YES
- Health Canada, Public Health Agency of Canada
- Statistics Canada
- National Institutes of Health (USA)

Nutrition Recommendations

How much is enough?

- Health professionals in Canada and USA use the Dietary Reference Intakes (DRIs)
  - Developed by the Institutes of Medicine
  - Developed by American and Canadian nutrition experts

6 Classes of Dietary Reference Intakes (DRIs)

1. *Estimated Energy Requirements (EER)*

- For calculating how many calories people need

2. *Acceptable Macronutrient Distribution Ranges (AMDR)*

- Used to see if you're getting the right amount of macronutrients

Age Group	Percent Calories From		
	Carbohydrates	**Protein**	**Fat**
1-3 yrs	45-65%	5-20%	30-40%
4-18 yrs		10-30%	25-35%
19+ yrs		10-35%	20-35%

3. *Estimated Average Requirements (EAR)*

- Based on SOLID EVIDENCE
- Meets the needs of 50% of the population
- NOT a good goal for individuals
- Tool for assessing the adequacy of diet within the population
- *Ex: EAR for iron*

4. *Recommended Dietary Allowances (RDA)*

- The RDA will meet the requirements of 98% of the population
- A goal for individuals

5. *Adequate Intake (AI)*

- For some nutrients, there isn't enough evidence to set an EAR or an RDA
  - An adequate intake (AI) is then used
- AI = the mean intake of a healthy population
- AI is a goal for individuals if an RDA doesn't exist

6. *Tolerable Upper Intake Level (UL)*

- UL = the highest average daily nutrient intake level that poses a risk of adverse health effects
- As intake increases above the UL, the risk of potential adverse effect may increase
- Refers to overconsumption
- Used to assess risk of adverse effects in individuals and populations

Applications of Dietary Reference Intakes (DRIs)

- They provide a set of standards that can be used to plan diets
- To assess the adequacy of diets
- Make judgments about excessive intakes for individuals and populations
- *E.g. Can be used as a standard for meals prepared at schools, hospitals etc.*

Eating Well with Canada's Food Guide

- Nutrition experts created Canada's Food Guide based on:
    - Information from the DRIs and
    - Foods that make up a healthy diet

Canada's Food Guide Serving Size

- 1 small fist = 1 cup
- 1 palm = 3 oz
- 2 fingers = 1 oz
- Top joint of thumb = 1tsp
- Whole thumb = 1 tbsp

How are These Foods Healthier? Vegetables and Fruit

- Lower in fat, sugar and salt in prepared versions
    - Fewer "empty calories"
    - Low salt- prevent high blood pressure
- Have dark green and orange vegetables
    - They have more vitamins : vitamins A and folate
- Have vegetables and fruit more often than juice
    - They have more fibre and will fill you up

How are These Foods Healthier? Grain and Milk Products

- Choose whole grains
    - More fibre and more minerals : magnesium
- Drink skim, 1%, 2% milk each day
    - Liquid milk has added vitamin D
- Select lower fat milk alternatives
    - Cheese is often high in fat and salt

How are These Foods Healthier? Meat Products

- Have meat alternatives more often
  - Beans are folate, high in fibre, and a good source of protein
- Have fish twice a week
  - Fish contain long chain omega-3 fatty acids. The healthiest fats

Other Tips

- Choose 2-3 tbsp oils and fats like canola oil or olive oil or soft tub margarine
- Avoid using hard fats like butter, hard margarine, lard or shortening
- Drink water

Reading Food Labels

- Nutrition labelling on foods include:
  - Nutrition facts label
  - The list of ingredients in the food
  - Sometimes nutrition/health claims

Reading Nutrition Facts Table

- Tells us:
  1. Which food is a healthier choice when we compare two foods
  2. If a food is a healthy choice based on some handy rules of thumb
  3. The amount of nutrients we are getting from the particular food/beverage item

% Daily Value

- Based on a 2000 calorie diet
- NOT based on the DRIs
- Not useful to use as a goal
- Not useful for tracking your intake
- BUT it can give us a general idea about how much of a nutrient there is
- 5% is a little, 15% is a lot (*Don't want a lot of salt and saturated fat, do want to have lots of fibre)*

List of Ingredients

- All of the ingredients for a food are listed by weight
- The ingredient that is in the largest amount is listed first, and so on

Nutrition Claims

- Found only on some food products
- Often on the front of food packages
- A quick and easy way to get information about a food

Sample Midterm Question:

Which of the following provides energy but is not a nutrient?

a) Alcohol, b) carbohydrate, c) fat, d) protein

Tips For Healthy Eating Out

- Avoid:
  - Anything deep fried
  - Processed foods, foods with lots of cheese and salt (give you additional fat and salt that you don't need)
  - Salad dressing overload (order dressings on the side)
  - Sweet drinks and juices (A lot of extra calories and sugar)
  - Large portion sizes!
- Go for:
  - Grilled lean meats like chicken, filet mignon, pork chops or fish like salmon
  - Plain baked potatoes and steamed veggies for sides
  - Skim milk in coffee drinks
  - Vegetarian meals with whole grains and beans

If You're Going to Indulge

- Make it once-in-awhile-treat
- Only eat half of the portion
  - Share with a friend
  - Have half packed up before you get your plate
- Share 1 dessert or appetizer between MANY friends
- Choose 1 healthy part and 1 indulgence

Digestion System Does 3 Things

- Your Digestive system does 3 things:

1. *Digestion*

- Breaking food into tiny pieces

2. *Absorption*

- Moving the tiny pieces from the inside of your intestine into the bloodstream

3. *Elimination*

- Getting rid of the waste
  - *Barrier Function*
  - Preventing the absorption of harmful substances

How Our Body Tells Us We're Hungry

- *Through the gut-brain axis*
  - Your stomach and intestines send nerve signals to the hypothalamus of the brain
  - "We're empty! Time to eat"
- *Glucose (Blood sugar) levels drop*
  - Insulin and glucagon levels in the blood change (*Hormones produced in the pancreas)*
  - These hormones signal for hypothalamus to make us feel hungry and tell us to eat

GI Tract and Barrier Function

- In addition to its role in digestion and absorption, the gastrointestinal tract has an important role in the maintenance of health called the __ function
- __ function refers to the __ role the gastrointestinal cells have in limiting the absorption of harmful substances and disease causing organisms.

Digestion Starts in the Mouth

- Mechanical Digestion: Teeth break up food
- Chemical Digestion: Enzymes
  - Enzymes in saliva start breaking up food
  - Salivary Amylase breaks up carbohydrates
  - Lingual lipase breaks up fat
  - Saliva helps in making making bolus (*Moist ball of food)*

Enzymes

- Important part of chemical digestion
- Made of proteins
- BIological catalysts
  - Facilitate chemical reactions in living things
- Enzymes have suffix -ASE
  - Examples: amylase, lipase

Swallowing

- Part conscious, part unconscious
- Epiglottis covers passageway of the lungs for bolus to enter the esophagus.

In the Esophagus

- Peristalsis
  - Waves of contractions in the esophagus that move the food
  - Inner circular muscles
  - Outer length-wise muscles
- Peristalsis starts in the esophagus and continues all the way through your GI tract
- Food moves into the stomach via the lower esophageal sphincter

The Stomach

- Churns food (*Twisting and turning food)*
- *Mechanical Digestion*
  - 3 thick muscle layers churn and break up food (longitudinal layer, circular layers, diagonal layer)
  - Food turns to chyme
- *Chemical Digestion*
  - Stomach is very acidic environment
  - Hydrochloric acid (HCL) denatures and unravels protein
  - pH of gastric juice is 2.0 (*7 is neutral and 1 is most acidic)*
  - Pepsin breaks down protein

- Pepsin functions best in an acidic environment

- *Stomach Regulation by nerves and hormones*
  - How your stomach churns and how much gastric juice is released is regulated by signals from both nerves and hormones.
  - The thought, smell, sight or taste of food causes the brain to send nerve signals that stimulate gastric motility and secretion, preparing the stomach to receive food. *Ex. Stomach growling*
  - Gastrin: Hormone secreted by the stomach mucosa that stimulates the secretion of gastric juice and helps stomach digestion, as well as chemical digestion.
  - Food entering the stomach stimulates the release of gastric secretions and increases stomach motility

Introducing Mucus
- Mucus lines your whole GI tract
  - Protects, helps food move easily throughout
- Mucus is especially important in the stomach, due to being such an acidic environment.
  - Stomach is made of protein, and mucus stops you from developing peptic ulcers
  - Preventing us from being eaten inside out.

The Small and Large Intestine
Moving Along the Small Intestine
- *Duodenum:* chemical digestion and some absorption.
  - More digestion via enzymatic action, and some absorption
- *Jejunum:* Digestion continues, LOTS of absorption
- *Ileum:* Absorption continues and leftovers are passed to the large I
- *Large Intestine:* Food particles not digested and absorbed are passed on to the large intestine to be expelled.

Entering the Small Intestine
- Chyme is delivered from the stomach through the pyloric sphincter
- In the duodenum (1st part of small Intestine)
- Lots of chemicals and gastric secretions are added - the liver, the gall bladder and the pancreas are involved

Liver and Gallbladder
- Bile is made in the liver
- It's stored in the gallbladder
  - Gallbladder adds bile
    - *Main function:* Bile emulsifies fat molecules, and breaks it into small droplets that mix well with water

Pancreas: Enzyme Powerhouse
- Pancreas produces and adds

- Bicarbonate ions are added to help neutralize the acid and chyme
- Enzymes
  - Pancreatic amylase (starch/carbohydrates)
  - Lipase (fat)
  - Protease (protein)

The Large Intestine

- Made of several parts
  - Cecum; ascending, transverse, descending
  - Sigmoid colon
  - Rectum
  - Anus
- *Key Functions:*
  - Does not participate in digestion
  - Absorbs water and some micronutrients
  - Contains friendly bacteria (commensals)
    - These digest what we can't (fibre)
    - Produce gas and vitamin K
    - Produce fatty acids that the large I uses
  - Rectum : holds the faeces until it's eliminated
  - Water, nutrients, and fecal material may spend up to 24 hours in the large intestine
  - Gas is produced is called flatus; Contains nitrogen, Carbon dioxide, hydrogen, methane, and hydrogen sulphide (*all bacterial fermentation of undigested food products, for example, fibre)*

Where do Nutrients Go?

- Into the bloodstream
- Nutrients are then transported to organs and tissues around the body

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Barrier Function of the GI Tract

- *Barrier Function*
  - Protective role of gastrointestinal cells
  - Limiting the absorption of harmful substances such as toxins, and disease-causing organisms
- GI tract contains some immune cells:
  - Phagocytes
  - Lymphocytes
  - B cells which produce antibodies
- The barrier function can detect antigens
  - (*foreign substances that when introduced to your body stimulates an immune response*)
- The first immune cells that respond are called phagocytes.
  - They target any invader, engulf it and destroy it by breaking it up
- These broken up antigens are then detected by lymphocytes, which react by producing and secreting protein molecules called antibodies
  - *Antibodies:* destroy or inactivate foreign substances in the body

Where do Nutrients go?

- Into the blood and lymph
- Nutrients are then processed and/or utilized for energy

Release of Nutrients into the Blood

- The circulatory system transports nutrients throughout the body and into cells

The Hepatic Portal Circulation

- Carriers blood and water soluble nutrients from the digestive tract to the liver
- The liver then processes and releases these nutrients
  a. Can break down nutrients further
  b. Can store nutrients for later use
  c. Transport to the rest of the body for immediate use
- Liver has small capillaries

The Lymphatic System: "*Think white blood cells*"

- Absorbs fat soluble nutrients that are unable to fit in small capillaries(*in the liver)*
- These nutrients are packaged into chylomicrons(*Little fat blobs)*
- Chylomicrons travel from the intestinal cells into the lymphatic systems, then into the blood
- The lymphatic system also collects and filters the body's fluid - it helps us fight infections
  - Lymphatic system acts as a 'gatekeeper' and controls blood flow in and out

Nutrients in the Blood Stream

- Nutrients are pumped through the body in the blood and lymph
- They can be picked up by body tissues for immediate use
- *Examples:*
    - *Carbohydrates would go right to the organs and muscles for energy*
    - *they may be stored in the body*
    - *fat stored in adipose tissues or calcium stored in bones*

Nutrient Transport into Cells

- Cell membrane
- Membrane that maintains the integrity of the cell and surrounds cell contents
- Selectively permeable membranes
    - Allows some substances, such as water to pass freely
    - Limits and controls the transport of others
- Nutrients from food are transported into cells via simple diffusion, facilitated diffusion, and active transport

Getting the Nutrients into Cells

- ***Simple Diffusion:***
    - Movement of substances from an area of high concentration to an area of lowe concentration
    - No energy is required
    - *Examples: Vitamin E and fatty acids are absorbed through simple diffusion*
- ***Osmosis:***
    - Passive movement of water across a semipermeable membrane in a direction that will equalize the concentration of dissolved substances on both sides
    - *E.g. If there is a high concentration of sugar in the intestine, water will move from the mucosal cells and into the intestine to help dissolve sugar*
- ***Facilitated Diffusion:***
    - The movement of substances across a cell membrane from an area of high concentration with the aid of a carrier molecule
    - No energy required
- ***Active Transport***
    - The transport of substances across a cell membrane with the aid of a carrier molecule
    - Requires energy
    - *E.g. The breakdown of starch from a slice of bread and amino acids from protein (e.g. chicken) are digested and absorbed using active transport*

Metabolism of Nutrients

- *What is metabolism?*
    - A chemical reaction that happens inside a living thing that results in the transformation of one molecule into another

Energy Metabolism

- How does it work?
- Breaking the bonds between atoms releases energy
- WHY?

Chemical Bonds are Less Chaotic

- Sticking two atoms together takes energy
- Breaking a bond releases energy

In Your Body…

- Carbohydrates, fats and proteins all contain strings of carbon atoms
- We release the energy stored in carbohydrates, fat and protein by breaking the bonds between atoms
- The energy is converted to:
    - Heat
    - Adenosine Triphosphate (ATP)

How does Energy Metabolism Happen?

- *Process of cellular respiration. Oxygen MUST be present in order to occur*

1. In the presence of oxygen, glucose, fatty acids and amino acids can be metabolized to produce acetyl-CoA
2. Acetyl-CoA is broken down by the citric acid cycle to yield carbon dioxide and high-energy electrons
3. The electrons are moved to the electron transport chain where their energy is used to generate ATP and they are combined with oxygen and hydrogen from water.
    - Water is released
    - ATP is bodies source of energy
    - Made up of adenosine and 3 phosphate groups which have high energy bonds between each phosphate group.

ATP: The energy currency

What does ATP do?

- Each cell of your body makes its own energy via cellular respiration
- That ATP is used by the cell to power all it's processes
    - Muscle contractions, making new cells and tissues, making DNA, transporting molecules into and out of cells

Other End Products of Energy Metabolism

- Carbon Dioxide from citric acid: waste product
- Nitrogen from breaking down protein: waste product
- Water

End Products of Energy Metabolism

- Products from our digestive system get excreted through the anus as waste (feces)
- Carbon dioxide is released from the citric acid cycle into the environment (we breath it out)
- Water is excreted as a waste product from breaking down protein (through our skin)
- Nitrogen is excreted through our urinary system (urine)
- Here we have the urinary system, respiratory system, digestive system, and integumentary system working together to remove bodily waste

Bodily Systems and Nutrient Transport

- The digestive system takes in nutrients and the respiratory system takes in oxygen, which are then distribute to all body cells by the circulatory system
- The urinary, respiratory and integumentary systems transfer metabolic wastes to the external environment

Anabolic Metabolism

- Smaller molecules get made into larger molecules using energy

Catabolic Metabolism

- Large molecule being broken down to produce lots of energy and smaller molecules

Overview of GI Tract:

1. *Mouth*
- Mechanical Digestion
2. *Liver:*
- Secretes bile to digest lipids
- Stores, breaks down and transports nutrients
3. *Gallbladder*
- Store bile for lipid digestion
4. *Small Intestine*
- Some nutrient absorption
- Breaking down of nutrients
5. *Salivary Glands*
- Lubricating food, and breaking down food
- Contains salivary amylase which breaks down carbohydrates
6. *Pharynx*
- Transports food down to esophagus
7. *Esophagus*
- Transports food down via peristalsis
8. *Large Intestine*

- Dehydration and compaction of indigestible materials in preparation for elimination

9. *Stomach*

- Chemical breakdown of materials via acid and enzymes
- Mechanical breakdown through muscular contractions

10. *Pancreas*

- Creates hormones for absorption and breaking down

January 20 Digestive Problems

Stool Types

Type 1: separate hard lumps, like nuts (hard to pass)	Hard or impacted stools: Someone suffering from constipation will experience this
Type 2: Sausage-shaped but lumpy	
Type 3: Like a sausage but with cracks on surface	Healthy Stools
Type 4: Like a sausage or snake, smooth and soft	
Type 5: Soft blobs with clear-cut edges (passed easily)	
Type 6: Fluffy pieces with ragged edges, a mushy stool	Loose stools to diarrhea
Type 7: Watery, no solid pieces	

Constipation

- Stools are infrequent or hard to pass
- *How frequent is infrequent?*
  - Anywhere between once a day and once every week can be normal
- *Why does it happen?*
  - Stress, travel
  - Aging, drugs, nerve disorders
  - Lack of exercise
  - Low fibre intake
  - Low fluid intake

Eat Right to Prevent Constipation

- Eat lots of fibre
  - Provides bulk.
    - In large intestine fibre is not digested, adding bulk to stool.
  - Holds onto water
    - Water in large intestine allows for ease of movement.
- Drink lots of water (or other liquids)
  - Keeps everything sot
  - Hot liquids help

Diarrhea

- Possible causes:
  - Bacteria (foodborne) viruses, parasites
  - Stress
  - Medications
  - Food intolerances (lactose, fructose, sorbitol)
  - Irritable bowel syndrome, celiac disease
- Causes dehydration and loss of electrolytes
- Probiotics may help treat diarrhea

Probiotics

- Foods that contain live bacteria or yeasts
- Yogurt, kefir, soy yogurt, miso
- Shown to decrease duration of diarrhea and prevent diarrhea caused by antibiotics
- May help prevent other diseases
  - Lactose intolerance; food allergies
- *How do they work?*
  - Increases # of commensals. (Increases number of good bacteria)
  - Help fight harmful bacteria and viruses, among others (Antibotics wipe out all bacteria, including probiotics)
    - These make short chain fatty acids, improve GI health
    - Help fight bad bacteria, viruses ect.

Vomiting (emesis)

- EJection of stomach contents through the mouth
- Reverse peristalsis occurs
- Protective reflex against toxins
- Caused by bacterial or viral infections, medication or other illness
  - Can also be related to eating disorders, pregnancy or food allergies
- Can result in electrolyte imbalance and dehydration
- Can damage the mouth, gums, esophagus and teeth

Heartburn

- Also known as Gastroesophageal reflux disease (GERD)
- Reflux of acidic contents from the stomach in the esophagus
- Lower esophageal sphincter may be damaged, or just not working hard enough
- Diagnosed as GERD if occurring twice per week
- 5 million canadians experience heartburn or acid reflux at least once per week
- *Why does it burn?*
  - When acidic contents from stomach come back up to the esophagus, it causes the esophagus to burn.

- *Causes:*
  - Genetics: Dysfunctional esophageal sphincter
  - Physical damage: Dysfunctional esophageal sphincter
  - Pregnancy: Extra stomach pressure
  - Hiatal Hernia: Extra stomach pressure
  - Overweight/Obesity: Extra stomach pressure
  - Other potential causes include anxiety and stress

Hiatal Hernia

- Where part of the stomach is coming up to the diaphragm and into your esophagus
- The hernia is when the stomach is protruding out from the diaphragm
  - Opening is a lot larger than normal
  - Causes some extra gastric contents to go up and into the esophagus

Dietary/Lifestyle Contributors

- Chemically affect muscle tone of the digestive tract/lower esophageal sphincter
  - Large meals: digested slowly
  - High fat meals *(Deep fried foods)*
  - Spicy foods
  - Smoking
  - Alcohol
  - Caffeine

What to Do

- Avoid high fat, spicy meals
- Avoid caffeine and alcohol
- Eat small meals
- Drink between meals, not with meals
- Don't lie down for at least 3 hours after a meal
- Tomato based foods, garlic, onions

Intolerances and Allergies

- *Intolerance:* Inability to properly digest a food or nutrient
  - *E.g. lactose intolerant*
- *Allergy:* Food causes an allergic reaction

Lactose Intolerance

- 65% of people worldwide
  - Common among asians, african, indigenous and mediterranean groups
- Due to deficiency of lactase, enzyme that breaks down lactose
  - Enzyme in the brush border of small intestine
  - All babies have lactase, some lose it as adults
- Find your intolerance level
  - Cheese has little lactose

    - Yogurt may be easier to digest
    - Kefir may be easier to digest
    - Smaller amounts may cause no problems
- Other options: Lactase treated milk, lactase tablets, soy milk or other calcium-fortified milk alternatives

Celiac Disease

- An autoimmune disease
- Gluten (a protein in wheat, rye, barley and spelt) stimulates an immune response
    - Immune cells attack the brush border
        - The brush border is located in our small intestine
- Often develops in childhood
    - But could develop anytime
- Caused by genetics, unknown trigger

Celiac Symptoms

- May have GI discomfort
- Lack of growth (children)
- Diarrhea and bloating
- Vitamin and mineral deficiencies
- Weak bones
- May have weight loss
- If untreated, greater risk of intestinal cancer

Celiac: What NOT To Do ‘

- NO gluten
    - Even slight contamination causes painful reaction
- NO
    - Bread, pasta, cakes, muffins made with, wheat, rye, barley or spelt
    - No foods with gluten containing thickeners. (*A lot of bbq sauces and regular sauces)*

What to do instead

- Alternative flours/grains:
    - Rice, amaranth, Corn, cassava, quinoa, arrowroot
- The good news:
    - More tasty gluten-free foods are on the market
    - Food labelling is making it easier to identify gluten-free foods

Allergies

- Immune response
    - Rashes, hives, swelling, itching
    - Severe - anaphylactic shock (you cant breath)
- Common food allergies
    - Cow’s milk, nuts, seeds, eggs, milk, shellfish. Soy, wheat, some fruit
- Treatment: Avoid

Midterm Question:

- In which part of the body is there chemical digestion of all macronutrients (carbs, protein and fat)

a. Mouth
b. Stomach
c. Small intestine
d. Large intestine

What are Carbohydrates

- All carbohydrates are made of sugar molecules

Types of Carbohydrates

- Simple carbohydrates (aka sugars)
  - One (monosaccharide) or two (disaccharide) sugar molecules
- Complex carbohydrates (aka polysaccharides)
  - Many sugar molecules strung together, (*e.g. starch and fibre)*
- Found in all plant foods and milk
- CHO in many foods NOT in a food group
- Meat, fish, poultry and fats have NO carbohydrate
- Eggs and cheese have VERY little CHO

Carbohydrate Terminology

- Suffix - ose means carbohydrate
  - GlucOSE, fructOSE, dextrOSE
- Saccharide= sugar molecule
  - Monosaccharide = 1 sugar molecule
  - Di-saccharide = 2 sugar molecules
  - Polysaccharide = LOTS of sugar molecules

The Monosaccharides

- Each contain 6 carbons, 12 hydrogens and 6 oxygen atoms

1. **Glucose**

- Glucose circulates in the blood and is the most important carbohydrate fuel for the body
- It is produced in plants by the process of photosynthesis, which uses energy from the sun to combine carbon dioxide and water
- Glucose occurs as a monosaccharide in honey but is most often part of a disaccharide or starch

2. **Fructose**

- Is a monosaccharide that tastes sweeter than glucose, it is found in fruits and vegetables and makes up more than half the sugar in honey
- It does NOT cause a great rise in blood glucose levels, so commonly used in diabetic products.
- Most of the fructose in our diets comes from high-fructose corn syrup (this is sweeter and less expensive than table sugar)

3. **Galactose**

- Rarely present as a monosaccharide in the food supply, but occurs most often as part of lactose, the disaccharide in milk
- Often added as sweeteners to processed foods (*e.g. Glucose, fructose)*

The Disaccharides

- Two monosaccharides linked together

- *Maltose:* 2 glucose molecules
  - Naturally found in beer and is used as a food additive
- *Sucrose:* 1 glucose, 1 fructose
  - Table sugar ("sugar" in most recipes)
- *Lactose:* 1 glucose, 1 galactose
  - Milk sugar (less sweet than sucrose)

Starch is Plant Energy Storage

- A class of polysaccharides
- LONG strings of monosaccharides
  - Straight - amylose
  - Branched - amylopectin
- Storage form of carbohydrates for plants
- Lots of starch in grains, potatoes, legumes

Whole Grains Vs. Refined Grains

- Whole or refined grains contain:
  - Bran Layers: A good source of fibre and vitamins
  - Germ: Good source of vegetable oils and vitamin E
  - Endosperm: Contains starch and some protein
  - Refined grains: (*e.g. corn flakes):* Made largely from the endosperm and are mostly starch
    - May be enriched with thiamin, riboflavin, niacin, and iron. May be fortified with folate.

Fibre

- A class of polysaccharides
- Often made of glucose but can be other monosaccharides
- Provide structure to the leaves, stems and seeds of plants
- Lots in whole grains, vegetables, fruit and seaweed
- Cannot be digested by enzymes our body produces

Types of Fibre

Soluble Fibre	**Insoluble FIbre**
- Absorb water - Often used as gelling agents or thickeners - Pectins, gums, mucilages - High in oatmeal, beans, oat bran, barley, apples, legumes - Digested by bacteria in large intestine	- Don't absorb water - Give stiff structure to plants - Cellulose, hemicellulose, lignin - Found in whole grains, wheat and rye bran, fruit skins and seeds - Unable to be digested by bacteria, excreted out of the body

Carbohydrate Digestion

- Starts in the mouth : salivary amylase
  - Salivary amylase breaks starch into glucose and smaller polysaccharides

- NO Carbohydrate digestion happens in the stomach
- *Small intestine:*
  - *Pancreatic amylase:* Breaks down starch into glucose and maltose
    - Starch → Glucose and maltose
  - *Sucrase:* Breaks down sucrose into glucose and fructose
  - *Maltase:* Breaks down maltose into 2 glucose molecules
  - *Lactase:* Breaks down lactose into glucose and galactose

Carbohydrate Absorption

- Monosaccharides → Intestinal Cells → Blood
- The blood delivers them to the liver
  - All monosaccharides are transferred through the hepatic portal system
- Glucose can be burned for energy or stored as glycogen in the liver

Glycogen

- Animals store glucose as glycogen
- Found in liver and muscle
- Liver - keeps blood glucose levels stable
- Muscle : fast energy for exercise
- NOT a dietary source of carbohydrate

Cellular Respiration

- Occurs within each cell, via the mitochondria
- Glucose metabolized to produce ATP
  - ATP is the energy currency of cells
- Glycolysis splits glucose (6-carbon molecule) into 2 molecules of pyruvate (3-carbon molecule)
  - This step produces high-energy electrons and a small amount of ATP each pyruvate is then either broken down to produce more ATP or used to make glucose via gluconeogenesis

Why Do We Need Carbohydrates?

- Carbohydrates break down into glucose
- Provide the quickest source of energy
    - Every cell can use glucose for energy
    - Glucose is the preferred energy source
    - Red blood cells, brain and nerve cells rely on glucose
    - The body regulates blood sugar levels closely to make sure we have enough
        - Regulated by insulin and glucagon

What do Carbohydrates do?

- Glucose and glycogen provide energy for exercise
    - Glycogen is storage form of glucose in the liver
- Allows for the breakdown of fat
    - Body can't metabolize fat without a little bit of carbohydrate to get it started
- Prevent Ketosis
    - If you eat too little carbohydrates, there's not enough to feed your brain and red blood cells
    - You start making ketone bodies out of fat
- Need 130g of carbohydrates each day for our bodies to function

"Hitting the Wall"

- Condition caused by a depletion of glucose stores in the liver and muscle(Glycogen storages)
- Characterized by sudden onset of fatigue
- Often common during endurance events (*running marathons)*

What Does CHO Do?

- Spare protein
    - If your body is low on glucose, muscle can be turned into glucose via gluconeogenesis
    - Not ideal because body needs protein to make organs, muscle, skin, enzymes, hormones, blood, EVERYTHING.
    - Body will steal protein from blood, organs and muscle to make glucose if no other form of energy is available
        - Not good, because these other body parts will suffer in growth due to lack of protein

Diabetes History

- Too much glucose in the blood
- First described in 1552 BC
    - In egypt: Great emptying of urine
    - In India: Sweet urine that attracted
- In 250 BC the greeks described it as the "Melting down of flesh and limbs into urine."

Canadian Diabetes Research

- Discoveries in the late 1700s to 1800s
  - Diets of meat or starvation diets with little carbohydrates kept people with diabetes from dying
  - Removing the pancreata of dogs caused diabetes
- 1921: Banting and Best discovered insulin
  - A “CURE” for diabetes

Insulin

- A hormone secreted into the blood by the pancreas
- Works with glucagon to control blood glucose levels
- Insulin allows glucose to be taken up into our bodies cells and used for energy
  - *“Gatekeeper” that allows glucose into cells*
- Peptide hormone
- Secreted by the beta cells in the pancreas
- Regulates metabolism of proteins, fats and carbohydrates

Glucagon

- Another hormone secreted by the pancreas
- Peptide hormone
- Secreted by the alpha cells of the pancreas
- Works to raise the concentration of glucose in the blood
  - Pancreas secretes glucagon, which then signals glycogen from liver to be broken down for energy allowing glucose to enter our bloodstream

Type 1 Diabetes

- 10% of cases in Canada
- An autoimmune disease
- Your immune system attacks the cells of the pancreas
- NO insulin produced
- Insulin therapy is required for life
- Often in children, but can happen any time
- *What happens?:*
  - Insulin is not produced because pancreas cells are being attacked, so glucose cannot be brought into cells.

Type 2 Diabetes

- 90% of cases in Canada
- Usually seen in middle aged to older adults
- Insulin resistant and not enough insulin
- Previously known as adult-onset diabetes, but is being diagnosed more often in children and adolescents

- *What happens?:*
  - Pancreas is still secreting insulin, but it doesn't seem to be enough or tissues/cells are not responding to it.
  - Body doesn't recognize insulin, so only limited amounts of glucose are getting into the cells, leaving most of it floating in our bloodstreams.
- Caused by diet and lifestyle, along with family history.
  - Obesity low fibre, high simple CHO, high fat diets and low physical activity are RISK factors for type 2
- Treated using lifestyle changes, insulin sensitizing drugs(Pills) and insulin injections

Bottom Line

- When your body doesn't make insulin or your insulin doesn't work properly,
  - Your cells don't take up glucose, and glucose builds up in your bloodstream

Symptoms

- Makes you have blurred vision (some cases)
- Makes you thirsty
- Makes you lose weight (Type 1)
- Makes you tired
  - Cells aren't getting any energy
- Makes you urinate a lot
- May not show any symptoms
- Ketoacidosis (Type 1)

Long Term Consequences

- Damages blood vessels and nerves
- Leads to atherosclerosis (*plaque build up in the arteries)*
  - Increased risk of heart disease (2-3 times the risk of those without diabetes)
  - Leading cause of blindness (*nerve damage in eyes*)
  - Leading cause of kidney disease/failure
- Damages peripheral nerves
  - Damages fingers and toes
  - Hurt foot, don't notice, gets infected (*Sugar coats nerves, causing them to not even function)*
  - Leading cause of amputations
- Also higher risk for dementia

Good News

- Controlling blood sugar levels decreases your risk of developing diabetes/complications
- Many people with both types of diabetes live healthy lives
- Goal is to maintain blood glucose within a normal range

Glycemic Index

- One way nutrition can help control diabetes
- GI is a measure of carbohydrate quality
- Classifies dietary carbohydrates based on a scale of 0-100
    - Low GI=<55
    - Medium GI=56-69,
    - High GI= >70
- Low GI foods result in gradual increase of blood glucose levels after meals

GI and Health

- Low GI helps control blood sugar
- Low GI foods may help control appetite
    - Lower obesity
- Low GI foods may increase insulin sensitivity and prevent diabetes

GI is Complicated

- Can't always predict which foods are high and low
    - Usually high-fibre foods are low GI but not always
- Each person is unique in their response

Meeting Carbohydrate Needs

- AMDR: 45-65% of our calories should come from carbohydrates
- For a 2,000 kcal diet:
    - 45% of 2000 kcal= 900 kcal/4g per kcal = 225g CHO
    - 65% of 2000 kcal= 1300 kcal/4g per kcal = 325g
- Carbohydrates also have an RDA of 130 of carbohydrates per day for adults and children

If You Don't Consume Enough

- Insufficient carbohydrate to fuel brain, <130g/day
    - Brain cells rely on glucose
    - Therefore, brain will seek an alternative source of energy
- Result is ketosis
    - Breakdown of fat to produce ketone bodies
- Ketone Bodies
    - Water soluble, organic compounds which provide energy to the brain when we fast or consume very little amounts of CHOs

Low Carb Diets and Ketosis

- Does these diets help people lose weight?
    - Yes, in the short-term

    - Ketone bodies suppress appetite
- Side effects
    - Constipation
    - Bad breath
    - High levels of fat in the blood
    - Decreased Athletic performance
    - Mildly acidic blood
    - Hormone imbalances:

Low Carb Diets Promote Ketosis for Fat Burning

- Help people lose weight in the short-term
- Side effects:
    - Constipation
    - Bad breath
    - High levels of fat in the blood
    - Decreased athletic performance
    - Mildly acidic blood
    - Hormone imbalances: Menstrual irregularities, kidney stones, weak bones, stunted growth in children

Fibre

- Class of polysaccharides
- Often made of glucose but can be other monosaccharides
- Provides structure to leaves, stems and seeds of plants
- Lots in whole grains, vegetables, fruit and seaweed
- Cannot be digested by enzymes we produce

Benefits of High Fibre Diet

- Lower risk of:
    - Constipation
    - Obesity (fibre is filling)
    - Diabetes
        - Fibre slows down CHO digestion, regulating blood sugars
    - Diverticulosis (pouches form in the large intestine)
    - Colon cancer (moving waste along)
    - Hemorrhoids

Fibre and Bowel Disease

- Fibre keeps you regular
- Decreases risk of:
    - Constipation
    - Diverticulosis
    - Colon cancer

- Good to have a healthy large intestine

Fibre Requirements

- **Women(19-50):** Need 25g per day
- **Men(19-50):** Need 38g per day
- On average, Canadians get 14g per day

High Fibre Foods

- Beans/legumes
- Whole grains
  - Bran based cereals or other products
  - Brown or whole grain rice
- Fruits & Vegetables (with skin on)
- Seeds/nut
- Dried fruit

Natural Sugars

- Natural sugars are found in milk products, fruit and vegetables
  - Sugars in fruit (fructose, glucose and sucrose)
  - Sugars in milk and milk products (lactose)
- These foods also contain fibre, vitamins and minerals
- More natural sugars related to better health

Added Sugars

- Added sugars are added to foods during processing or preparation
  - Table sugar (sucrose)
  - High fructose corn syrup (Fructose and glucose)
  - Honey (fructose)
  - Molasses
  - Glucose
  - Dextrose

Added Sugars and Health

- Considered “Empty Calories ”
- High added sugar consumption is related to
  - Low quality diet (fewer vitamins and minerals)
  - Obesity
  - Low insulin sensitivity
  - Dental Cavities

How Much is TOO Much Sugar

- DRIs say <25% of kcals should come from sugar
- World Health Organization says <_% _
- For a 2000 kcal diet
  - <25% = 500 kcal/4 kcal per g CHO = 125g of sugars
  - <5% = 100 kcal/4 kcal per g CHO = 25g sugars

Sweeteners

- Also called the artificial sugar or non-nutritive sweeteners
- Provide little to no energy
  - Added to products
- Differ from carbs
  - Not monosaccharides or disaccharides
  - Added to products labelled as “sugar-free”
- Often found in poor dietary choices that are low in other nutrients

Food Sweeteners

- **Sugar Alcohols** (*e.g. sorbitol)*- often in sugar-free gum.
  - Too much causes GI to get upset
- **Cyclamate-** aka “sugar twin”,
  - Use only as a table-top sweetener
- **Aspartame-** Made of amino acids, found in MANY sugar-free foods
  - Is it harmful? YES in large quantities
- **Acesulfame Potassium(Ace-K)-** Often in sugar-free or diet products with other sweeteners
  - Up to 200 times more sweet than table sugar
- **Sucralose(Splenda)**
  - Often found in sugar-free foods
  - Very safe, you can bake with it
- **Stevia-** New sweetener in Canada

Sample Midterm Question

Which statement correctly defines aspartame?

a. Artificial sweetener
b. Composed of amino acids
c. Often found in soda or soft drinks
d. All of the above

Fat Digestion: Throughout the GI tract

- **Mouth:** Chewing and lingual lipase (saliva releases lipase)
- **Stomach:** Churning shapes fat into small droplets(Mechanical) , gastric lipase
- **Small Intestine(Where most digestion occurs):** Bile emulsifies fat into small droplets
    - Pancreatic lipases break fatty acids off of glycerol
        - Free fatty acids and monoglycerides

Fat Absorption

- Bile surrounds the fatty cell(Micelle) which allows for the absorption of fat
- Bile makes the micelle (which is naturally fat soluble) water soluble so fatty acids can be transferred through the blood
-

Some Problems

- How do nutrients move through the body?
    - In the blood
- Blood is mostly made of water, what will happen if you add fat to blood
    - It won't mix, fat will float
    - Solution is **lipoprotein**

Lipoprotein Structure(Ball of fat)

- Made of a bunch of different fats
    - Cholesterol, triglycerides, phospholipids and protein
- Fatty acid tails on interior section (Water insoluble)
- Phospholipid heads on outside (Water soluble, mix well with blood)

Lipoproteins

- Help with transportation of fatty acids and fat soluble vitamins through blood
- Go through lymphatic system

Types of Lipoprotein

- **Chylomicrons**
    - Made in the cells of small intestine
    - Carries dietary fat to the liver and the rest of the body for burning or storage
- Other types made in the liver
    - Very low density lipoprotein (VLDL)
        - Turn into low density lipoproteins (LDL)
    - High Density Lipoproteins (HDL)
- Transports fats to and from the liver
- HDL and LDL are types of cholesterol
    - HDL is more helpful to body
    - Want less LDL

Lipoproteins and Heart Health

- Different blood lipoproteins affect your heart health
- Good and bad cholesterol affect heart health

Why do we need Lipids?

- **For Structure and lubrication**
  - Provides insulation
  - Protects bones, joints and organs
  - Very important for making and protecting of the nervous system
  - Oils lubricate the myelin sheath
    - Myelin Sheath helps transport different nerve signals across the body
- **For Cell Structure**
  - Lipids make up cell membranes
  - **Phospholipids** keep membranes fluid (animals only)
- Regulation of body processes
- Need lipids for things like:
  - Vitamin absorption (A,D,E,K)
  - Making hormones (*e.g. sex hormones)*
  - Blood pressure regulation
  - As a building block to make other fats
  - Regulating blood clotting
- Hormones are important regulators
- ATP production for energy
- 1g of fat provides 9 kcal of energy
- High fat foods have high energy content
- Cells burn fat at rest and during exercise
- Energy storage
- Triglycerides stored in adipose tissue(fat cells)
- Stored fat gives you energy reserves
  - Keeps you from starving
- Fatty acids used for energy when carbs are not present

Body Shapes

- **Apple:** Most weight is above the waist
- **Pear:** Most weight is below the waist

How Much Fat is 20-35%

- For a 2000 kcal diet 44-78g of fat
- 5g from 1 cup 2% milk
- 1g from a bagel
- 15g from 2 tbsp. Peanut butter
- 15g from a sandwich
- 30g from 2 slices of pizza

- 2 cups of poutine
- Large poutine at NYF is 57g of fat

Weight Pattern & Disease Risk

- Excess body fat in apple body shape associated with higher risk of:
  - High blood pressure
  - Type 2 diabetes
  - Heart disease
  - Stroke

Essential Fatty Acids

- **Linoleic Acid (omega-6)**
  - 18:2 w-6
- **Alpha (a) Linolenic Acid (omega-3)**
  - 18:3 w-3
- Necessary for:
  - Regulating blood clotting
  - Regulating inflammation
  - Normal brain development
- Omega-3's reduces inflammation
- Omega-3's linked to brain health

How Do we Get Essential Fats?

- **Linoleic Acid**
  - Oils, margarine, nuts and seeds
- **Alpha Linoleic Acid**
  - Canola, flax, soy, fatty fish, omega eggs

How Much Fat Do We Need?

- DRIs have _ for:
  - Linoleic Acid
  - Alpha-Linolenic Acid
- AIs based on how much essential fats you need to keep clotting etc. under control
- For a healthy adult, use the AMDR for fat- 20-35% of calories from fat

Recommendations for Different Types of Fat

- AMDR state that for cholesterol, saturated fat and trans fat:
  - As low as possible while consuming a nutritionally adequate diet

Lipids

- Large class of organic molecules
- Includes :
  - Fatty acids, triglycerides, phospholipids and sterols
- Lipids contribute to texture, taste, flavor and aroma of foods
- 1 g of lipid yields 9 kcal of energy
- Large group of molecules that are not soluble in water (Hydrophobic)
- What makes things soluble in water?
  - Polarity, whether they have a charge or not.

What Lipids Do We Eat?

- Lipids in the diet consist of
  - **Triglycerides** : 95% of dietary lipid
    - Usually what we're talking about when we say "fat"
  - **Phospholipids**
    - Make up cell membranes
  - **Sterols**
    - Cholesterol is the main one

Triglycerides

- Eat triglycerides and store our body fat as tri's
- Made of
  - 1 glycerol molecule "**backbone**"
  - With 3 fatty acids
    - Long hydrophobic chains of carbon and hydrogen

Fatty Acids

- Different fatty acids give triglycerides physical properties
- Fatty acids can be different
  - Lengths
  - Saturation
  - Shapes

Fatty acids of different lengths

- **Short chain fatty acids**
  - Fewer than 8 atoms
  - Can you remember talking about short chain fatty acids before?
- **Medium chain fatty acids**
  - 8-12 carbons
- **Long chain fatty acids**
  - 12 or more carbons

Fatty Acid Length Affects

- How it is digested and metabolized in the body
- Its function in the body
- Its structure before/when you eat it
- *Example: Lauric Acid*

Fatty Acids with Different Saturation

- **Saturated (SFA)** = **NO** double bonds
  - Most common palmitic and stearic aci, which are found only in animals foods like meat and dairy
- **Unsaturated** = _ double bonds
  - Monounsaturated (MUFA) = 1 double bonds
  - Polyunsaturated (PUFA) = 2 or more double bonds

Saturation Effects

- Properties at room temperature
  - Solid or liquid depending on saturation
  - Long chain = solid at room temp
- How they are processed in the body
- The effect on metabolism of nutrients

What Foods Have Saturated Fats?

- **Saturated Fats:** Animal fats, tropical oils
  - Saturated palm oil extends self-life

Monounsaturated Fats

- Olive oil, canola oil (plant based)
  - Most common is oleic acid

Polyunsaturated Fat

- Soybean oil, safflower, corn oil, fish, nuts and seeds (plant based)
  - Most common is linoleic acid found in corn, safflower and soybean oils

Where is that Double Bond?

- The bond is a carbon-carbon bond of the fatty acid (double bond)
  - The omega (w) or (CH_3) end
  - This last bond affects how your body uses the fat
- Omega-3 fatty acids = double bond at the 3^{rd} and 4^{th} carbons from the (w) or (CH_3) end
- Omega-6 fatty acids = double bond at the 6^{th} and 7^{th} carbons from the (w) or (CH_3) end
- Affects how our body metabolized the fatty acid

The Shape

- **Cis =** Hydrogen molecules on the same side
- **Trans =** Hydrogen molecules on opposite sides
- MOST fatty acids have the cis configuration
- Trans fatty acids are on nutrition labels
    - Found naturally
    - Produced via hydrogenation- mixing of hydrogen gas with liquid oil

Trans Fats

- Naturally in: Hydrogenated Fats

Naming Your Fatty Acids

- Fatty acids are given common names AND numerical notations
- Example: 18:2 w-3
- 18= # of carbon atoms
- 2= # of double bonds
- 3= Where last bond is located

Phospholipids

- Sub-groups of lipids
- Lipids are attached to a phosphate group
- Phospholipids from a lipid bilayer in the cell membrane
    - Maintenance of membrane integrity
    - Helps regulate what can pass in and out of a cell
    - Some dietary sources include: Egg yolk, fish, milk, beef
- Phospholipids mix well with both water and fat
- Important in our bodies as they act as emulsifiers

Sterols

- A large group of hydrophobic compounds
    - Found in plants and animals
    - Most common in animals = cholesterol
    - 90% of cholesterol in body is found in our cell membranes
- Helps make up hormones
    - Active role in monitoring estrogen and testosterone levels
- Bodies need cholesterol, but too much causes high cholesterol

Midterm Multiple Choice Question

What is the end of a fatty acid chain containing a methyl group called?

a. **Omega**
b. Alpha
c. Delta
d. Beta

Cardiovascular Disease (CVD)

- **What is it?**
  - Disease of the heart and blood vessels
  - Includes heart disease, high blood pressure, heart attacks, strokes
- 30% of all deaths in Canada are from CVD
- CVD costs the Canadian economy more than $20.9 billion every year
- 2nd leading cause of death in Canada after cancer
- **Main Cause:** Atherosclerosis
  - Buildup of plaque in arteries

Atherosclerosis

- An inflammatory response to injury within the artery walls
- Lipids and fibrous material are deposited within the artery walls due to action of immune system
- Reduces elasticity of blood vessels and eventually blocks blood flow
  - Blockage of blood flow to heart leads to heart attack
  - Blockage of blood flow to brain leads to stroke

Risk Factors for CVD

- Age, gender, family history of CVD
  - Females at higher risk of CVD
- Being overweight/obese
- Being physically inactive
- Smoking
- High blood pressure
- Diabetes
- Diet- High in fat

Types of Fat

- Saturated fat
- Trans fat
- Monounsaturated fat
- Polyunsaturated fats

Fats and Heart Disease

- Saturated and trans fats increase risk of heart disease
- Omega 3 and Omega 6 polyunsaturated fats decrease risk
  - They affect the type and amount of lipoproteins, triglycerides and cholesterol in the blood

VLDL and LDL

- Chylomicron → VLDL → LDL & HDL
- Transporting lipids to cells around the body

HDL

- Removing lipids from cells around the body so that they can be excreted

- Doctors measure blood lipids to look assess CVD risks
- When they measure:
    - LDL-cholesterol, they measure the # of LDL particles
    - HDL-cholesterol, they measure the # of HDL particles
    - Triglycerides, they measure # of triglycerides
    - LDL:HDL ratio measures which “dump-trucks” are winning

Foods that Affect Blood Lipids

- **Saturated Fats:** Increase LDL
- **Trans Fats:** Increase LDL, decrease HDL
- **Added Sugars:** Increase VLDL (Triglycerides)

Cholesterol

- We eat cholesterol in animal foods (meat, milk, eggs)
- Liver makes cholesterol
- For most people, dietary cholesterol is not associated with higher blood levels
    - NOT a main dietary target for reducing heart disease

Foods that Affect Blood Lipids

- **Mufa:** Decrease LDL
- **Omega-3 PUFA:** Decrease VLDL, Increase HDL
- **Exercise:** Decrease VLDL, increase HDL

Omega-3 Polyunsaturated Fats

- Are regulatory molecules
    - Don’t just affect lipoproteins, but also affect cell function
- Eating Omega 3s
    - Help infant brains develop
    - Help prevent cognitive decline with aging
    - Decrease risk of CVD
        - Improve blood lipids levels
        - Decreases blood clotting
        - Resolves inflammation

Omega 3 Fats

- Long chain omega 3 fats are the most heart healthy
- Role in reducing inflammation is what might help reduce the development of atherosclerosis
- Found in fish
    - Sardines, salmon, trout, herring, mackerel

Two Types of Long Chain Omega 3s

- EPA (20:5)
- DHA (22:6)

Getting Enough Omega 3s

- Eating well with Canada's Food Guide recommends eating at least 2 servings of fish per week
- Don't like fish?
    - Omega 3 foods - milk, yogurt, eggs
    - Supplements- Fish oil, fish oil capsules, microencapsulated fish oil

Vegetarian and Vegans

- ALA is another type of omega-3 that we can obtain from flaxseed and canola, soy and walnut oils
- Our bodies do also have the capability to turn ALA into DHA and EPA
    - But conversion is not efficient
- ALA may then also have benefits to reducing the risk of CVD
    - BUT association between ALA and CVD is not as strong in comparison to receiving omega 3 in the form of DHA and EPA from fish and/or fish oils

Too Much Omega 3

- Eating too many omega 3 fats can lead to adverse health effects
    - Possible dysfunction of immune system
    - Weight gain

Want to Eat Less Fat?

- Low fat products use:
    - Thickeners: usually carbs
    - Moistening: Fruit purees
    - Milk or egg protein for creamy texture
- Not always healthier
- Fat substitutes
    - Replacements similar in structure to fats, but aren't absorbed by the body
        - OLESTRA: may cause GI discomfort, bloating, diarrhea
        - Reduces absorption of specific vitamins
        - Not approved for use in Canada

Limiting Cholesterol, Trans, Saturated

- Choose lower fat cuts of meat
- Opt for chicken without skin
- Try a vegetarian meal 1x per week
- Use low in fat milk, yogurt and cheese
- Cut down on packaged foods with trans fat

Increase Mufa and Pufa

- Choose olive oil, peanut, or canola oil for cooking and salad dressing
- Use corn, sunflower or safflower oil for baking
- Snack on nuts and seeds
- Add olives, avocados and seeds to salad

Get Enough Omega-3's

- Sprinkle flaxseed on cereal, yogurt or use for baked goods
- Add another serving of fish to your weekly menu (aim for 2x per week)
- Have a leafy green vegetable with dinner
- Put walnuts in your salad
-

Coffee

- A beverage made from the seeds of the coffee plant (coffea arabica)
- A light roast maintains the original flavour of a coffee bean, and the darker the roast, the more roasted the flavour
- **Three ways of making coffee**

1. **Boiling (Decoration)**
2. **Infusion (steapping or french press)**
3. **Drip Brewing:**
4. **Pressurized Percolation (Espresso)**

What's In Coffee?

- Caffeine
- Phenolic substances (mildly acidic)
- Antioxidants

Caffeine

- A stimulant
- Most commonly used drug in the world
- ⅔ of north americans consume it everyday

Physical Effects of Caffeine

- Vary from person to person, but typically include:
  - Nervousness, irritability, restlessness, insomnia, heart palpitations
  - Caffeine dependency is possible
  - Experience withdrawal symptoms
  - addicting with repeated use

Caffeine and Hypertension

- Caffeine increases blood pressure for ~3 hrs
- Not in regular caffeine users

Caffeine and Bone Health

- Caffeine inhibits the absorption of calcium
- Those who consume caffeine AND have low bone mineral density are at higher risk of having poor bone health

Caffeine During Pregnancy

- Caffeine crosses the placenta, so if you drink caffeine, so will your baby
- High amounts of caffeine may increase risk of low birth weight and preterm birth
- Recommendation during pregnancy same as for non-pregnant women (300mg/day)

Other Effects of Caffeine

- Caffeine may increase or decrease anxiety, depression, other mental health conditions
- Caffeine may help prevent parkinson's disease
- Caffeine affects sleep pattern
    - Lack of sleep can lead to obesity, chronic disease, mental health disorders
- Caffeine can improve sports performance

Caffeine Recommendation

- Women of childbearing age <300mg per day
- All other adults <400mg per day
- About 2-4 cups per day

Oily Substances in Coffee

- Kahweol and cafestol- oily compounds
- Increase blood LDL levels(associated with increased risk of heart disease)
- Mostly found in boiled or french press coffee
- Filters keep the kahweol and cafestol out
- Dark roast has more oils

Oxidation: When electrons are taken off of atoms

- Can damage cells and DNA
- Free radicals are created

Antioxidants: Reverse oxidation and fix damage

- Study in Finland found that 66% of antioxidants in the diet came from coffee
- Antioxidants include
    - quinines, flavonoids, melanoidins
- Coffee also contains potassium, niacin (B Vitamin) and magnesium

Confounding Factors

- People who drink coffee aren't like people who don't
- Coffee drinkers may be more likely to:
    - Smoke
    - Drink alcoholic beverages
    - Have less healthy lifestyles

Overall Effect of Coffee On Health

- Moderate intake of coffee is related to improved health
- Decreases risk of: (due to antioxidants)
    - Type 2 diabetes
    - Some cancers
    - Parkinson's

    - Liver disease
- Some concerns for : (due to caffeine)
    - Sleep, mental health, pregnant women, bone health, children

Tea

- Soaked leaves of the tea plant Camellia Sinensis
- **Black Tea:** Leaves are picked, oxidized (Also called fermented) and dried
- **Green Tea:** The leaves are not oxidize, heated to prevent oxidation either through roasting or pan frying
- **White Tea:** The leaves are not oxidized and they are dried in the sun
- **Oolong Tea:** Withered in the sun and oxidized
- **Rooibos Tea:** Made from a different plant, aspalathus linearis
    - Does NOT contain caffeine
- **Herbal Tea:** Made from infusions of different plants

What's In Tea?

- Caffeine
- Antioxidants
- Other good stuff

Antioxidants in tea

- **Catechin**
    - A polyphenol
    - Protects against oxidative stress
    - Highest content in white and black teas
    - Black tea still contains a lot
- **L-Theanine:** An non protein amino acid derivative
    - Has a calming effect
    - Helps strengthen the immune system

Tannins In Tea

- Can bind non heme iron in the digestive tract to inhibit adsorption
- Too much tea could cause iron deficiency anemia

Health Effects of Tea

- Improved cardiovascular health (>3 cups per day)
    - Decrease blood pressure by protecting the health of blood vessels
- Green tea may help with body weight maintenance
    - Small increase in energy expenditure (5%) and fat burning
- Increase bone mass
- Prevents dental cavities- Fluoride in tea
- Improve immune system and mental activity
- **Health Effects are inconsistent**

- The “Dose” of tea required to see effects ranges from 1-6 cups/d
- Tea drinkers may differ from non-tea drinkers
- antioxidant contents depends on:
    - Geographical location, growing conditions, processing
- The action of antioxidants in the body may be different than their action in a test tube

Energy Drinks

- Sports drinks re-hydrate the body and provide sugars and electrolytes (NOT ENERGY DRINKS
- Redbull, monster etc
    - Caffeine level can range between 50-200mg per can
        - Taken on an empty stomach
        - Should not replace food
        - Should NEVER be mixed with alcohol

Sample Midterm Question

Identify which substances below are the oily substances found in coffee

a. Quinnes and flavinoids
b. Kahweol & cafestol
c. Cafestol & quinnes
d. Kahweol & catechin

Alcohol

- Any molecule with hydroxyl group on the end of the structure (OH)
- A common component of eating patterns around the world- our body has to detoxify it
- Alcohol can be burned for energy, but it is NOT a macronutrient
    - 7 kcal per gram of alcohol
- Found in:
    - Wine
    - Beer
    - Vodka, Scotch, rum, tequila, whisky, etc.

Fermentation- Creating alcohol

- Yeast is used to break down sugar into alcohol
    - Specifically ethanol

Making Wine

- Grapes are crushed
- The pulp is combined with yeast (1-2 weeks)
- Secondary fermentation/aging- wine is stored in barrels(often oak) to slowly ferment and mature (3-6 months or longer)
- **White Wine:** Crushed grapes, but grape skins removed
- **Fortified Wines:**
    - Higher alcohol as juice is concentrated
    - More sugar + fermentation= more alcohol
- **Sparkling Wines:** Fermentation _ means CO_2 captured

Making Beer

- Malted barley, water, yeast and hops
- Malting- barley is soaked in water until the sprouting, then the grain is dried
    - during germination starch turns to maltose
    - Starch → Maltose
- Hops add flavour and provide stability (zesty, bitter, citric)
- Yeast ferments the maltose to alcohol (2-4 weeks)

Digestion/Metabolism of Alcohol

- Alcohol is absorbed in the small intestine AND in the stomach
    - Mostly in the small intestine
- No digestion is required before absorption into the bloodstream
    - Body does not digest anything, only absorbs
- Your body metabolizes alcohol in several ways

Metabolizing Alcohol

1. **Alcohol dehydrogenase and acetaldehyde dehydrogenase in the liver**

- Alcohol→ Acetaldehyde→ Acetate
- Primary pathway when moderate amounts of alcohol are consumed

2. **MEOS (microsomal ethanol oxidizing system)**

- Second pathway to metabolize alcohol in the liver
- Requires oxygen and the input of energy(ATP) to break down alcohol
- Especially important for longer term, heavy drinkers (alcohol tolerance of alcoholics)
- This system forms acetaldehyde, water and reactive oxygen
- Reactive oxygen molecules are compounds that react with components in cells such as protein, DNA and lipids in a way that causes them to be oxidized
    - Oxidation can impair the functioning of cells by damaging cell membranes, changing the activity of enzymes, and introducing mutations to DNA
- The rate of ADH breaks down alcohol is fairly consistent, but MEOS activity increases when more alcohol is consumed
    - *E.g. drinking more heavily will cause systems activity to increase because body wants to metabolize alcohol*
- The MEOS system also metabolizes other drugs, so as activity increases in response to high alcohol intake, the metabolism of other drugs may be altered

3. **10% of the blood alcohol is lost in the breath and urine (Breathalyser)**

- Explains why people reek of alcohol

How Fast Do We Metabolize It?

- Varies from person to person
- Alcohol waiting to be metabolized is in the blood and raises blood alcohol levels
- Peak blood concentrations are attained approximately 1 hour after consuming
- Body considers it a toxin and tries to rapidly eliminate it from the body

Factors Affecting Blood Alcohol Level

1. **Weight:** The more people weigh, the more body water they have, so the more dilute the alcohol in their blood is after they consume a given amount
2. **Gender:** Men have more body water and more stomach alcohol dehydrogenase (ADH) activity and thus have a lower blood alcohol level after consuming a standard amount of alcohol than women of the same size
3. **Food:** Food in the stomach slows alcohol absorption so the more food people eat before drinking, the lower their blood alcohol level will be
4. **Drinking Rate:** The body metabolizes alcohol slowly. As the number of drinks per hour increases, blood alcohol level steadily rises
5. **Type of Drink:** The amount of alcohol in the drink affects how fast the blood alcohol level rises. When carbonated mixers(such as tonic water or club soda) are used, the body absorbs alcohol more quickly

What is One Drink?

- 12 oz beer
- 10 oz wine cooler
- 1 ½ oz hard liquor
- 5 oz wine

How Much Alcohol is Moderate?

- **Women:** Less than 10 drinks per week with no more than 2 drinks in one day
  - On special occasions, no more than 3 drinks
- **Men:** Less than 15 drinks per week with no more than 3 drinks in one day
  - On special occasions, no more than 4 drinks

Alcohol and Central Nervous System

Number of Drinks	Blood Alcohol (%)	Effect on Central Nervous System
2	0.05	Impaired judgment, altered mood, relaxed inhibitions and tensions, increased heart rate
4	0.10	Impaired coordination, delayed reaction time, impaired peripheral vision
6	0.15	Unrestrained behaviour, slurred speech, blurred vision, staggered gait
8	0.20	Double vision, inability to walk, lethargy
12	0.30	Stupor, confusion, coma
>14	0.35-0.60	Unconsciousness, shock, coma, death

How Much Can Be Dangerous?

- **Alcohol Poisoning**
  - Stupor, unconsciousness, vomiting while semi-conscious, seizures, difficulty breathing, coma
  - Women: as little as _
  - Men: as little as _
  - Depends on _, stomach contents, speed of consumption, age

- **Drinking and Driving**
  - _ can put you over the legal limit (0.08 blood alcohol contents)
  - Health Canada recommends _ if you plan on driving

Alcoholism

- 5-6 drinks per day for 10 years causes
  - Cirrhosis of the liver
    - Occurs in ~20% of people with alcoholism
  - Vitamin and mineral deficiencies
    - Not just caused by poor dietary intake
    - B vitamins and antioxidants get depleted
    - Wernickie- Korsakoff syndrome: an alcohol induced dementia caused by thiamin (vitamin B1) deficiency
  - Cirrhosis looks gross

Chronic Effects of Alcohol Use

- Long-term excessive alcohol consumption generates toxins and free radicals that cause:
  - Liver damage, hypertension, increased risk of certain types of cancers

Alcohol During Pregnancy

- **Fetal Alcohol Spectrum Disorder**
  - A whole range of disorders caused by alcohol intake during pregnancy
    - Stunting (in growth)
    - Learning difficulties
    - Vision and hearing impairments
    - Physical deformities
  - NO amount of alcohol is safe during pregnancy

Good News About Alcohol

- **Cardiovascular Disease**
  - Moderate drinkers have 20-40% lower risk
  - Moderate alcohol intake can increase HDL levels
  - Decreases fibrinogen, prevents clots
    - Prevents and helps fight off plaque development
- **Lower Risk of Type 2 Diabetes**
  - Alcohol may improve insulin sensitivity

Red Wine

- **Protects Bones:** Moderate red wine consumption and bone maintenance in older women
- **Mental Function:** Reduced risk of cognitive decline with red wine consumption

Why Red Wine

- Red wine may be most beneficial
  - Contains many polyphenols including resveratrol- an antioxidant
    - Possible role in cancer prevention
    - Reducing damage to cells by free radicals

Proteins

- Large molecules with many functions
- Body contains thousands of different proteins
- Contain carbon, hydrogen, oxygen and nitrogen
- Are made of long strings of amino acids

Where is Protein Found in the Diet

- Largest quantities in:
  - Meat, poultry, fish
  - Dairy products, eggs
  - Legumes, pulses, nuts, seeds
- There is some protein in grain products (3-5g)
- There is little protein in vegetables and fruit
  - So small of amount that they don't count as a protein source

Amino Acids

- Contain;
  - hydrogen group
  - amino group (NH2)
  - acid group(=O, OH)
  - Side chain is unique to each type of amino acid
- There are 20 amino acids
- 9 of these are essential amino acids, meaning our body cannot make them and you have to consume them through food
- 11 are non-essential still important, but our body can make them through transamination
  - **Transamination:** Amino group gets transferred onto another carbon molecule

Making Protein

1. **Peptide Bonds**

- Bond is occurring between an amino group and the acid group
- Bonds form a long amino acid chain

How Many Amino Acids in a Protein?

- **Peptide:** Amino acids attached using a peptide bond
  - **2 amino acids**: dipeptide
  - **3 amino acids**: tripeptide
  - **A few amino acids**: oligopeptides
  - **A lot of amino acids**: polypeptide
- Proteins are made from one or more polypeptide strands

Protein Shape

- Different amino acids in the chain are attracted to each other
  - Complex folding of the molecule

- Folding determines the shape- which determines the function
- One protein may contain several polypeptide chains

Genetic Mutations: Can cause proteins that don't work
- *E.g. Sickle Cell anemia*
- Amino acid difference changes shape, function of hemoglobin

‘

Protein Digestion
- **Mouth:** Mechanical digestion
- **Stomach:**
  - Acid denatures and unravels protein
  - Pepsin breaks long proteins into smaller chunks and single AAs
  - Denatured proteins are nonfunctional
    - This is why you can't take protein- hormones or enzymes orally
- **Small Intestine**
  - Release of enzymes trypsin and chymotrypsin from pancreas break down remaining proteins into oligopeptides, tripeptides, dipeptides and amino acids
  - Free amino acids, di- and tripeptides can be absorbed into the intestinal cells
  - The cells break di- and tripeptides into AAs
  - Intestinal cells further break down di- and tripeptides into single amino acids

1. Mouth some mechanical digestion occurs
2. Stomach, pepsin and HCL denature proteins
3. Small intestine- breaking down even further
4. Different pathways that help with the absorption that help with the absorption of di-tri peptides
5. Once they are in the intestinal cells, they move into the bloodstream and go to the liver(The processing center) Liver then decides where to send them.

Functions of Proteins
- Energy production
- Synthesize glucose or fatty acids
- Synthesize nonprotein molecules that contain nitrogen
- Dietary protein is used to make body proteins
- **Protein Turnover:** We recycle- old cells are broken down and we save the amino acids of the proteins to use again

How are New Proteins Made?
- Your body keeps a "pool" of amino acids
- Your DNA tells your body how to string amino acids together to make proteins
  - Transcription- RNA message
  - Translation- Creating protein from the RNA message

1. In the nucleus, the code for the protein is copied or transcribed from the DNA gene into a molecule of messenger RNA (mRNA)
2. **Transcription:** The mRNA takes the genetic information from the nucleus to structures called ribosomes in the cytosol, where proteins are made
3. **Translation:** In the cytosol, transfer RNA (tRNA) reads the genetic code and delivers the needed amino acid to the ribosome to form a polypeptide chain

Essential AAs

- Important to get essential AAs
- If there aren't enough of ALL the essential AAs, your body can't synthesize key proteins
- Protein synthesis will be stopped if one amino acid is lacking or in limited supply
    - Referred to as limiting amino acids

Protein in the Body

- Provide structure
- Many cell structures contain structural protein
    - Muscle, skin, bones, organs, blood cells, tendons
- **Enzymes**
    - Allow chemical reactions to happen
    - Needed for every chemical reaction in the body
- **Transport Proteins in Cell Membranes**
    - Facilitated diffusion
    - Active transport
- **Transport proteins within the blood circulation**
    - Albumin- transports nutrients such as calcium, zinc and vitamin B6
    - Lipoproteins
- **Contractile Proteins**
    - **Actin and Myosin:** Proteins in muscles that allow them to contract
- **Protein Hormones**
    - **Hormones:** Chemical signals in the body
    - Protein hormones include:
        - Glucagon
        - Insulin
        - Prolactin (stimulates milk production)
        - Gastrin (stimulates the stomach)
- **Maintains Fluid Balance-** Specific proteins help maintain fluid content circulating in our blood
    - Fluids are attracted to protein- simple diffusion
    - Balanced concentrations of protein are needed between the insides and outsides of cells and in the blood (intra/extra cellular fluid)
    - If not- swelling of tissues occurs (when protein levels are decreased)
- **Maintains your immune system**
    - **Antibodies:** proteins that destroy invaders (bacteria, viruses, etc)

- **Acid Base Balance**
  - Some proteins are buffers; they help maintain a constant pH
  - Blood too acidic or basic? Protein can help
- **Provide Energy**
  - Body prefers to use carbohydrates and fat as a source of energy
  - If you get rid of the amino acid group you can;
    - Burn the acid group for energy
    - Turn the acid group into fat
    - Turn the acid group into glucose (only some amino acids)

Getting Rid of Nitrogen

- Protein deamination results in ammonia
- TOXIC
- Liver turns ammonia into urea
- Urea travels through the blood to the kidney where it is filtered into the urine

1. The amino group is removed by deamination
2. Deamination of some amino acids produces 3-carbon molecules that can be used to synthesize glucose, via gluconeogenesis or be used to synthesize fatty acids
3. Deamination of some amino acids results in 2-carbon molecules that form acetyl-CoA, which can enter the citric acid cycle or be used to synthesize fatty acids
4. Deamination of some amino acids forms molecules that are intermediates in the citric acid cycle
5. High-energy electrons from the breakdown of amino acids are transferred to the ETC where the energy is trapped and used to produce ATP and water

How Much Is Enough Protein

- **AMDR:** Acceptable Macronutrient Distribution Ranges
  - Used to see if we're getting the right proportions of macronutrients

Age Group	**% From Calories**		
	Carbs	**Proteins**	**Fats**
1-3 Yrs	45-65%	5-20%	30-40%
4-18 Yrs		10-30%	25-35%
19+ Yrs		10-35%	20-35%

If You Don't Eat Enough Protein

- You can't replace important proteins so some sacrifices are made:
  - Your body breaks down muscle for amino acids
  - Most dispensable proteins are broken down first (enzymes are broken down)
  - Impaired cell function, impaired nutrient transport, fluid balance
- If NOT corrected, other functions are lost (electrolyte balance, acid base balance- can lead to death over time)
- Not very common in wealthy countries

Marasmus and Kwashiorkor

1. **Marasmus:** Severe protein energy malnutrition(to waste away)

- Chronic condition
- Low in protein, calories (energy), carbs, fat, vitamins, minerals- protein-energy malnutrition
- **Emaciation:** Slowly starving to death- very common when you have marasmus
  - Skin and bones
  - Body fat stores are used for energy, body proteins are used for energy
  - Most common in youth, impoverished children (6-16 months old)
  - Results in stunted growth, dehydration, increased risk of infections, and heart failure
  - Often occurs when infants and children are fed diluted baby formula
  - Can be caused by GI tract infections
  - Less common in breastfed infants
  - Marasmus in Canada: Also known as **cachexia** (wasting away due to chronic illness)
    - Most often happens in diseases (cancer, anorexia, AIDS, elderly)
    - Often due to reduced food intake coupled with abnormal metabolism

2. **Kwashiorkor:** “the disease the first child gets when the second child is born”

- A child with Kwashiorkor would have hair changes, miserable expression, very underweight but puffed out belly, skin changes, and oedema
- Common in children1-3 yrs old in impoverished countries
- Severe protein malnutrition
- Children are weaned from breast milk and are given an adult diet too early
- Stunting in growth
- Skinny legs and big stomach
    - Big stomach caused by excess fluid and fatty liver
    - Low blood proteins causes fluid imbalance
    - Blood proteins can’t transport fat
- Prone to infections and disease
    - immune system compromised, frequently die of infections, dehydration due to damage and death of cells in GI tract
- Both Marasmus and Kwashiorkor can be cured but
    - It must be done carefully
    - Relapse will happen if returned to impoverished environment
    - Could suffer from long term effects of low nutrient intakes
        - Negative effects on growth, brain development and cognitive abilities because fat has a very important role in brain development.

Too Much Protein?

- High protein intakes (above 35% of kcals) is associated with high saturated fat intake & lower intake of grains, fruit & vegetables
    - Causes an increased risk of heart disease & cancer
    - May contribute to bone loss with aging (increase calcium excretion)
    - Eating extra protein won’t make you jacked

What happens to extra protein?

- The amino acid “pool” doesn’t store much protein
- Extra amino acids are stripped of nitrogen (excreted in urine)
- Turned into glucose to be burned for energy or to be stored as fat

- Most athletes meet their protein needs by consuming the RDA (0.8g/kg) or slightly more (1.2-1.4g/kg body weight)
    - Endurance athletes/body builders may need more than RDA (1.0-1.2g/kg body weight)
        - Ultra-marathoners, long distance cyclists- helps maintain blood glucose levels
        - For body builders, helps with the building of muscles
    - These needs can be met through the diet without protein supplements

How Much Protein is Enough?

- **Adults:** RDA is 0.8g/kg body weight

- Based on the amount of protein you need for maintaining good health
- A 60kg (130lbs) women needs 48g
- A 80kg (180lbs) man needs 64g
- **Children:** 0.95g/kg
- **Adolescents:** 0.85g/kg
- **Pregnant:** 25g per day
- **Athletes:** 1.2-3g/kg
- **Recovering from illness, burns or surgery:** High as 2g/kg
- **Vegetarians/Vegans:** Protein from grain products is less well digested and absorbed

- Canadians eat more than 0.8g/kg
    - Most people consume 15% of their calories from protein
    - Most Canadians have protein intakes that meet the AMDR
    - 62% of our dietary protein intake comes from meat, poultry, fish, eggs and dairy products

Sample Midterm Question:
Which Amino Acids are essential in the diet but only under certain conditions

a. Dispense amino acids
b. Conditionally essential amino acids
c. Polypeptides
d. Dipeptides

Protein Quality

- The health of proteins is dependant on:
  - If it is a complete or incomplete protein
  - The digestibility of the protein
    - meat, milk, eggs and beans have high digestibility(more “bang for your buck”)
    - Whereas grains, fruit, and vegetables have a low digestibility
  - The nutrients found in your protein food
    - Low in saturated fat, salt
    - High in fibre, iron, calcium, B vitamins
    - Omega-3 fats

Canada’s Food Guide Recommendations

- Have plant based alternatives when possible
- Eat at least 2 servings of fish/week (specifically fatty fish which give omega-3 fatty acids)
- Select lean meat/alternatives with little fat or salt added to the product
  - Trim visible fat and remove skin on poultry
  - Use cooking methods such as roasting, baking or poaching which require little or no added fat
  - Choose lower sodium and fat luton meat, sausages and prepackaged meats

Protein Quality: A measure of how efficiently a protein in the diet can be used to make body proteins (not all proteins are created equal)

- Proteins that don’t contain all the essential amino acids are considered lower in quality
- A varied diet allows us to meet these needs

Complete Protein: Proteins that provide all essential amino acids in the proportions needed to support protein synthesis (build up of proteins in the body for various functions)

- Animal foods- meat, fish, poultry, eggs, milk
- Very few plants- soy products

Incomplete Protein: Protein that is deficient in 1 or more essential amino acid relative to body needs

- Proteins found in grains (oats, rice, wheat, rye) are low in isoleucine and lysine which are both essential amino acids- proportion is so low, you body needs a lot more
- Legumes are low in methionine and tryptophan

Complementary Proteins: Important for regions of the world where protein is scarce

- Protein complementation involves the combination of different incomplete plant sources of protein (e.g. rice and beans, rice and tofu)
- Eating mixed dishes provides all the amino acids

Protein Complementation: Process of combining proteins from different sources so that they collectively provide the proportions of amino acids required to meet needs (protein complementation) can be done- typically done by vegetarians/vegans

- Eg. rice and beans, rice and lentils, bread w/ peanut butter

Vegetarianism

Vegetarian	Poultry	Fish	Milk	Eggs	-Vegetarian	Poultry	Fish	Milk	Eggs
Semi-	X	X	X	X	**Lacto-**			X	
Lacto-ovo-Pesco		X	X	X	**Ovo-**				X
Lacto-Ovo-			X	X	**Flexitarian**	Eats meat occasionally			
Pescatarian		X			**Vegan**	NO animal products			

Why Become Vegetarian?

- **Religion:** Hinduism, Buddhism, some christians (seventh day adventists) don't eat meat
- **Ethical Reasons:** Belief that animal treatment is inhumane
- **Food Safety:** E.g. Mad cow disease, hormones and antibiotics that are fed to animals
- **Ecological Reasons:** Meat calories cost more than plant calories in terms of financial and environmental costs
    - **Antibiotics:** May contribute to 'superbugs' bacteria that are resistant to our current antibiotics- this might lead to the need for development of new medications
    - **Greenhouse Gases:** Cattle create greenhouse gases
    - **Forests:** Destroying forests for pastures
    - **Transport:** Pollution for transportation of meat products
- **Health Reasons:** Vegetarian diets are high in fibre, vitamins, minerals & low in saturated fats
    - Decreased risk of cardiovascular disease, obesity, many cancers, diabetes and kidney disease

Challenges of Vegetarian Diet

- Can be challenge to get calcium and iron
- Careful dietary planning required
- Incorporation of eggs and cheese
- Complementary sources of protein
- Enhance iron absorption (avoid eating calcium and iron together)
    - Eat iron with citrus fruits

Challenges of Vegan Diet

- Vitamin B12 found in animal products
- Calcium and vitamin D
- Iron- meat alternatives, whole grains and leafy greens

Obesity

- Most prevalent in the USA and Saudi Arabia, Egypt, South Africa and more
- Becoming more prevalent in Canada, Russia, parts of Europe and Australia
- Normal BMI= 12-24
- Within Canada the most common in Newfoundland and Labrador, and Saskatchewan to have BMI > 25
    - Diet quality is fairly bad in the territories because they don't have access to fresh food
    - Lowest in Ontario and Quebec
    - Obesity increases risk of many disease (heart disease, type 2 diabetes, cancer, reproductive problems, joint problems, sleep apnea, depression)

Estimated Energy Requirement (EER)

- Energy balance occurs when energy intake= energy expenditure
- You gain weight if energy in outweighs energy out
- You lose weight if energy out outweighs energy in
- Energy in=Food, beverages, alcohol, dessert, pizza etc.
- Energy out is more complex:
    - **Basal Metabolic Rate (BMR):** Energy needed to maintain our body's resting functions (60-70% of our energy expenditure)
        - Breathing, keep heart beating, maintaining body temperature, making or repairing cells, removing waste products, making nerve cells
        - Factors that affect BMR include lean body mass, (the more muscle you have, the more energy you will burn at rest)
        - Gender, growth(children, pregnant), body size, age (BMR decreases with age), stress/injury/illness(increases BMR), low energy diets(decrease BMR), thyroid hormones levels
    - Energy expenditure with exercise
        - You do more intense exercise
        - You exercise for a longer duration
        - You are more physically active

Basic Metabolic Rate: Energy required to run our body at rest

- 60-70% of our energy expenditure
- Energy needed to maintain our body's resting functions
    - Breathing
    - Keep heart beating
    - Maintaining body temperature
    - Making/repairing cells
    - Removing waste products
    - Making nerve signals

Thermal Effect of Food

- The energy needed to digest, absorb, transport and metabolize food
- 10% of our energy intake is used to metabolize our food
- Fat takes less energy to metabolize than carbs and protein
- TEF increases with the size of the meal
    - The more you eat, the more energy that is required within the 5-10% range

Eating More Kcals Than Burning

- You store extra energy as:
    - **Triglycerides**: stored in the adipose tissue
        - Adipocytes grow in size as they accumulate more triglycerides and shrink as they are removed
    - **Glycogen**: Stored in the muscles and liver
        - Body generally stores about 200-500g of glycogen
        - If you're starving, you'll also use energy from protein
- **Amino acids**: From protein are first used to synthesize needed body proteins
- **Carbohydrates**: Used to maintain blood glucose and build glycogen stores
- **Fat:** Usually not needed as a source of fuel
- **Excess Kcals are stored as fat**

How Many Kcals do you need?

- Can be measured directly
    - **Direct Calorimetry:** Measures the amount of heat released by the body
        - Very expensive, and only used in certain circumstances
- Can be estimated using equations
    - The DRIs have EER- equations that let you calculate your energy needs based on age, sex height, weight and physical activity

Why is Obesity Concerning?

- Heart disease, Type 2 diabetes(most common), Cancer, Reproductive problems, Joint problems, Sleep apnea, Depression

Weight Bias

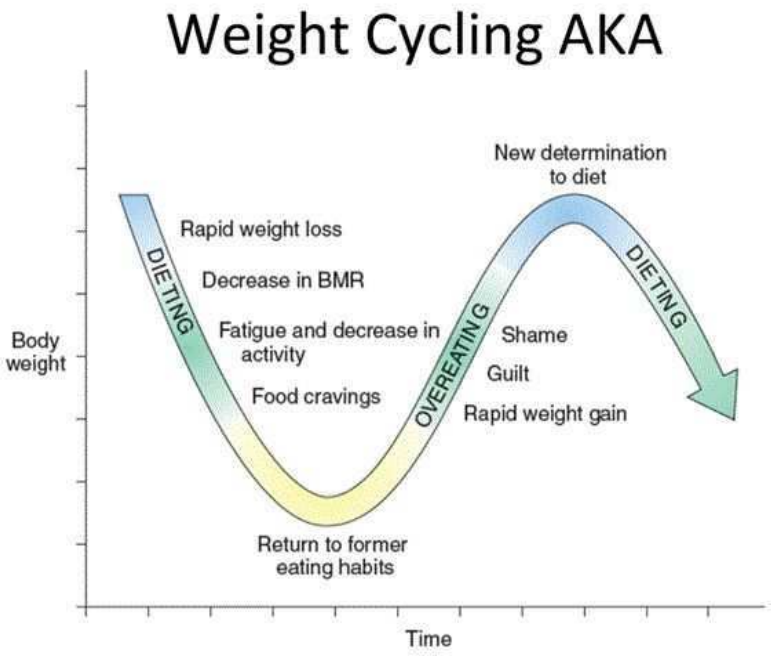
- Overweight and obese people are
  - Discriminated against- In public, more likely to be unemployed, socially isolated and depressed
- People are overweight for many reasons:
  - Hormones, genetics, lifestyle, diet,

Obesity Research

- **The Canadian Obesity Network**
  - Brings together researchers, government and industry
- **Dr. Sharma's Blog**

Yo-Yo Dieting

- Start at a less ideal weight, and start 'dieting'
- Causes quick initial weight loss, but also a decrease in BMR and increase of cravings
- Normally, after the diet they go back to regular eating patterns
- Rapid weight gain, feelings of guilt
- Starts a new diet



What is a Healthy Body Weight?

- A body that has enough body fat and enough lean muscle for health, but not too much
  - Too much fat increases risk of disease
  - Too little fat causes compromises in body function
  - Too little muscle decreases our ability to move and function independently
- **Body Mass Index (BMI):** The main way health professionals determine if our body weight is healthy
  - Based on reference population

Healthy Body Weight Chart

Classification	BMI Range	Risk of Health Problems
Underweight	< 18.5	Increased
Normal Weight	18.5-24.9	Lowest
Overweight	25.0-29.9	Increased
Obese Class I	30.0-34.9	High
Obese Class II	35.0-39.9	Very high
Obese Class III	> 40	Extremely high

In Children

- BMI is compared to other children of the same sex
- **Percentiles:** A measurement that shows how the child is doing relative to children from the same age and gender group
- A higher percentile means the child is heavier compared to other children that age and gender

Child's Percentile	Weight Category
Below 3rd Percentile	Risk for underweight
3rd Percentile to below 85th percentile	Healthy weight
85th to 97th percentile	Overweight
Above the 97th percentile to the 99.9th percentile	Obese
Above the 99.9th percentile	Severely obese

Problems with BMI

- Can't distinguish between certain individuals and disease risk
- It is a screening tool NOT a diagnostic tool
- Does not directly assess body fat%
- It is inaccurate for:
    - Muscular people- Body builders are classified as obese
    - People with low muscle mass- sarcopenia or low muscle mass- common in older adults and in some disease states like cancer
    - Pregnant and breastfeeding women

Skin Folds

- Measures thickness of the skinfolds on the body: triceps, back, thigh (subcutaneous fat)
- **Good-** Portable, measures body fat
- **Bad-** Accuracy? Training needed to do it well

Bod Pod

- Measures volume by air displacement
- When we know the body's weight and volume, we can calculate density
- The denser the body, the more muscle there is
- A very accurate, but expensive method

Fat Distribution

- Visceral adipose tissue= fat around the organs
- Subcutaneous adipose tissue= fat under the skin
- Visceral adipose tissue is more metabolically active and more visceral adipose tissue is related to increased risk of disease

Visceral Adipose Tissue

- People who carry their weight in the apple shape have more visceral adipose tissue(Fat around organs)
- Apple shapes are at higher risk of chronic disease
    - Diabetes, CVD

Waist Circumference

- Measure halfway between ribs and hip bone OR an inch above belly button
- Risk for M > 120 cm (40 inches)
- Risk for F > 88 cm (35 inches)

Genetics and Obesity

- We inherit our body shape and characteristics from our parents
- Some
- **Set-Point Theory:** The theory that when people finish growing, their weight remains relatively stable for long periods of despite periodic changes in energy intake or output (partly genetic, partially environment)

Genetics and Satiety Hormones

- **Leptin-** A “satiety” hormones
    - A hormone made by adipose cells that helps regulate energy balance by inhibiting hunger
    - With obesity, there is often a decreased sensitivity to leptin occurs, resulting in an inability to detect satiety despite high energy stores
    - Studies with mice have seen a decrease in appetite and prevents obesity
    - In humans, not so much (more complicated)
    - Bottom line: Main function, is the regulation of fat stores

Leptin

- Help signal the brain that the body has enough energy stores such as body fat
- When people diet, they eat less and their fat cells lose some fat, thus decreases the amount of leptin produced
- Levels of leptin (appetite suppressor) are lower when you're thin and higher when you're overweight

Genetics and Hunger Hormones

- Ghrelin is known as the hunger hormone
    - Major role in regulating appetite
    - Plays a significant role regulating the distribution and rate of use of energy
- When the stomach is empty, ghrelin is secreted, when the stomach is stretched(filled with food) the secretion stops
- This hormone works on the hypothalamic brain cells both to increase hunger, and increase gastric acid secretion
- It also plays an important role in regulating reward perception

Food Intake and Obesity

- Consuming more kcals than you burn causes weight gain
- Food is very available in our environments- Wide variety of tempting foods make us eat more
- Portions, colours, lighting ect. can affect how much you end up eating

Physical Activity and Obesity

- Both not getting enough exercise and too much sedentary activity are related to greater risk of obesity

- Building more muscle raises your metabolic rate (BMR)
- The risk of obesity decreases by 5% for each km walked per day
- The risk of obesity increases by 6% for each hour spent in a car

Social Factors Affecting Food Intake and Physical Activity Levels

- Time constraints
- Social pressure, social norms
- Environmental availability of food and exercise opportunities
- Nutrition education, food skills
- Energy levels (sleep patterns)
- Work hours
- Support systems

Managing Body Weight

Intermittent Fasting: Repeated short-term fasts to reduce energy intake

- **Associated with:** weight loss, body fat reduction, LDL reduction, blood pressure reduction
- Puts body into a state of semi-starvation which may cause (unwanted) adaptation within adipose tissue
- More research is needed to understand long-term effects

Losing Weight the Safe Way

- If you lose weight too quickly you risk
    - Nutrient deficiencies
    - Losing muscle, NOT fat
    - Gaining weight back fast
- A reasonable weight loss goal is 0.5-2 lb. per week
- When you make a change, you have to maintain it, or the weight will come back

How Many Fewer Calories Should I Eat?

- 1 pound of fat contains 3500 kcals of energy
- If you decrease your energy intake by 500 kcal per day, you should lose 1 pound of fat a week

Tips for Keeping Calories Low

- Eat smaller portions
- Avoid high fat foods
- Avoid high in sugar foods
- Avoid high calorie beverages- they fill you up less
- Have more fibre(whole grains and vegetables) - it fills you up more
- Have protein with each meal (keeps you feeling satisfied)
- Eat out less often- big portion sizes and higher fat content (or use a take out container)

Physical Activity and Weight Loss

- It's challenging to lose weight using physical activity alone
- A 60kg women would have to run for 1 hour everyday to burn 500 extra calories
- However, physical activity is important for maintaining weight

How much Weight Can People Lose and Keep Off?

- On average, people who are trying to lose weight are successful at losing 5% of their body weight and keeping it off
    - A 150 pound person could lose 7.5 pounds
    - A 300 pound person could lose 15 pounds
- No one diet has been deemed better or worse, but low-calorie diets that reduce energy intake by 500-1000 kcal tend to be most common amongst successful weight losers

Bariatric Surgery

- Bariatric surgeries can result in loss of 20-25% of a person's body weight
- Bariatric surgeries may remove parts of the stomach and small intestine or may slow the entry of food into the stomach

Bariatric Survey

- Eligible if you have BMI of 40kg/m^2 and those with a BMI between 35-40 kg/m^2 who have other life threatening conditions(type 2 diabetes, heart disease)
- **Gastric Banding:** A surgical procedure in which an adjustable band is placed around the upper portion of the stomach to limit the volume that the stomach can hold and the rate of stomach emptying
- **Gastric Bypass:** A surgical procedure to treat morbid obesity that both reduces the size of the stomach and bypasses a portion of the small intestine

Micronutrients

- Vitamins and minerals
- Vitamins are organic molecules our body needs in order to function (organic)
- Minerals are inorganic molecules (from periodic table) our body needs in order to function (*e.g. Fe-Iron)*
- Don't provide us with energy, but we need to eat them so that our body can function well
    - Antioxidants
    - Control nerve and muscle action
    - Make and maintain tissues like bones and blood
    - Regulate energy metabolism

Water Soluble Vitamins

- **Vitamins:**
    - Organic molecules that we need to eat for our bodies to function well
    - We talk about vitamins being either water- soluble or fat-soluble

Fat-Soluble	**Water-Soluble**
- Vitamins A, D, E and K - Are best absorbed when eaten with fat - Are absorbed into intestinal cells via active chylomicrons - Transported in the body as lipoproteins or bound to transport proteins - Too much? Often stored in the body, could be dangerous	- B vitamins, C - Some absorption in the stomach - Transported into intestinal cells using facilitated diffusion or active transport - Transported in the body bound to blood proteins - Too much? Excreted in urine

What B Vitamins have in Common

- They are coenzyme vitamins
- ALL involved with enzyme activity
    - Burning carbs, fat and protein
    - They act as coenzymes for energy metabolism

Understanding Vitamin Functions

1. Vitamin combines with chemical group to form the functional coenzyme (active vitamin)
2. The functional coenzyme combines with the incomplete enzyme to form the active enzyme
3. The active enzyme binds to one or more molecules and accelerates the chemical reaction to form one or more new molecules
4. The new molecules are released, and the enzyme and coenzyme (vitamin) can be reused or separated

B-Vitamins

- B1
- B2
- B3(niacin)
- B5 (pantothenic acid)
- B6
- B7 (biotin)
- B9
- B12 (cobalamin)

Where can we find them?

- Not just in supplements
- Grains (B1,B2,B3,B6)
- Vegetables and fruit (B2,B6, Folate)
- Milk (B2,B12)
- Meats (B1,B2,B3, B12, Folate)

Fortfied and Enriched Foods

- **Fortification:** Process of adding nutrients to foods that generally are not found in that food
  - E.g. Adding calcium to orange juice
  - Health Canada regulates which foods must be fortified and which nutrients should be added
  - *E.g.: Table salt with iodine, Milk with Vitamin D, Grains with thiamin, riboflavin, niacin, iron, folic acid*
- **Enrichment:** Adding nutrients back to foods that have been lost due to food processing
  - E.g. adding B vitamins to white rice

Enrichment of Flours in Canada

- Flour, white flour, enriched flour or enriched white flour is enriched with:
  - Thiamine, niacin, folic acid and iron

Thiamin (B1)

- Needed to burn glucose for energy
- Needed for carb and protein metabolism
- Grains naturally contains it
- Thiamin is also added to enriched grain products
- Pork also contains thiamin

What Happens if we Don't Get Enough?

- Beriberi, "I cannot"
- Became very common in Asia when polished (white) rice was introduced
- Causes lethargy, fatigue, depression and cardiovascular problems
- Nerve damage
  - Dementia, confusion and memory loss

Beriberi in Canada
- Occurs with alcoholism
- Wernicke-Korsakoff Syndrome
    - Caused by a combination of poor nutrient absorption and low quality diet
    - Memory disturbances, confusion

Folate or Folic Acid
- Folate is derived from latin work for foliage
- Folic acid is the **synthetic form of the vitamin** used to fortify foods in Canada since 1998
    - White flour, corn meal, pasta, infant formula, cereals, instant breakfasts, meal replacements
- Folate coenzymes needed for:
    - DNA synthesis
    - Metabolism of some amino acids
- Low folate intake in early pregnancy is associated with an increased risk of neural tube defects
- Low folate intake has been associated with increased risk of heart disease and anemia(prevents red blood cell formation)

Folate Deficiency and Neural Tube Defects
- Abnormalities in the brain or spinal cord that result from errors that occur during prenatal development
- The expression of the genes involved in this development process is alternated because of the low intakes of folate.
- Defects in the brain are fatal, while those of the spinal cord often result in paralysis

Fortification in Canada
- Neural tube defects have decreased by 50% in Canada since food fortification
- Newfoundland rates have dropped by 80%

Folate Fortification
- Some studies have shown an increase in colon cancer since folate fortification began in 1998
- This may be the result of folate stimulating DNA synthesis and promoting growth of pre-existing cancer cells
- Food fortification may benefit one segment of the population and may harm other segments
- Also possible cofounders

Vitamin C
- Alternate name is ascorbic acid
- A water-soluble vitamin
- Can be carried freely in the blood
- Is not produced in the body, meaning it is essential and should be eaten regularly

What Does Vitamin C Do?

- A coenzyme needed for making
  - Collagen
    - A protein that makes up connective tissue
    - A key component in wound healing
  - Bile acids
  - Neurotransmitters
  - Hormones (thyroid and steroid)

Vitamin Absorption

1. In the mouth, chewing breaks food into small particles, helping to release vitamins
2. In the stomach, digestion of food releases vitamins. Some niacin is absorbed here
3. The gallbladder releases bile, which emulsifies fat and helps absorb fat-soluble vitamins
4. The pancreas secretes digestive enzymes that aid in the release of vitamins from food
5. In the small intestine, fat-soluble vitamins are incorporated into micelles and then absorbed by simple diffusion. Once they are inside the mucosal cells, fat-soluble vitamins are packaged in chylomicrons, which enter the lymph before passing into the blood
6. Water-soluble vitamins are absorbed from the small intestine directly into the blood
7. In the large intestine, bacteria synthesize small amounts of vitamins, some of which are absorbed

Vitamin C

- Major water soluble antioxidant
    - It is water soluble, so it mostly works in the blood stream
    - It donates its electrons to free radicals
    - Helps to protect lipids and DNA from oxidative damage

Oxidation: The steal of electrons by free radicals

- A product of metabolism
- We need oxygen to burn energy
    - The oxygen sometimes forms free radicals during the process of energy metabolism

What can be Oxidized

- phospholipids (in cell membranes)
- DNA
- Low density lipoprotein (LDL)
- Proteins
- If they’re oxidized they don’t work

Oxidative Stress and Disease

- More oxidation increases risk for:
    - Heart disease
    - Cancer
    - Diabetes
    - Arthritis
    - Cataracts
    - Kidney disease
    - Alzheimer’s disease
    - Parkinson’s Disease

Antioxidants

- Antioxidants are chemicals that decrease the adverse effects of free radicals by:
  - Donating their electrons (without creating more free radicals)
  - Neutralizing free radicals into less harmful substances

Where Do you Find Vitamin C?

- Citrus fruits

Preparation Matters

- Oxygen can destroy vitamin c
  - Raw, fresh vegetables and fruit have the most
- Cooking methods
  - Boiling in water, vitamin C dissolves in the water
- Baking may destroy vitamin C
- Steaming, roasting or stir fry retains vitamin C

Scurvy

- Can occur after about 3 months with little or no vitamin C
- Bleeding gums, loose teeth, hemorrhaging, impaired wound healing, swelling, bone pain, diarrhea
- Very rare, but does happen

Too Much Vitamin C

- It's hard to eat toxic amounts
- Excess vitamin c is excreted in urine

Fat Soluble Vitamins

- Vitamins A, E, D and K are fat soluble
- Fat-soluble vitamins require bile and dietary fat for absorption
- Once absorbed, they are transported with fats through the lymphatic system in chylomicrons before entering the blood
- Can be stored in body fat
  - Intakes can vary without a risk of deficiency (as long as there are average intakes overtime)
- Because they can be stored as fat, fat-soluble vitamins are not easily excreted
  - This increases the risk of toxicity with high intakes

Water Soluble Vitamins	Fat Soluble Vitamins
- B vitamins, Vitamin C - Absorbed with facilitated or active transport - Transported freely in the blood or with proteins	- _ - Absorbed with fat in micelles - Transported in lipoproteins or with protein transporters - Stored in fat cells

- Not stored in the body
  - Deficiencies can happen quickly
  - Toxicity is unlikely
	- Deficiency takes awhile
	- Toxicity is possible

Vitamin A

- Retinol, retinal and retinoic acid are ALL vitamin A
- Absorbed in small intestine with fat
- Fat content of diet affects absorption
- Vitamin A plays a key role in night vision, cell differentiation and growth regulation
- Found in 2 forms:
  - from animal products or supplements, known as retinoids
  - or in precursor form from plant foods, known as carotenoids

Beta-Carotene

- Yellow, orange and red pigments
- A carotenoid
- Is a precursor form of vitamin A
  - Our body can convert it to vitamin A
- Sources are:
  - Mangoes, carrots,

What does Beta Carotene Do?

- Is a Antioxidant
  - Protects cell membranes
  - Prevents cancer, heart disease, macular degeneration, cataracts

How Much do You need?

- RDA: 900 RAE for men, 700 RAE for women
- In Canada, most of our dietary Vitamin A comes from preformed vitamin A
  - Retinol/retinal/retinoic acid in foods
- The remainder from beta carotene

Vitamin A is Needed for Sight

- Needed for sight, vitamin A from the blood replaces retinol
- Deficient= Light vision and night vision issues

What Does Vitamin A Do?

- Needed for cell differentiation
  - Young cells are undifferentiated- they could become several different types of cells
  - *E.g.: Stem cells can become ANY type of cell,* vitamin A makes sure this happens properly

- Needed for maintenance of epithelial tissue
    - Epithelial tissues are the tissues that are on the surface of the body- skin, linings of the eyes, digestive tract, lungs etc.
    - Vitamin A ensures that epithelial cells differentiate properly
- Needed for immune system
    - To make healthy skin cells, healthy cell membranes
    - Needed for the differentiation of immune cells (t-cells)
- Needed for reproduction
    - For the development of embryo
    - For the continued growth of the child

Sample Midterm Question

Where are the majority of the vitamins absorbed?

a. Mouth
b. Stomach
c. Small intestine
d. Large intestine

Vitamin A Deficiency

- A threat to health, sight, and lives of children around the world
- Can be caused by an insufficient intake of Vitamin A, fat, protein or zinc

If you Don't get enough vitamin A

- Night blindness
- Xerophthalmia- Greek word for dry eyes
- Blindness
- Poor growth
- Vitamin A deficiency kills hundreds of thousands of children every year in lower resource countries
- Can happen in Canada too

Too much Vitamin A

- Loss of appetite
- Blurred vision
- Pain, nausea
- Liver and other organ damage, can cause death
- Birth defects in pregnant women
- Preformed vitamin A can be toxic if taken in high amounts
- Medications made from vitamin A (e.g, retin A, Accutane) can cause serious side effects
- It's possible to overdose from 10x the RDA alone
- UL is 2000 RAE (just over 300 ug preformed vitamin A)

Vitamin E: Also called alpha-tocopherol(form of vitamin E absorbed in the body)

- Fat soluble vitamin
- Absorb it better when you eat it with fat
- It's absorbed in the intestines
- Transported in the blood via lipoproteins
- Your body stores vitamin E in fat cells (adipose tissue)

Function of Vitamin E

- An antioxidant
- Works in lipid environments
    - Saturated fatty acids
    - Stored triglycerides and other fatty tissues
    - Lipoproteins
- Vitamin E donates electrons to free radicals (neutralizes the free radical- elevates or prevents oxidative stress)

Did you know

- Some fatty acids are oxidized more easily than others
- The more unsaturated, the easier the oxidation reaction (PUFA's are trouble)
- This is why saturated/trans fats have a longer shelf life
    - Old fish smell bad (PUFAs are trouble- although they are healthy they can easily be oxidized)
    - Frying in oil with high heat can smell bad

The More PUFA you Eat

- The more PUFA you eat, the more antioxidants you need to protect those fats from oxidation
- Luckily the foods that contain PUFA also contain vitamin E

Where is Vitamin E

- Food sources of plant oils, nuts, seeds and leafy green vegetables have tons of vitamin E

Vitamin E is Destroyed by:

- Oxygen, light and metals
- Keep oils in a dark, cool place
- Uncooked oils contain the most vitamin E (salad dressings, margarine)
- Frying in oil kills almost all the vitamin E

Vitamin E Toxicity

- Uncommon and only happens with supplement use, not with food
- Doses would have to be huge (over 50x the RDA)
- Nausea, upset stomach

Vitamin E Deficiency

- Acute deficiency is short term because our bodies store vitamin E
- Nerve damage- impaired vision, speech, movement, leg cramp
- Anemia (breaking blood cells)

Low Vitamin E Intake

- 90% of North Americans have low vitamin E levels
    - Caused by lower intakes of fat in the diet to increased intakes of carbs and protein
    - Cooking methods of frying in oil reducing vitamin E content in meals
- Greater risk of heart disease

Vitamin E and Cardiovascular Disease

- Reduces oxidation of LDL
- Reduces inflammation of the blood vessels which can lead to plaque flaking off
- Reduces stickiness or clumping of platelets within blood vessels

Vitamin E and CVD

- Vitamin E also :
  - Reduces _ of the blood vessels which can lead to plaque flaking off
  - Reduces _

Vitamin D

- AKA “sunshine vitamin” because it can be produced in the skin by exposure to ultraviolet light
- Only a few sources contain vitamin D
  - Fatty fish such as salmon, mackerel, sardines
  - Egg yolks
  - These foods contain cholecalciferol

Vitamin D Synthesis

- Vitamin D from the diet and from synthesis in the skin is inactive until it is chemically altered in the liver and then in the kidney
- In the liver → A hydroxyl group (OH) is added to vitamin D to form 25-hydroxy vitamin D_3
- In the kidney → Another hydroxyl group is added to make the active form of vitamin D- 1,25-dihydroxyl vitamin D_3

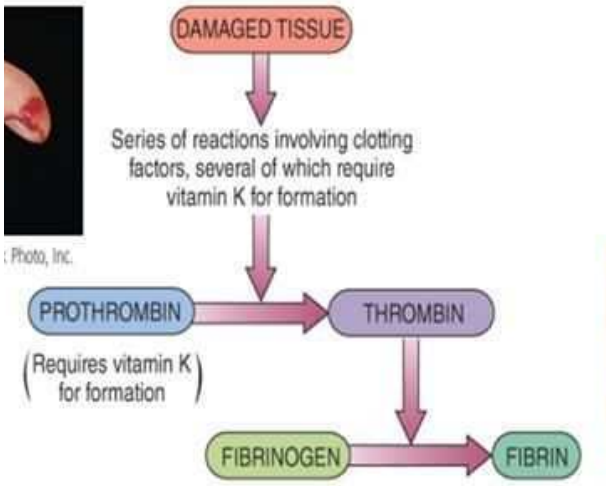
Vitamin D and Bone Health

- THe main role of vitamin D is to maintain levels of calcium and phosphorous in the blood
- RDA for men and women up to 70 years of age is 600 IU
- Active vitamin D helps to maintain blood calcium and phosphorus levels, and has an impact on the parathyroid hormone

1. Enzymes in the liver add a hydroxyl group to carbon #25
2. Enzymes in the kidney add a hydroxyl group to carbon #1, forming active vitamin D
3. Low levels of active vitamin D stimulate calcium absorption from the intestine. Higher levels act with parathyroid hormone (PTH) at the bone to increase bone breakdown and at the kidney to increase calcium retention
4. Blood calcium and phosphorus are maintained at levels that support bone mineralization

Vitamin K

- Fat soluble vitamin found in two forms:
  - Phylloquinone: The form found in plants and the primary form in our diets
  - Menaquinones: Found in fish oils and meats, they are synthesized by bacteria in the human intestine



Vitamin K in the Body

- Vitamin K is a coenzyme needed for the production of the blood-clotting protein prothrombin and other blood-clotting factors
- **AI for Men:** 120 ug/day
- **AI for Women:** 90 ug/day

When You Have Damaged Tissue:

- When blood clotting factors are activated (*e.g. thrombin)* through the help of vitamin K the formation of fibrin occurs
- Injuries (as well as normal wear and tear) produce small tears in blood vessels
- To prevent blood loss, these tears must be repaired with blood clots
- Found in dark leafy greens, and some oils (soybean oil)

Bioavailability of Vitamins

- **Bioavailability:** The degree to which nutrients in food are available for absorption and utilization in the body- The amount that is absorbed and utilized
- Vitamins must be absorbed by the body in order to perform their functions
- Approx. 40-90% are absorbed in the small intestine
- Fat-soluble vitamins require fat in the diet to be absorbed
- Water-vitamins may require transport molecules or specific molecules in the GI tract
- Some vitamins are absorbed in a vitamin precursor form that must be converted into the active form by the body (*e.g. vitamins A and D)*

To Supplement or Not?

- Approx. 40% of Canadian Adults use vitamin and mineral supplements
- People who may benefit from supplements:
  - Those on energy (calorie) restrictive diets
  - Vegans and people who eliminate all dairy foods
  - Infants and children
  - Young women and pregnant women
  - Older adults
  - Individuals with dark pigmentation or who cover their bodies outdoors (vitamin D)
  - Individuals with restricted diets

- People taking medications
  Cigarette smokers and alcohol users

What is a Fluid

- Molecules that are far enough apart that they can slide past each other
- Our bodies are 60% fluid, though we lose fluid content as we get older
- **Blood:** 90%
- **Muscle:** 75%
- **Bone:** 25%
- **Fat:** 10%

Where is Fluid?

- **Inside:** Intracellular fluid
- **Outside:** Extracellular fluid
    - Fluid located outside of cells
    - *E.g. blood*
    - In gastrointestinal tract

Body Fluids Made Of..

- Water with stuff dissolved in it
- Electrolytes
    - Positively and negatively charged ions that are dissolved in water

Electrolytes

- Dissolved mineral- ions with both positive and negative charge
- This charge allows them to do what they do
- Major electrolytes are:
    - Sodium, potassium, chloride, phosphorus(in hydrogen phosphatase) and calcium

What do Fluids Do?

- Dissolve and transport substances
    - Transports many nutrients and waste
    - Carbohydrates, amino acids, water soluble vitamins, minerals, medications
    - Fat-soluble substances do NOT dissolve in fluids, but transported with the help of proteins
        - *E.g. Chylomicrons, lipoproteins, albumin*
- Protect us
    - Cerebrospinal fluid cushions the brain
    - Amniotic fluid protects a developing fetus
- Moisten us
    - Saliva, tears, mucus
- Help maintain body temperature
    - Water isn't easy to heat
    - Being made of mostly water helps us keep cool
- Water is involved in Chemical reactions
    - Water is often needed to break 2 molecules apart- Hydrolysis

- Water is often released when 2 molecules are joined together- Condensation

Sweating and Vasodilation

- When your core temperature rises, your blood is warming up
- This causes the body to sweat. The water from sweat evaporates into the air, and through sweat, heat is carried out of body.
- The sweating process helps cool down the blood that is circulated back to your core, essentially cooling down your core temperature
- **Vasodilation:** The redness in our skin caused by the dilation of blood cells to release heat

Water Balance: A state of equilibrium in which fluid intake from water and other beverages and foods equals fluid losses from the GI tract, urine, sweat and other secretions (*e.g. Tears)*

Water Intake

- 75-80% of the water we get comes from beverages
- 20-25% comes from food
- Some also comes from metabolic processes(*e.g. Glucose being broken down/cellular respiration)*

Dietary Sources of Water

- **Cucumber:** 96% water
- **Celery, Blueberries, Radish:** 95% water
- **Tomato:** 94% water
- **Strawberry:** 92% water
- **Grapefruit:** 90% water
- **Broccoli, Pear:** 89% water

We Get Water From..

- Metabolism
- $C_6H_{12}O_6 + 6O_2 \rightarrow H_2O + CO_2 + \text{Energy}$
- Making triglycerides and peptide bonds creates water too

How do We Lose Water?

- Urine, feces, evaporation, sweat, breath- Insensible losses

Thirst- Regulating Water Intake

- Hypothalamus regulates your thirst as well as hunger
- Things that stimulate thirst:
    - High concentrations of solutes in the blood (*e.g. Electrolytes, nutrients)*
    - Low blood volume or blood pressure
    - Dryness in the mouth

Thirst Mechanism

- If you have decreased blood volume, and increased solute concentration, you'll have decreased saliva production which leads to a dry mouth.
- Taking a drink of water will increase blood volume and decrease solute concentration

Problem with Our Thirst Mechanism

- It gets worse with age
    - Older adults are frequently dehydrated
- Sometimes we feel hungry, when in reality we are thirsty.
    - Mistake hunger for thirst

Regulation of Water Losses

- When you are dehydrated you don't urinate
- How does it work?
    - When the blood becomes concentrated antidiuretic hormone(ADH) is released
    - This hormone tells the kidneys to keep as much water as possible from being lost in the urine

How Much Fluid Do We Need?

- The DRIs provide an AI for water
- **Women:** 2.7 L
- **Men:** 3.7 L

Dehydration

- When you excrete more water than you take in
- Can be measured using change in body weight
- Symptoms begin when you have 1-2% decrease in body weight
    - Loss of appetite
    - Crankiness
    - Headaches, faintness, tiredness
    - Dry eyes and mouth
    - Dark urine

Moderate to Severe Dehydration

- Losses of 3-5% of your body
- Can result in sleepiness, nausea, headaches, decreased concentration
- Greater than 7% can lead to delirium
- 10-20% can cause death

People Susceptible to Dangerous Dehydration

- Infants and children: increased body surface area- ratio of skin surface to bodyweight is 3x greater than that of an average)
- Older adults: Decreased sensitivity to thirst
- Athletes

Did you Know…

- Hockey players lose 3.5L in sweat per game
- Goalie water bottles are important

Too Much Water

- Overhydration or water intoxication happens
- Most often caused by too much fluid without enough sodium or electrolytes in the diet
- When there are low sodium levels in the blood, water moves from the blood vessels ot the tissues- causes swelling of the tissues(Swelling in the brain is an issue)
- Can lead to seizures, coma and death

Water Sources

- Drinking water contains dissolved minerals
    - Different water sources have different minerals
    - People like what they're used to
- Is bottled water safer? Is bottled water healthier?

Environment and Bottled Water

- The energy used each year making the bottles needed to meet the demand for bottled water in the United States is equivalent to more than 17 million barrels of oil. That's enough to fuel over 1 million cars for a year

- That bottle that takes just three minutes to drink can take up to a thousand years to biodegrade
- If water and soft drink bottles had used 10% recycled materials in their plastic bottles in 2004, they would have saved the equivalent of 72 million gallons of gasoline. If they has used 25%, they would have saved enough energy to electrify more than 680,000 homes for a year

Electrolytes

- Dissolved minerals- ions with positive or negative charge
    - This charge allows them to do what they do in our bodies
- Major electrolytes are sodium, potassium, chloride, phosphorus(in the form of hydrogen phosphate), calcium
- Help regulate fluid balance through osmosis: the process in which fluids pass through a semipermeable membrane into a solution of lower concentration to equalize the concentration on both sides of the membrane
- Allow our nerves to work: Nerve impulses are created by a change in the electrical charge across all cell membranes
- Allow our muscles to contract: Change in electrical charge across cell membranes leads to contraction of the muscles

Regulation of Electrolyte Levels

- Electrolyte levels in the blood are strictly controlled
    - Organs and tissues will not work properly when electrolyte levels are unbalanced
    - Symptoms of electrolyte deficiencies include:
        - Poor appetite
        - Muscle cramps
        - Confusion
        - Irregular heartbeat
- The kidneys are the main electrolyte regulators
    - Too many electrolytes? They go into the urine
    - Not enough? The kidneys keep them from going out in urine

1. A decrease in blood pressure triggers the kidneys to release the enzyme renin
2. Renin converts angiotensinogen into angiotensin I, which is activated to angiotensin II.
3. Angiotensin II increases blood pressure by constricting the walls of blood vessels
4. Angiotensin II stimulates release of aldosterone from the adrenal gland.
5. Aldosterone increases sodium reabsorption by the kidneys. Water follows the sodium, helping to maintain blood volume and blood pressure

Where Do You Get Electrolytes?

- All foods contain electrolytes
  - Potassium, sodium, calcium
- Electrolyte imbalances can happen in, Kidney disease, Vomiting, diarrhea, sweating, IV fed hospital patients

Sodium

- Found in table salt (NaCl)
- The positively charged electrolyte
  - Required for nerve signals
  - Required for fluid balance
  - Required for blood pressure
  - Required for nutrient transport
- We need it

Getting Enough Sodium

- Most Canadians consume more sodium than the UL
- 77% comes from processed foods
- 11% comes from salt added at the table or during cooking
- 12% is found naturally in foods

Sodium Intake Above the UL

- Increase risks of hypertension= high blood pressure
- Optimal blood pressure is 120/80
  - **Systolic:** Pressure when the heart contracts
  - **Diastolic:** Pressure when the heart relaxes
- High blood pressure
  - Systolic > 140 mm Hg
  - Diastolic > 90 mm Hd

Hypertension

- 20% of Canadians have hypertension (7.5 million Canadians)
- 70% of those aged 80+ years old have hypertension
- Almost 20% of people with hypertension don't know they have it
- People who have hypertension have higher risk for heart attacks, strokes, and kidney disease
- Affected by: genetics, age, family history and lifestyle facts

The DASH Diet

- Diet recommended to treat hypertension
- 30-60 minutes of physical activity most days
- More fruits and vegetables, low in saturated fat, lots of whole grains, low fat dairy, low fat meats, and low sodium foods

Sodium Reduction Strategy

- Reduce average intakes from 3,400 mg/day to the UL of 2300 mg/day
- Reduction in processed foods: through the development of sodium reduction targets for different food groups.
- Increased awareness, education and research

Sample Final Question

What is the reaction that breaks large molecules into smaller ones by the addition of water?

a. Exchange
b. Replacement
c. Hydrolysis
d. Condensation

What Are Minerals?

- Inorganic elements that your body needs in order to function
  - Major minerals- You need more than 100 mg/day
    - Calcium, phosphorus and magnesium
  - Trace elements- You need less than 100 mg/day
    - Iron, zinc, copper, selenium, iodine

What Do Minerals Do?

- **Structural Roles:** Calcium, magnesium, phosphorus and fluoride are needed for the structure of bone
- **Regulatory Roles:** Iodine is used to make thyroid hormones
  - Iron is needed for oxygen transport in red blood cells
  - MANY minerals are needed as cofactors for enzymes

Bone Consists of…

- 65% minerals
  - Hydroxyapatite: Calcium and phosphorus crystals deposited in protein matrix of the bone to help give bone strength
- 35% organic substances
  - Collagen (a fibrous protein that helps make up bone)

Nutrients Involved in Bone Health

- **Major Roles:** Calcium, Vitamin D, Phosphorus
- **Minor Roles:** Magnesium, vitamin K, Vitamin A, Protein, Fluoride

Calcium

- A major mineral- We need >1000 mg/day
- The most abundant mineral in the body
- It makes up 1-2% of our body weight
- RDA:
  - Men&Women aged 19-50: 1000 mg/day
  - 70+ men, 50+ women: 1200 mg/day

Sources of Calcium

- **Milk and Milk Products**
- Milk alternatives and fortified foods (i.e. Calcium fortified orange juice, soy milk)
- Fish eaten with bones (*i.e. Canned salmon, sardines*
- tofu
- Some nuts (walnuts) and seeds (sesame)
- Dark green veggies (Kale, bok choy, chard, broccoli)

Absorption of Calcium

- Only 25% of calcium in foods is absorbed
    - Less if you have a diet low in vitamin D, will only absorb 10% of calcium
    - More like 50% when you're pregnant, 60% as an infant

Getting the Most out of Calcium

- Spread your calcium throughout the day
    - Your intestines can only absorb about 30% worth of calcium at one time
- Oxalates (in green vegetables), phytates (in whole grains) and tannins (tea) decrease absorption
- Avoid taking zinc, iron or magnesium when you're eating a source of calcium

Calcium is Critical for Strong Bones

- 99% calcium stored in bones and teeth
- Critical part of hydroxypatite crystals
- Provide strength to the bones

Calcium as Electrolyte

- 1% of calcium is in the blood as an electrolyte
    - Muscle contration
    - Blood clotting
    - Normal functioning of nervous system
    - Blood pressure regulation
- The body controls blood levels closely (Never <1%)

Not Enough Calcium

- Your body will take what it needs from the bones
- Blood Ca levels don't change but bones can become weakened over time
- **High blood calcium levels:** thyroid glands will release calcitonin which inhibits calcium release from bone = normal blood calcium
- **Low Blood Calcium Levels:** Parathyroid glands release parathyroid hormone which:
    - Stimulates calcium release from the bone = normal blood calcium (decrease bone strength)
    - Allows calcium to be reabsorbed by the kidney
    - Activates vitamin D, increasing intestinal calcium absorption

RDA's for Calcium

Age	Men	Women
13-18	_ mg/d	1300 mg/d
19-50	1000 mg/d	1000 mg/d
51-70	1000 mg/d	_ mg/d
70+	1200 mg/d	1200 mg/d

Not Enough Calcium

- Form of supplements- How absorbable is it?
  - Most supplements are about 28%
  - Calcium citrate malate is slightly better absorbed (35%)
  - Calcium Carbonate is the cheapest- Tums

Maximizing Supplement Absorption

- Don't take calcium with multivitamin
  - Interferes with iron, magnesium and phosphorus absorption
- Take calcium supplement with foods
  - At mealtime or right after eating
- Take smaller amounts throughout the day to maximize absorption

Too Much Calcium

- Eating more increases blood levels of calcium
- When you have enough, body stops absorbing it
  - Extra comes out in the feces
- Too much calcium could interfere with absorption of other minerals
  - Such as iron, magnesium and phosphorus

Phosphorus

- Another major mineral (>700 mg/day)
- 85% phosphorus found in bones and teeth
- Part of hydroxyapatite crystals

Phosphorus in the Diet

- In almost everything we eat
- Only a deficiency risk in very low energy and low protein diets
- Well absorbed in the intestine
- Added to baked goods & carbonated beverages
- Deficiency is rare and usually not caused by low dietary intake
- Highest amounts of phosphorus are found in high protein foods

Other Roles of Phosphorus

- 15% in soft tissues and fluids in the body
    - Cell membranes (in phospholipids)
    - Energy metabolism (ATP, creatine)
    - Activates enzymes in metabolic reactions
    - Important for DNA
    - Cell signaling (it's an electrolyte)
    - Acid-base balance: Helps regulate pH within cells

Phosphorus Deficiency

- vERY rare because it's found in all foods
- Those with very low protein diets may have marginal intakes
- Most common in:
    - Premature infants
    - Alcoholics
    - Elderly

Too Much Phosphorus

- Concern about over-consuming processed foods and _
- Too much can interfere with calcium & excretion, may also affect bone mineralization
- Like calcium, phosphorus intake does not affect blood levels

Magnesium

- 50-60% of body's magnesium is in the bone
- Influences hydroxyapatite formation
- Regulates the transport of calcium and potassium ions across cell membranes
- Is a cofactor for over 300 enzymes in our body
    - None of these enzymes would work without it
    - None of the chemical reactions would happen
- These enzymes control energy production, building DNA and proteins, blood pressure and regulation and muscle contractions

Where is Magnesium

- Found in most foods, so acute deficiencies are rare
- Best sources: whole grains, nuts, leafy green vegetables, seeds and beans

Too Much or Too Little

- Too much possible from supplements, causes diarrhea and nausea
- Acute deficiencies are rare, but low intake are related to increased risk of :
    - Osteoporosis
    - Type 2 diabetes
    - High blood pressure
    - Migraines

Vitamin D

- Also called cholecalciferol or calcitriol (active form)
- A fat-soluble vitamin
- Also considered a hormone
- Conditionally essential- Can make it if we get enough exposure to sunlight

Vitamin D and Bone Health

- Vitamin D is important for calcium balance
    - Helps absorb calcium
    - Helps retain calcium (decreased excretion)
    - Helps regulate levels of calcium

Other Roles of Vitamin D

- Importance in preventing cell mutation- Role in cancer prevention
- Immune system
    - Vitamin D may play a role in helping the body fight viruses and infections

Getting Enough Vitamin D

- Synthesize it from a form of cholesterol in our skin (need UV light from the sun for synthesis to occurs)

1. Starts as 7-dehydrocholesterol (in skin)
2. Then cholecalciferol(Vitamin D_3),
3. then converted to Calcidiol,
4. then converted to calcitriol at kidneys(active form of vitamin D)

People who Absorb Less

- People with darker skin
- People who live far from the equator
    - In edmonton alberta, people synthesize NO vitamin D between october and may
- Up to 40% of canadians have inadequate blood vitamin D levels during winter and/or spring

Other People Who Absorb Less

- Elderly- older skin has fewer vitamin D making compounds
- People wearing sunscreen
- People who cover all their skin
- People who work inside during the middle of the day (between 10am to 3pm)

Few Foods Containing Vitamin D

- **Fatty Fish**- wild salmon, herring, trout, mackerel
    - Farmed salmon has about ¼ the vitamin D as wild

    - Wild salmon has almost 1000 IU in a 3oz serving
- Most of our dietary vitamin D comes from fortified beverage
    - Milk, soy milk, almond milk, orange juice
    - Yogurt and cheese are NOT fortified with vitamin D

Supplements

- It is recommended that men and women over 50 take one
- For other people in the winter if they don't consume a lot of milk and/or fatty fish
- And in the summer if: you're inside or wear sunscreen
- A supplement containing 10 ug (600-800 IUs)

Lack of Vitamin D

- Rickets: Wrickken
- Rickets was common in children living in cities during the industrial revolution
- Pollution blocked the sun= no vitamin D
- Rich children were sent to the country to be cured

Osteomalacia

- In adults, soft bones due to Vitamin D deficiency is called osteomalacia
- Poor mineralization
- Bowed legs
- Bone pain
- Muscle aches and weakness

Vitamin D Toxicitiy

- Not possible from sun exposure
- Possible from supplements but is rare
    - May cause hypercalcemia (high blood calcium levels)
    - Calcium deposits on organs
- Excess vitamin D is stored in fat deposits and the liver

Vitamin D and Cancer

- One study showed that women taking a vitamin D supplement had a 60% lower risk of cancer
- There is emerging evidence that too much vitamin D may be related to increased risk of some cancers
- This is why the DRIs for vitamin D have remained moderate

Nutrition and Osteoporosis

- Nutrients that affect bone health; Calcium, phosphorus, magnesium and vitamin D

- If you don't get enough of these nutrients you will be at increased risk of osteoporosis

Bone Consists of:

- 65% minerals- Hydroxyapatite
  - Calcium and phosphorus crystals
- 35% organic substances
  - Collagen (a fibrous protein)

Osteoporosis

- Most prevalent bone disease in N. America
- Most commonly seen in older adults
- Bone is weakened
  - Low bone mass & deterioration of bone tissue
  - Increase bone fragility
  - Increase mineral loss
- Fractures are serious problems for older adults

What Happens when Bones Fracture

- Osteoporosis causes:
  - Pain, disfigurement(bone won't heal back to it's normal self), low self-esteem, fear of falling, loss of mobility

How Does Osteoporosis Develop?

- Life-long process
  - Childhood and adolescence are particularly important periods
- Low intake of calcium, vitamin D and other bone nutrients
- Low levels of physical activity
- Some medications can also affect bone health

Changes in Bone Over Time

- Your bones grow in size and density during childhood and adolescence
- You reach your peak bone mass between 20-30 years of age
- Your bone mass levels out during adulthood
- Your bone mass declines after the age of 50

Osteoporotic Spine

- When weakened by osteoporosis, the front edge of the vertebrae collapses more than the back edge, so the spine bends forward

Process of Bone Remodelling

- Your body constantly breaks down and builds up your bones to keep them strong
- This is called bone remodelling. Your body does this in two steps
  - **Bone Resorption:** Breakdown of bone by osteoclasts

    - **Bone Formation:** Formation of bone by osteoblasts
- As you grow, osteoclasts work faster- you gain bone
- As you age, osteoclasts work faster- you lose bone

Peak Bone Mass

- Have a high peak bone mass protects you from osteoporosis
    - 75% is predetermined by;
        - genetics,
        - gender(women at increased risk),
        - level of estrogen(more estrogen=decreased risk)
        - Lifestyle choices (diet that is rich in calcium, vitamin D and other nutrients) (exercise regularly) (smoking increases risk)

To Protect your Bones

- Get enough bone nutrients and physical activity
- Throughout your WHOLE life
- This will help you build your peak bone mass and maintain it

Cool Facts

- If you don't use your bones you will lose them
- When astronauts go to space, they lose bone mass
    - Some have lost up to 30% of their bone mass

How To Know If Your Bones are Healthy

- Dual energy x-ray absorptiometry
    - Measures bone mineral density (BMD)
        - Bone mineral content (g) /bone area (cm^2) = BMD (g/cm^2)
    - Monitor changes in BMD
    - Used to diagnose osteoporosis
    - BMD value compared
        - T-score

Women Have Higher Risk of Osteoporosis

- Lower peak bone mass
- Longer life expectancy
- –
    - During menopause, low estrogen levels cause increased bone reabsorption and decrease bone formation

Trace Elements

- Include iron, zinc, copper, selenium, iodine
- Required in amounts less than 100 mg per day
- Trace elements have been very difficult to study as they are difficult to remove from the diet
- Bioavailability is a concern

Zinc (Zn)

- Most abundant intracellular trace element
- Essential for growth and development
- Involved in the functioning of over 300 different enzymes (
    - *E.g. superoxide dismutase, important for protecting cells from free radical damage from oxidative stress*
- Toxic if taken in excess

Functions of Zinc

- Required by enzymes important for:
    - Carbohydrate metabolism
    - DNA and
- Helps regulate:
    - Immune function
    - Sexual maturation
    - Bone development
    - Cell division
- Structural role in specific transcription factors
    - Zinc _

How Zinc Fingers Work

- Finger like structures called zinc fingers allow nuclear protein receptors that bind to vitamin A,D and hormones to interact with the regulatory region of a gene and thus affect gene expression

1. Proteins containing will fold around the zinc atom (Known as zinc finger/loop)
2. Zinc fingers help with binding of vitamin D, A and other hormones. Affects gene expression

Low Intake Vs. Low Intake

a. When zinc intake is low, more zinc moves from the lumen into the mucosal cells and from vesicles into the cytosol and little metallothionein is synthesized
b. When zinc intake is high, little zinc is transported from the lumen into the mucosal cells and more zinc moves out of the mucosal cells into the lumen and from the cytosol to the vesicles. The synthesis of metallothionein, which binds zinc and limits its uptake into the blood, increases the synthesis of metal

Zinc in the Canadian Diet

- CCHS suggests that a # of canadians are not meeting their zinc requirements
- Richest sources of zinc are animal products
- Better absorbed from animal sources than plant sources

Zinc RDA's

	RDA (mg) - Mixed Diets	**RDA (mg)- Vegan**
Men (+19)	11	Up to 17
Women (+19)	8	Up to 12

Zinc Deficiency

- Characterized by:
  - Growth retardation
  - Loss of appetite
  - Impaired immune function
  - Delayed sexual maturity
- Individuals most at risk:
  - Persons with gastrointestinal diseases (poor absorption)
  - Pregnant and breastfeeding (Higher requirements)
  - Alcoholics (Decreased absorption)
  - Vegans/Vegetarians (Decreased bioavailability)

Meeting Requirements

- Often bound by phytates(storage form of phosphorus) reducing its bioavailability
- Vegetarians are more vulnerable to having inadequate zinc intakes
- Vegans may be 50% more vulnerable due to lower bioavailability of zinc from vegan sources
- Wise food choices are necessary
- Canadian regulations require some foods to be fortified with zinc
  - *E.g. breakfast cereals*

Zinc Toxicity

- Mostly due to high supplement intake
- Characterized by:
  - Nausea, Vomiting, loss of appetite, abdominal cramps, diarrhea, headaches

Zinc & the Common Cold

- Several clinical trials have been run to determine effects on zinc supplementation (lozenges) on the severity of colds
- No consensus on findings
- Physiological basis not well understood

- Prolonged intake (>5 days) of lozenges can also lead to toxicity
    - Side effects of bad taste and nausea

Copper (Cu)

- The richest sources of copper are organ meats, such as liver and kidney
    - Also found in seafood, nuts and seeds, whole-grain breads, cereals and chocolate
- About 30-40% of the copper in a typical diet is absorbed and absorption is affected by the presence of other minerals in the diet
- When zinc is in high intake, it stimulates the synthesis of the protein metallothionein in mucosal cells. It works to bind copper, preventing it from being moved out of the mucosal cells and into the blood
- Antagonism between copper and zinc is so great that phytates, which inhibit zinc absorption, actually increase the absorption and utilization of copper.
- Copper absorption is reduced by large intakes of:
    - I, manganese, Molybdenum, vitamin C
- High levels of zinc can inhibit copper absorption by stimulating the synthesis of metallothionein which then preferentially binds copper and limits absorption

Copper in Your Body

- Helps the functioning of a # of enzymes critical to iron and lipid metabolism, connective tissues synthesis, maintenance of heart muscle, and the functioning of the immune and CNS
- **Ceruloplasmin**→ The major copper carrying protein in the blood
    - Converts iron into a form that be bound to transferrin for transport from body cells
- Copper is also needed for:
    - Glucose and cholesterol metabolism
    - Synthesis of neurotransmitters norepinephrine and dopamine
    - Several blood clotting factors

Manganese (Mn)

- Best dietary sources are found in whole grains and nuts
    - Fruits and vegetables are fair sources
- Manganese requiring enzymes are involved in:
    - Amino acid, carbohydrate, and cholesterol metabolism
    - Cartilage formation
    - Urea synthesis
    - Antioxidant protection

Selenium (Se)

- Seafood, kidney, liver and eggs are excellent sources of selenium (
    - *Grains and seeds depending on how rich the soil they were grown in is(rich with selenium)*

- It functions mostly through association with proteins called selenoproteins
    - Several of these proteins, including **glutathione peroxidase** are enzymes that help protect cells from oxidative stress or damage
    - This spares vitamin E, because this vitamin stops the action of free radicals once they are produced
- Selenium is also needed for the synthesis of thyroid hormones, which regulate basal metabolic rate (BMR)
- RDA is 55 ug/day (ug=micrograms)
    - Based on the amount needed to maximize the activity of the enzyme glutathione peroxidase in the blood
    - Estimates of selenium content of the Canadian diet suggests that we are meeting our needs

Selenium Deficiency

- Symptoms include: muscular discomfort and weakness
- Deficiency not identified until the late 1970s, when it was observed in patients fed TPN(through the bloodstream directly) solutions
- Also discovered in China, known as Keshan Disease
    - A type of heart disease that occurs in areas of China were soil is very low in selenium
    - Believed to be a combination of viral infection and selenium deficiency.
    - Heart damage can be reversed by selenium supplementation

Iodine

- Primarily needed for the synthesis of thyroid hormones
- Iodine content in food varies, depending on the soil where plants are grown or where animals graze
- It is found in seawater, so seafood and plants that are grown near the sea are often high in iodine
- In Canada: most of our iodine content comes from salt fortified with iodine, referred to as ionized salt
- RDA is 150 ug/day
    - Based on the amount needed to maintain normal iodine levels in the thyroid gland
    - RDA is higher during pregnancy to account for the amount of iodine needed by the fetus and during lactation to account for the amount secreted in milk production

Iodine in Your Body

- More than half of the iodine in the body is located in the thyroid gland in the front of the neck
- It is concentrated here because it is an essential component of the thyroid hormones thyroxine(T_4) and triiodothyronine (T_3), which are made from the amino acid tyrosine

- The thyroid hormones act by affecting gene expression in target cells in a manner similar to vitamin A and D
    - Through gene expression, thyroid hormones promote protein synthesis and regulate basal metabolic rate, growth and development

Iodine Deficiency

- Reduces the production of thyroid hormones
- Metabolic rates slow with insufficient hormones, causing fatigue and weight gain
- Most common symptom is an enlarged thyroid gland called a goiter

Fluoride (F)

- The importance of fluoride to dental health has been recognized since the 1930s, when an association between the fluoride content of drinking water and the prevalence of dental caries was noted
- Fluoride is present in small amounts in almost all soil, water, plants and animals
- The richest dietary sources are fluoridated water, tea, marine fish consumed with their bones
- In Canada most of the fluoride in the diet comes from toothpaste and from fluoride added to our water supply
    - Because food readily absorbs fluoride in cooking water

Fluoride in Your Body

- About 80-90% of ingested fluoride is absorbed
    - Absorption is decreased with milk or items that have a high calcium content
- AI is 0.05 mg/kg/day for everyone 6 months of age and older
- Deficiency: when deficient tooth decay is more common
- Toxicity:
    - In children, fluoride intakes of 2-8 mg/day can cause stained, pitted teeth aka fluorosis
    - In adults, doses of 20-80 mg/day can result in changes in bone that can be crippling, as well as changes in kidney function and _

Exam Notes

Jan 11 Lecture

Essential Nutrients: Nutrients that our bodies cannot produce and must be received through fortified foods, natural health products, phytochemicals and zoochemicals

Nutrients

- 6 types

1. Protein: Macro
2. Carbohydrates: Macro
3. Fats: Macro
4. Vitamins: Micro
5. Minerals: Micro
6. Water: Micro

Macronutrients: Carbs, Fats, Proteins

- Give us energy(Measured in kilocalories[kcal])
- Carb= 4 kcal of energy/gram
- Fat= 9 kcal of energy/gram
- Protein= 4 kcal of energy/gram
- Alcohol= 7 kcal of energy/gram

Micronutrients: Vitamins and Minerals

- Don't provide energy
- **Vitamins:** Organic carbon containing molecules our body needs to function
    - Help body use the energy from macronutrients
    - Involved in bone growth, vision, blood clotting, oxygen transport and tissue growth/development
- **Minerals:** Inorganic molecules our body needs to function
    - Make and maintain tissues, such as bones and blood

Water

- Our bodies need water for everything
- Good environment for:
    - Chemical reaction, cell growth, muscle and nerve function, hormone signalling, nutrient transport, regulation of body temperature

Calorie

- Unit of energy
- 1 calorie is the amount of energy is takes to warm 1 kg of water by 1 degrees celsius

Undernutrition

- Form of malnutrition caused by deficiency of energy or nutrients
- *Starvation:* Most severe form of undernutrition
    - Causes weight loss, poor growth, inability to reproduce, death(severe cases)

Overnutrition

- Excess of nutrients
- When excess number of nutrients are consumed a toxic reaction may occur
- *E.g obesity*

Why People Eat Unhealthy/Healthy Food

- **Availability/Accessibility(Cost, Location, Cooking skills)**
    - Culture, background
- **Personal Preference**
    - Health concerns (*Allergies)*
    - Psychological and emotional factors (*Sad=eat junk food)*
    - Media(*Fad diets)*

Credible Sources

1. **Educated People with Credentials**

- Registered Dietitians (RD, PDt, RDt)
- Nutritional Professionals with advanced degrees

2. **Government**

- Health Canada, Public Health Agency of Canada
- Statistics Canada
- National Institutes of Health (USA)

Jan 13 Lecture

6 Classes of Dietary Reference Intakes (DRIs)

1. **Estimated Energy Requirements (EER)**

- Calculating how many calories people need

2. **Acceptable Macronutrient Distribution Ranges (AMDR)**

- Used to see if you get the right amount of macronutrients

Age Group	Percent Calories From		
	Carbohydrates	**Protein**	**Fat**
1-3 yrs	45-65%	5-20%	30-40%
4-18 yrs		10-30%	25-35%
19+ yrs		10-35%	20-35%

3. **Estimated Average Requirements (EAR)**

- Meets the needs of 50% of the population
- NOT a good goal for individuals
- Tool for assessing the adequacy of diet within the population
- *E.g. EAR for Iron*

4. **Recommended Dietary Allowances (RDA)**

- Meets the requirements of 98% of the population
- Goal for individuals

5. **Adequate Intake (AI)**

- Used when EAR or RDA does not have enough evidence
- AI= mean intake of a healthy population

6. **Tolerable Upper Intake Level (UL)**

- UL = the highest average daily nutrient intake level that poses a risk of adverse health effects
- As intake increases above the UL, the risk of potential adverse effect may increase
- *Overconsumption*

Applications of Dietary Reference Intakes (DRIs)

- Provide a set of standards that can be followed
- Assess the adequacy of diets

Canada's Food Guide Recommendations: How are These Foods Healthier?

1. **Vegetables and Fruit:**

- Low salt- Prevent high blood pressure
- Have dark green and orange vegetables
    - Have more vitamins; A and folate
- Have vegetable and fruits more than juice
    - Will fill you up b/c of fibre

2. **Grain Products**
- Choose whole grains
    - More fibre, minerals; magnesium

3. **Milk Products**
- Drink skim, 1%, 2% milk each day
    - Liquid milk has added vitamin D
- Select lower fat milk alternatives
    - Cheese often high in fat and salt

4. **Meat and Alternatives**
- Have meat alternatives
    - Beans; high in folate, fibre, protein
- Have fish twice a week
    - Fish contain long chain omega-3 fatty acids(*healthiest fat)*

5. **Other**
- Choose 2-3 tbsp oils and fats like canola oil, olive oil or soft tub margarine
- Avoid using hard fats such as butter, hard margarine, lard or shortening
- Drink water

Nutrition Labels
- All ingredients for a food are listed by weight
    - Ingredient in largest amount is listed first

% Daily Value
- Based on 2000 calorie diet
- NOT based on DRIs
- 5% is a litte, 15% is a lot
    - *Don't want a lot of salt and saturated fat, do want a lot of fibre*

Jan 16 Lecture

Digestion System
- Does 3 things:

1. **Digestion**
- Breaking food into tiny pieces

2. **Absorption**
- Moving the tiny pieces from the inside of your intestine into the bloodstream

3. **Elimination**
- Getting rid of waste
- Also has a barrier function, preventing the absorption of harmful substances

Hunger

- **Gut-Brain Axis**
  - Stomach and intestines send nerve signals to the hypothalamus of the brain
  - Tell's hypothalamus that we need to eat food, thus we become hungry
- **Glucose (Blood sugar) Levels Drop**
  - Insulin and Glucagon levels in the blood change
    - Hormones produced in the pancreas
    - Signal for hypothalamus to make us feel hungry

GI Tract and Barrier Function

- **Barrier Function:** Protective role of gastrointestinal cells
  - Limits the absorption of harmful substances such as toxins and disease-causing organisms
- **Immune Cells:** GI tract contains some immune cells
  - Phagocytes
  - Lymphcytes
  - B cells which produce antibodies
- **Antigens:** Barrier function can detect antigens
  - Antigens: Foreign substances that when introduced to your body stimulates an immune response
- **Phagocytes:** First immune cells that respond to antigens
  - Target invader, engulf it and destroy it
  - Broken up antigens are then detected by lymphocytes, which react by producing and secreting protein molecules called antibodies
    - Antibodies: Destroy or inactivate foreign substances in the body

Steps to Digestion

1. **Mouth**

- **Mechanical Digestion:** Teeth break up food
- **Chemical Digestion:** Enzymes
  - Enzymes in saliva start breaking up food
  - Salivary amylase breaks up carbs
  - Lingual lipase breaks up fat
  - Saliva helps make bolus (moist ball of food)
- **Enzymes:**
  - Made of protein
  - Biological catalysts
  - Have suffix -ASE

2. **Swallowing**

- Part conscious, part unconscious
- Epiglottis covers passageway of lungs so bolus can enter the esophagus

3. **Esophagus**

- Peristalsis: Brings food through GI tract
  - Waves of contractions in the esophagus that move the food
  - Inner circular muscles
  - Outer length-wise muscles
- Food moves into stomach via the lower esophageal sphincter

4. **Stomach**

- Churns food (*twisting and turning of food)*
- **Mechanical Digestion**
  - 3 thick muscle layers churn and break up food
    - Longitudinal layer, circular layer, diagonal layer
  - Food turns to chyme
- **Chemical Digestion**
  - Stomach is very acidic environment
  - HCL denatures and unravels protein
  - pH of gastric juice is 2.0
  - Pepsin breaks down protein
    - Functions best in acidic environments
- **Stomach Regulation by Nerves and Hormones**
  - How your stomach churns and how much gastric juice is released is regulated by signals from both nerves and hormones
  - Gastrin: Hormone secreted by the stomach mucosa that stimulates the secretion of gastric juice and helps stomach digestion, as well as chemical digestion
  - Food entering the stomach stimulates the release of gastric secretions and increases stomach motility
- **Mucus:** Lines the GI tract
  - Protects and helps food move easily throughout
  - Especially important in stomach, due to such an acidic environment
    - Stomach is made of protein, and mucus stops you from developing peptic ulcers
    - Prevents us from being eaten inside out.

5. **Small Intestine**

- Chyme is delivered from the stomach through pyloric sphincter
  - Pyloric sphincter located in duodenum
- Lots of chemicals and gastric secretions are added
  - Liver, gallbladder and pancreas involved
- **Duodenum:** Chemical Digestion and some absorption
  - 1st part of small intestine
- **Jejunum:** Digestion continues, LOTS of absorption
- **Ileum:** Absorption continues and leftovers go to large intestine

6. **Large Intestine**

- Made of several parts:
    - Cecum; ascending, transverse, descending
    - Sigmoid Colon
    - Rectum
    - Anus

- **Key Functions**
    - Does NOT participate in digestion
    - Absorbs water and some micronutrients
    - Contains friendly bacteria called commensals
        - These bacteria digest what we can't (*fibre)*
        - Produce gas and vitamin K
        - Produce fatty acids that the large intestine uses
    - **Rectum:** Holds feces until time of elimination
    - Water, nutrients and fecal material may spend up to 24 hours in large intestine
    - **Flatus:** Gas produced, contains nitrogen, CO_2, Hydrogen, Methane & Hydrogen Sulphide

7. **Liver and Gallbladder**

- Bile is made in liver.
    - Stored in the gallbladder
- **Main Function:**
    - Bile emulsifies fat molecules, and breaks it into small droplets that mix well with water

8. **Pancreas: Enzyme Powerhouse**

- Produces and adds:
    - Bicarbonate ions to help neutralize acid and chyme
    - Enzymes
        - Pancreatic amylase: starch/carbs
        - Lipase: fat
        - Protease: protein

Jan 18 Lecture

Where do Nutrients Go?

- Into the bloodstream
- Nutrients are then transported to organs and tissues around the body
- Circulatory system transports nutrients throughout the body and cells

The Lymphatic System: "*Think White Blood Cells*"

- Absorbs fat soluble nutrients that are unable to fit in small capillaries (*in the liver)*
- Nutrients are packaged into chylomicrons(*Little fat blobs)*
- Chylomicrons travel from the intestinal cells into the lymphatic systems, the into the blood
- The Lymphatic system also collects and filters body's fluid
    - Helps us fight infection
    - Acts as a "gatekeeper" and controls blood flow in and out

Nutrients in the Bloodstream

- Nutrients are pumped through the body in the blood and lymph
- Can be picked up by body tissues for immediate use
    - *E.g:*
    - *Carbohydrates would go right to the organs and muscles for energy*
    - *Can be stored in the body*
    - *Fat stored in adipose tissues or calcium stored in bones*

Nutrients Into Cells

- Through the cell membrane
- Membrane maintains the integrity of the cell and surrounds the cell's contents
- Selectively permeable membranes
    - Allows some substances to pass freely, such as water
    - Limits and controls the transporting of others

Types of Transportation Into Cells

1. **Simple Diffusion:** No energy, No carrier

- Movements of substances from an area of high concentration to an area of low concentration
- NO energy required
- *E.g. Vitamin E and fatty acids are absorbed through simple diffusion*

2. **Osmosis:** No energy, no carrier, semipermeable

- Passive movement of water across a semipermeable membrane in a direction that will make the concentration of dissolved substances equal
- *E.g. If there is a high concentration of sugar in the intestine, water will move from the mucosal cells and into the intestine to help dissolve the sugar*

3. **Facilitated Diffusion:** No energy, carrier molecule

- The movement of substances across a membrane from an area of high concentration with the aid of a carrier molecule
- NO energy required

4. **Active Transport:** Energy, carrier molecule
- Transportation of a substance across a cell membrane with the aid of a carrier molecule
- REQUIRES ENERGY

Metabolism
- **Of Nutrients:** A chemical reaction that happens inside a living thing that results in the transformation of one molecule into another
- **Energy:** Breaking the bonds between atoms releases energy
    - Breaking bond releases energy
    - Attaching two atoms together takes energy
- Carbs, Fats and proteins all contain strings of carbon atoms, and release the energy by breaking the bonds between atoms.
    - Energy converted to:
        - Heat
        - Adenosine Triphosphate (ATP)

How Energy Metabolism Works
- Process of cellular respiration
- Oxygen MUST be present in order to occur
1. In the presence of oxygen, glucose, fatty acids and amino acids can be metabolized to produce acetyl-CoA
2. Acetyl-CoA is broken down by the citric acid cycle to yield CO_2 and high-energy electrons
3. Electrons are moved to the ETC(electron transport chain) where their energy is used to generate ATP.
    - Combined with oxygen and hydrogen from water
    - Causes:
        - Water to be released
        - ATP is bodies source of energy
        - ATP is made up of adenosine and 3 phosphate groups, each phosphate group has high energy bonds between them.
- **End Products of Metabolism:**
    - ATP: Bodies energy source
    - CO_2 from citric acid: Waste, excreted via Respiratory system
    - Nitrogen from breaking down protein: Waste, excreted via urinary system
    - Water, excreted via our skin
    - Products from digestive system get excreted via. Anus as waste

ATP: The Energy Currency
- **What does ATP do?**
    - Each cell of your body makes its own energy via cellular respiration
    - ATP is used by the body to power everything

- Muscle contractions, making new cells and tissues, making DNA, transporting molecules in and out of cells

Bodily Systems and Nutrient Transport
- Digestive system takes in nutrients
- Respiratory system takes in oxygen for ATP formation
- Circulatory system transports nutrients and oxygen to body cells
- Urinary, respiratory and integumentary system transfer metabolic waste to the external environment

Anabolic Metabolism(Small→ Big): Small molecule gets made into larger molecules using energy
Catabolic Metabolism(Big→ Small): Large molecule gets broken down to produce lots of energy and smaller molecules

Overview of GI Tract:

1. **Mouth**
- Mechanical Digestion

2. **Liver:**
- Secretes bile to digest lipids
- Stores, breaks down and transports nutrients

3. **Gallbladder**
- Store bile for lipid digestion

4. **Small Intestine**
- Some nutrient absorption
- Breaking down of nutrients

5. **Salivary Glands**
- Lubricating food, and breaking down food
- Contains salivary amylase which breaks down carbohydrates

6. **Pharynx**
- Transports food down to esophagus

7. **Esophagus**
- Transports food down via peristalsis

8. **Large Intestine**
- Dehydration and compaction of indigestible materials in preparation for elimination

9. **Stomach**
- Chemical breakdown of materials via acid and enzymes
- Mechanical breakdown through muscular contractions

10. **Pancreas**
- Creates hormones for absorption and breaking down

Jan 20 Lecture

Constipation: Stools are infrequent and hard to pass
- **How infrequent?:** Anywhere between once a day and once every week
- **Due To:**
    - Stress, Travel, aging, drugs, nerve disorders, lack of exercise, low fibre intake, low fluid intake

Diarrhea
- **Possible causes:**
    - Bacteria, viruses, parasites, stress, medications, food intolerances, irritable bowel syndrome, celiac disease
- Causes dehydration and loss of electrolytes
- Probiotics help treat diarrhea

Probiotics
- Foods that contain live bacteria or yeasts
- Decreases duration of diarrhea
- **How do they work:**
    - Increases # of commensals (good bacteria)
    - Help fight harmful bacteria and viruses, among others
        - Make short chain fatty acids, improving GI health
        - Help fight bad bacteria, viruses ect.

Vomiting (Emesis)
- Ejection of stomach contents through the mouth
- Protective reflex against toxins
- Can result in electrolyte imbalance and dehydration

Heartburn(Gastroesophageal Reflux Disease (GERD)
- Reflux of acidic contents from stomach into the esophagus
- Diagnosed as GERD if occurring twice per week
- **Why it burns:** When acidic contents from stomach come back up to the esophagus, it causes esophagus to burn

- **Causes:**
  - Damaged Esophageal sphincter: Genetics, physical damage
  - Extra stomach pressure: Pregnancy, Hiatal Hernia, overweight/obesity

Hiatal Hernia
- Where part of the stomach is raised up to the diaphragm and into your esophagus
- Hernia is when the stomach is protruding out from the diaphragm
  - Opening a lot larger than normal

Intolerances and Allergies
- **Intolerance:** Inability to properly digest a food or nutrient
- **Allergy:** Food causes an allergic reaction

Lactose Intolerance
- Due to deficiency of lactase enzyme that breaks down lactose
  - Enzyme located in the brush border of small intestine

Celiac Disease
- An autoimmune disease
- Gluten stimulates an immune response
  - Immune cells attack the brush border, located in the small intestine
- **Symptoms:**
  - GI discomfort, Lack of growth(Children), Diarrhea and bloating, Vitamin and mineral deficiencies, Weak bones, Weight loss

Allergie
- Immune response
  - Rashes, hives, swelling, itching
  - Severe: Anaphylactic shock
- Common Food Allergies:
  - Cow's milk, nuts, seeds, eggs, milk, shellfish, soy, wheat, some fruit

Jan 23 Lecture

Carbohydrates
- All made up of sugar molecules
- Found in all plant foods and milk
- Meat, fish, poultry and fats have NO carbs
- Eggs and cheese have small amounts of carbs

Types of Carbs

1. **Simple Carbohydrates (Sugars)**

- One or two sugar molecules. (Monosaccharides and disaccharides)

2. **Complex Carbohydrates**

- Many sugar molecules strung together (*e.g. starch and fibre)*
    - Polysaccharides

The Monosaccharides: Each contain 6 carbons, 12 hydrogen and 6 oxygen

1. **Glucose**

- Circulates in blood and is the most important fuel for the body
- Simplest form of sugar

2. **Fructose**

- Sweeter than glucose
- Found in fruits and vegetables
- Does NOT cause a big rise in blood glucose levels

3. **Galactose**

- Occurs most often as part of lactose
- Often added as sweeteners to processed foods

The Disaccharides

1. **Maltose:** 2 glucose

- Naturally found in beer and used as a food additive

2. **Sucrose:** 1 glucose, 1 fructose

- Table sugar

3. **Lactose:** 1 glucose, 1 galactose

- Milk sugar (less sweet than sucrose)

Starch: Class of polysaccharide

- LONG strings of monosaccharides
    - Straight: amylose
    - Branched: Amylopectin
- Storage form of carbs for plants

Whole Grains Vs. Refined Grains

- Whole or refined grains contain:
    - **Bran layers:** Good source of fibre and vitamins
    - **Germ:** Good source of vegetable oils and vitamin E
    - **Endosperm:** Contains starch and some protein
    - **Refined Grains:** *e.g. corn flakes*: made largely from the endosperm and are mostly starch
        - May be enriched with thiamin, riboflavin, niacin, and iron

Fibre: Class of polysaccharide

- Often made of glucose but can be any monosaccharide
- Provide structure to the leaves, stems and seeds and plants
- CANNOT be digested by enzymes our body produces
- **Types of Fibre:**

1. **Soluble:**

- Absorb water
- Often used as gelling agents/thickeners
- Pectins, gums, mucilages
- Digested by bacteria in the large Intestine

2. **Insoluble**

- Don't absorb water
- Give stiff structure to plants
- Cellulose, hemicellulose, lignin
- Found in whole grains, wheat, and rye bran, fruit skins and seeds
- Unable to be digested by bacteria, excreted out of the body
- Helps with constipation

Carbohydrate Digestion

- **Mouth:** Starts in the mouth via salivary amylase
  - Breaks down starch into glucose and smaller polysaccharides
- **Stomach:** NO carb digestion in the stomach
- **Small intestine:**
  - *Pancreatic Amylase:* Starch → Glucose + Maltose
  - *Sucrase:* Sucrose → Glucose + Fructose
  - *Maltase:* Maltose→ Glucose + Glucose
  - *Lactase:* Lactose → Glucose + Galactose

Carbohydrate Absorption

- Monosaccharide → Intestinal Cells → Blood
- Blood delivers carbs to the liver
  - All monosaccharides transferred through the hepatic portal system
- Glucose can be used for energy or stored as glycogen in the liver

Glycogen

- Glucose stored as glycogen
- Found in liver and muscles
- NOT a dietary source of carbohydrate

Cellular Respiration

- Occurs within each cells, via mitochondria
- Glucose metabolized to produce ATP

- Glycolysis splits glucose(6-carbon molecule) into 2 molecules of pyruvate (3-carbon molecule)

Jan 25 Lecture

Why We Need Carbs

- Carbs break down into glucose, which provide the quickest source of energy
  - Red blood cells, brain and nerve cells rely on glucose
  - Body regulates blood sugar levels to make sure we have enough glucose for energy
    - Regulated by insulin and glucagon

Role of Carbs

- Glucose and glycogen provide energy for exercise
- Allows for the breakdown of fat
  - Body can't metabolize fat without a little bit of carbohydrate to get it started
- **Prevents ketosis**
  - If you eat too little carbs, there is not enough energy to feed brain and red blood cells
  - Ketone bodies then made out of fat
- Need 130g of carbs a day for our bodies to function

"Hitting the Wall"

- Condition caused by depletion of glucose stores in the liver and muscle
- Characterized by sudden onset of fatigue
- Often occurs during endurance events

What Do Carbs Do?

- Spare protein
  - If body is low on glucose, muscle can be converted into glucose via gluconeogenesis
  - Not ideal because body needs protein for other important bodily functions.

Diabetes History

- Too much glucose in the blood
- First described in 1552 BC
  - In egypt: Great emptying of urine
  - In India: Sweet urine that attracted ants
- In 250 BC the greeks described it as the "melting down of flesh and limbs into urine."

Canadian Diabetes Research

- Discovered in late 1700s and 1800s
  - Diets of meat or starvation diets with little carbs kept people with diabetes from dying
  - Removing pancreata of dogs caused diabetes
- 1921: Banting and Best discovered insulin
  - "CURE" for diabetes

Insulin

- Hormone secreted into the blood by the pancreas
- Work with glucagon to control blood glucose levels
- Insulin allows glucose to be brought into a cell and used for energy
  - Insulin acts as a "Gatekeeper" into the cells
- Peptide hormone
- Secreted by the beta cells in the pancreas

Glucagon

- Peptide hormone
- Secreted by alpha cells of pancreas
- Works to raise the concentration of glucose in the body
  - Pancreas secretes glucagon, which then signals for glycogen from the liver to be broken down for energy allowing glucose to enter our bloodstream

Type 1 Diabetes

- 10% of cases in Canada
- Autoimmune disease
- Immune system attacks cells of the pancreas, preventing insulin from being produced
  - Therefore glucose cannot be brought into cells

Type 2 Diabetes

- 90% of cases in Canada
- Insulin resistant and not enough insulin
- Being diagnosed far more often in children
- **What happens?**
  - Pancreas is releasing insulin, but it doesn't seem to be enough OR body cells do not recognize it
  - Only limited amounts of glucose is getting into the cells, leaving most of it floating in our bloodstreams
- Caused by diet and lifestyle
  - Obesity, low fibre, high simple carbohydrates, high fat diets, low physical activity

Symptoms of Diabetes

- Blurred vision
- Thirsty
- Lose weight (Type 1)
- Fatigue(Cells aren't getting any energy)
- Frequent urination
- May not show any symptoms
- Ketoacidosis (Type 1)

Long Term Consequences

- Damages blood vessels and nerves
- **Leads to atherosclerosis (*Plaque buildup in arteries)***
  - Increased risk of heart disease
  - Leading cause of blindness
  - Leading cause of kidney disease/failure
- **Damages peripheral nerves**
  - Damages fingers and toes
  - Hurt foot, don't notice, gets infected (*sugar coats nerves, causing them to not even function)*
  - Leading cause of amputations
- Higher risk for dementia

Jan 27 Lecture

Glycemic Index

- GI is a measure of carbohydrate quality
- Classifies dietary carbohydrates based on a scale of 0-100
  - Low GI = <55
  - Medium GI = 56-69
  - High GI = >70
- Low GI foods result in gradual increase of blood glucose levels after meals

GI and Health

- Low GI helps control blood sugar
- Low GI foods may help control appetite
  - Lower obesity
- Low GI foods may increase sensitivity to insulin and prevent diabetes
- Typically high-fibre foods are low GI

Meeting Carbohydrate Needs

- AMDR: 45-65% of calories should come from carbs
- For a 2000 kcal diet
  - 45% of 2000 kcal= 900 kcal/4g per kcal = 225g CHO
  - 65% of 2000 kcal= 1300 kcal/4g per kcal = 325g CHO
- Carbohydrates also have an RDA of 130 of carbohydrates per day for adults and children
- **If not enough CHO is consumed:**
  - Insufficient amount to fuel brain
    - Brain cells rely on glucose
    - Therefore, brain seeks other alternatives for energy
  - Result is ketosis
    - Breakdown of fat to produce ketone bodies for energy
    - Ketone bodies: water soluble, organic compounds which provide energy to the brain when we fast or consume very little amount of CHO

Ketosis and Low Carb Diets

- Help people lose weight in the short-term
- Side effects:
  - Constipation
  - Bad breath
  - High levels of fat in the blood
  - Decreased athletic performance
  - Mildly acidic blood
  - Hormone imbalances: Menstrual irregularities, kidney stones, weak bones, stunted growth in children

Benefits of High Fibre Diets

- Lower risk of :
  - Constipation
  - Obesity(Fibre is filling)
  - Diabetes(Fibre slows down CHO digestion)
  - Diverticulosis (Pouches form in the large intestine)
  - Colon cancer
  - Hemorrhoids

Fibre Requirements

- **Women(19-50):** Need 25g per day
- **Men(19-50):** Need 38g per day
- On average, Canadians get 14g per day

High Fibre Foods

- Beans/legumes
- Whole grains
    - Bran based cereals or other products
    - Brown or whole grain rice
- Fruits & Vegetables (With skin on)
- Seeds/nuts
- Dried fruit

Natural Sugars

- Found in milk products, fruits and vegetables
    - Sugars in fruit (Fructose, Sucrose, glucose)
    - Sugars in milk (Lactose)
- Natural sugars related to better health

Added Sugars

- Added to foods during processing or preparation
    - Table sugar (sucrose)
    - High fructose corn syrup (fructose and glucose_
    - Honey (Fructose)
    - Molasses
    - Glucose
    - Dextrose

Effect on Health

- Considered “empty calories”
- High added sugar consumption related to:
    - Low quality diet
    - Obesity
    - Low insulin sensitivity
    - Dental cavities

Sugar Requirements

- DRIs say <25% of kcals should come from sugar
- World Health Organization says <5%
- For 2000 kcal diet
    - <25% = 500 kcal/4 kcal per g CHO = 125g sugars
    - <5% = 100 kcal/4 kcal per g CHO = 25g sugars

Sweeteners (Artificial Sugar or Non-nutritive sweetener)

- Provide little to no energy
    - Added to products
- Added to products labelled “Sugar free”

Food Sweeteners

1. **Sugar Alcohols(E.g. sorbitol)-** Often in sugar-free gum
    - Too much causes GI to get upset
2. **Cyclamate("Sugar Twin")-** Use only as a table-top sweetener
3. **Aspartame-** Made of amino acids

- Found in MANY sugar-free foods
- Harmful in large quantities

4. **Acesulfame Potassium(Ace-K)-** OFten in sugar-free or diet products

- Up to 200 times more sweet than sucrose

5. **Sucralose(Splenda)-**Very safe
6. **Stevia-** New sweetener in Canada

Sample Midterm Questions:

Which of the following provides energy but is not a nutrient?

a. **Alcohol**
b. carbohydrate,
c. fat
d. protein

In which part of the body is there chemical digestion of all macronutrients? (Carbs, protein and fat)

a. Mouth
b. Stomach
c. **Small intestine**
d. Large intestine

Which statement correctly defines aspartame?

a. Artificial sweetener
b. Composed of amino acids
c. Often found in soda or soft drinks
d. **All of the above**

1. **In Addition to the # of carbons in their carbon chain, what is another way to commonly distinguish between different unsaturated fatty acids**

a. By ratio of carbon to hydrogen atoms in the chain
b. Solubility in oil
c. The types and locations of bonds between the carbons
d. The number of acid groups in the fatty acids chain

2. **What best describes food fats consisting mainly of fatty acids with single bonds?**

a. Solid at room temperature
b. Soluble in water
c. Liquid at room temperature
d. Gaseous at room temperature

3. **Fish oils are a good dietary source of what type of fatty acids**

a. Emulsifiers
b. Tropical oils
c. Omega-3 fatty acids
d. Trans fatty acids

4. **Alcohol provides how many kcal/g?**

a. 4
b. 7
c. 9
d. 12

5. **Which does NOT occur as a consequence of the metabolism of alcohol by ADH?**

a. The production of acetyl CoA
b. The buildup of NADH
c. The speeding up of the citric acid cycle
d. The synthesis of fatty acids and their accumulation in the liver

6. **What happens when a protein is heated**

a. Transamination
b. Deamination
c. **Denaturation**
d. All of the above

7. **When is the process of copying the information in DNA to a molecule of mRNA**

a. Translation
b. Denaturation
c. Transamination
d. Transcription

8. **Which of the following functions is performed by proteins in the body?**
a. Acid base balance (pH)
b. Fluid balance
c. Catalysts (enzymes)
d. All of the above

9. **Most body fat is stored in which cells?**
a. Adipocytes
b. Beta-cells
c. Red blood cells
d. Leptin cells

10. **For which of the following would the recommended energy intake, per unit of body weight be the lowest?**
a. 2-month old infant
b. 80-year old female
c. 26-year old women, in third trimester of pregnancy
d. 15-year old male

Focus on:
- Complete vs. incomplete proteins
- ENERGY out is more complex(thermic effect of food)
- How much protein is enough (0.8g per kg body weight)
- What are amino acids
- Essential amino acids
- Transamination
- Cardiovascular disease
- Atherosclerosis
- Types of lipoprotein

Feb 3 Lecture: Lipids

Lipids: Large class of inorganic molecules
- Includes: Fatty acids, triglycerides, phospholipids and sterols
- Lipids contribute to texture, taste and aroma of foods
- 1g of lipid yields 9 kcal of energy
- Not soluble in water- Hydrophobic

Polarity: Whether something has a charge or not
- Polarity affects solubility in water
- Polar substances dissolve in water
    - H_2O is polar, so polar dissolves polar

Lipids We Eat

1. **Triglycerides:** 95% of dietary lipids

- Eat triglycerides and store our body fat as tri's
- Made of:
    - 1 glycerol molecule ("the backbone")
    - With 3 fatty acids- Long hydrophobic chains of carbon and hydrogen

2. **Phospholipids:** Makes up cell membranes

- Sub-group of lipids
- Lipids are attached to a phosphate group
- Phospholipids from lipid bilayer in the cell membrane
    - Help with;
    - Maintenance of membrane integrity, regulates transportation in and out of cell
    - Dietary sources are; egg yolk, fish, milk, beef

3. **Sterols:** Cholesterol is the main one

- 90% of cholesterol is found in our cell membranes
- Make up hormones
    - Active role in monitoring estrogen and testosterone levels

Fatty Acids: Give triglycerides their properties
- Fatty acids can differ in length, saturation and shape
- Different shaped fatty acids affect triglyceride properties

Lengths of Fatty Acids
- **Short:** Fewer than 8 atoms
- **Medium:** 8-12 carbons
- **Long:** 12 or more carbons

- **Length Affects:**
  - How it's digested and metabolized in body
  - Function in the body
  - Structure before/when you eat it
    - *E.g. lauric Acid*

Fatty Acid Saturation

- **Saturated(SFA)=** NO double bonds
  - Most common is palmitic and stearic acid(only found in animal foods like meat and dairy)
- **Unsaturated=** Have double bonds
  - **Monounsaturated(MUFA):** 1 double bond
  - **Polyunsaturated(PUFA):** 2 or more double bonds

Saturation Effects

- **Properties at Room Temp:**
  - Solid or liquid depending on temp.
    - **Saturated:** Solid at room temp
    - **Unsaturated:** Liquid at room temp
  - How the body processes them
  - The effect on metabolism of nutrients

Saturated Fats: Animal fats, tropical oils
Monounsaturated: Olive oil, canola oil (plant based)- Most common is oleic oil
Polyunsaturated: Soybean oil, safflower oil, corn oil, fish, nuts and seeds (Plant based)

Double Bond Location

- Carbon-Carbon bond (C-C)
  - The omega(w) or (CH_3) end
- **Omega-3 Fatty Acids:** Double bond at the 3rd and 4th c's from the (w) or (CH_3) end
- **Omega-6 Fatty Acids:** Double bond at the 6th and 7th c's from the (w) or (CH_3) end
- Location of double bond affects how our bodies metabolize the fat

The Shape

- **Cis:** H molecules on the same side
  - Most fatty acids are cis
- **Trans:** H molecules on opposite sides
  - Produced via hydrogenation- mixing of $H_{2(g)}$ with liquid oil (makes trans fat)

Naming Fatty Acids

- Given common name and numerical notations
- *E.g. 18:2 w-3*
- 18= # of carbons
- 2= # of double bonds
- 3= where last bond is located

Feb 6 Lecture: Lipids Continued

Fat Digestion: Throughout GI tract

- **Mouth:** Chewing and lingual lipase
- **Stomach:** Churning shapes fat into small droplets, gastric lipase
- **Small Intestine:** Most of digestion occurs here
    - Bile emulsifies fat into small droplets
    - Pancreatic lipase breaks fatty acids off of glycerol
    - Free's fatty acids and monoglycerides

Fat Absorption

- Bile surrounds the fatty cell(micelle), allowing its absorption
- Bile makes the micelle water soluble for fatty acids can be transferred through the blood

Lipoprotein:

- Help with transportation of fatty acids and fat soluble vitamins through blood
- Go through the lymphatic system
- **Structure:** Made of various fats; Cholesterol, triglycerides, phospholipids and protein
    - Fatty acid tails on interior section (water insoluble)
    - Phospholipid heads on outside (water soluble, mix well with blood)

Types of Lipoproteins

1. **Chylomicrons:** Made in cells of small intestine
- Carries dietary fat to the liver and the rest of the body for burning or storage

2. **VLDL:** Very low density lipoprotein; Made in liver
- Turns into LDL (low density lipoprotein)
3. **HDL:** High density Lipoprotein; Made in liver
- Transports fat to and from liver
- HDL is helpful to body, LDL is not

Lipid Functions

1. **Structure and Lubrication**
- Provides insulation
- Protects bones, joints and organs
- Very important for making and protecting nervous system

- Oil lubricates myelin sheath

2. **Cell Structure:** lipids make up cell membranes
- **Phospholipids:** keep membranes fluid

3. **Regulation of Body Processes**
- Vitamin absorption (A, D, E, K)
- Making hormones (e.g. sex hormones)
    - Hormones are important body regulators
- Blood pressure regulation
- Regulating blood clotting

4. **Energy Storage**
- ATP production for energy
- 1g of fat provides 9 kcal
- Cells burn fat at rest and during exercise
- Energy storage
- Triglycerides stored in adipose tissue (fat cells)
- Fatty acids used for energy when carbs are not present

Essential Fatty Acids
- **Linoleic Acid (omega-6):** 18:2 w-6
- **Alpha(a) Linolenic Acid (omega-3):** 18:3 w-3
    - Reduces inflammation, linked to brain health
- Necessary for: Regulating blood clotting, regulating inflammation, normal brain development.

Getting Essential Fatty Acids
- **Linoleic Acid:** Oils, margarine, nuts and seeds
- **Alpha Linoleic Acid:** Canola, flax , soy, fatty fish, omega eggs

How Much Fat Do We Need?
- For healthy adult, use the AMDR for fat: 20-35% of calories from fat

Feb 8 Lecture: Lipids and Disease

Cardiovascular Disease (CVD)
- Disease of the heart and blood vessels
- Includes heart disease, high blood pressure, heart attacks, strokes
- 30% of all deaths in Canada from CVD
- 2nd leading cause of death

Atherosclerosis: Leading cause of death in Canadians

- An inflammatory response to injury within the artery walls
- Lipids and fibrous material are deposited within the artery walls due to action of immune system
- Reduces elasticity of blood vessels and eventually blocks blood flow
    - Blockage of blood flow to heart leads to heart attack
    - Blockage of blood flow to brain leads to stroke

Fats and Heart Disease

- Saturated and trans fats increase risk of heart disease
- Omega 3 and omega 6 fats decrease risk(polyunsaturated)
    - 3 and 6 affect the type and amount of lipoproteins, triglycerides and cholesterol in the blood

VLDL and LDL

- Chylomicron→ VLDL→ LDL & HDL
- Transporting lipids to cells around the body

HDL

- Removing lipids from cells around the body so that they can be excreted

Foods that Affect Blood Lipids

Factor	**VLDL(bad)**	**HDL(good)**	**LDL (bad)**
Saturated Fat	/	/	Increase
Trans Fat	/	Decrease	Increase
Added Sugars	Increase (triglycerides)	/	/
Mufa	/	/	Decrease
Omega-3 Pufa	Decrease	Increase	/
Exercise	Decrease	Increase	/

Omega-3 Polyunsaturated Fats

- Regulatory molecules- Affect lipoproteins and cell function
- Helps infant brain development, prevents cognitive decline with aging, decrease risk of CVD
- Improve blood lipid levels, decrease blood clotting, resolves inflammation

Omega 3 Fats: Found in fish, flaxseed and canola, soy and walnut oils

- Long chain omega 3 fats are the most heart healthy

- Reducing inflammation

Types of Long Chain Omega-3

- **EPA (**20:5)
- **DHA (**22:6)
- Flaxseed, canola, soy and walnut oils contain ALA which can be converted to EPA and DHA

- Too much Omega 3 can lead to possible immune system malfunction and weight gain

Feb 10 Lecture: Coffee

Coffee: A beverage made from the seeds of the coffee plant (coffea arabica)

- Contains Caffeine, phenolic substances(mildly acidic) and antioxidants
- **Ways to make Coffee:**

1. **Boiling (Decoration)**
2. **Infusion (Steeping or French press)**
3. **Drip Brewing**
4. **Pressurized Percolation (Espresso)**

Health Effects of Caffeine

1. **Hypertension:** Caffeine increases blood pressure for ~3hrs
2. **Bone Health:** Caffeine prevents calcium absorption
3. **Pregnancy:** Caffeine crosses the placenta, increasing risk of low birth weight and preterm birth
4. **Other:** May increase or decrease anxiety, depression

- Help prevent parkinson's
- Affects sleep pattern
- Improves sports performance

Caffeine Recommendation

- **Women:** <300mg per day
- **Other Adults:** <400mg per day (about 3-4 cups)

Kahweol and Cafestol: Oily compounds in coffee

- Increase LDL levels
- Mostly found in boiled or french press coffee, dark roast has more oils
- Filters keep oily substance out

Antioxidants: Reverse oxidation and fix damage

- **Oxidation:** when electrons are taken off atoms, causing free radicals
- Antioxidants in coffee include:
    - Quinines, flavonoids, melanoidins

- Also contains potassium, niacin and magnesium

Tea: Soaked leaves of the tea plant **Camellia Sinensis**
- Tea contains caffeine, antioxidants and other good stuff
- **Black Tea:** Leaves are picked, oxidized/fermented and dried
- **Green Tea:** Leaves are not oxidized, heated to prevent oxidation either through roasting or pan frying
- **White Tea:** Leaves are not oxidized and dried in sun
- **Oolong Tea:** Withered in the sun and oxidized
- **Rooibos Tea:** Made from different plant, aspalathus linearis(NO caffeine)
- **Herbal Tea:** Made from infusions of different plants/flowers

Antioxidants in Tea
- **Catechin:** A polyphenol
  - Protects against oxidative stress
  - Highest content in white and black teas(black tea contains a lot)
- **L-Theanine:** A non-protein amino acid derivative
  - Has calming effect
  - Helps strengthen the immune system

Tannins in Tea: Can bind to non-heme iron in the digestive tract to prevent absorption
- Too much tea can cause iron deficiency

Health Effects of Tea
- **Improved cardiovascular health:** Decrease blood pressure by protecting health of blood vessels
- **Weight Maintenance with Green Tea:** Small increase in energy expenditure(5%) and fat burning
- **Increase bone mass**
- **Prevents cavities**: Fluoride in tea
- **Improve immune system and mental activity**

Energy Drinks(Redbull, Monster)
- Caffeine level can range between 50-200mg per can
  - Taken on an empty stomach

Feb 13 Lecture: Alcohol

Alcohol: Any molecule with hydroxyl group on the end of the structure (OH)
- 7 kcal per gram of alcohol

Fermentation: Process of creating alcohol

- Yeast is used to break down sugar into alcohol (specifically ethanol)

Making Wine

1. **Grapes are crushed**
2. **Pulp is combined with yeast (1-2 weeks)**
3. **Secondary fermentation/aging:** Wine is stored in barrels to slowly ferment and mature (3-6 months)

- **White Wine:** Crushed grapes, but skins removed
- **Fortified Wine:** Higher alcohol content
- More sugar + fermentation= more alcohol
- **Sparkling Wine:** Fermentation causes CO_2 to be captured

Making Beer

- Malted barley, water and yeast and hops
- Malting: Barley is soaked in water until the sprouting, then the grain is dried
  - During germination starch→ maltose
- Hops add flavour and provide stability (zesty, bitter, citric)
- Yeast ferments maltose into alcohol (2-4 weeks)

Digestion of Alcohol

- Absorbed in the small I and stomach
- No digestion required, only absorption into bloodstream

Metabolizing of Alcohol

1. **Alcohol dehydrogenase and acetaldehyde dehydrogenase in the liver**

- Alcohol → Acetaldehyde → Acetate
- Primary pathway when moderate amounts are consumed

2. **MEOS (Microsomal Ethanol Oxidizing System):** 2nd pathway to metabolize

- Requires O_2 and the input of ATP to break down alcohol
- Especially important for longer term, heavy drinkers
- System forms acetaldehyde, water and reactive oxygen
- **Reactive Oxygen Molecules:**
  - Compounds that react with components in cells such as protein, DNA and lipids in a way that causes them to be oxidized
- Rate of ADH breaks down alcohol is consistent, but MEOS activity increases when more alcohol is consumed

3. **10% of blood alcohol is lost in the breath and urine:** Why people reek of alcohol

What is One Drink?

- 12 oz beer

- 10 oz wine cooler
- 1 ½ oz hard liquor
- 5 oz wine

Alcohol Moderation

- **Women:** Less than 10 drinks per week, no more than 2 drinks in one day
- **Men:** Less than 15 drinks per week, no more than 3 drinks in one day
    - One special occasions, no more than 4 drinks

Alcohol and Central Nervous System

Number of Drinks	Blood Alcohol (%)	Effect on Central Nervous System
2	0.05	Impaired judgment, altered mood, relaxed inhibitions and tensions, increased heart rate
4	0.10	Impaired coordination, delayed reaction time, impaired peripheral vision
6	0.15	Unrestrained behaviour, slurred speech, blurred vision, staggered gait
8	0.20	Double vision, inability to walk, lethargy
12	0.30	Stupor, confusion, coma
>14	0.35-0.60	Unconsciousness, shock, coma, death

Alcoholism

- 5-6 drinks per day for 10 years causes the cirrhosis of the liver (~20% of people)
- Vitamin and mineral deficiencies
    - Vitamin B and antioxidants get depleted
    - **Wernicke-Korsakoff Syndrome:** Alcohol induced dementia caused by thiamine deficiency

Fetal Alcohol Spectrum Disorder: Caused by drinking alcohol during pregnancy

- Stunting, learning difficulties, vision and hearing impairments, physical deformities

Red Wine

- **Protects bones:** Moderate red wine consumption and bone maintenance in older women
- **Mental Function:** Reduced risk of cognitive decline with red wine consumption
- Contains polyphenols including resveratrol- an antioxidant with roles in cancer prevention and reducing damage to cells by free radicals

Feb 15 Lecture: Proteins

- Large molecules with many functions
- Contain carbon, hydrogen, oxygen and nitrogen
- Made of long string amino acids

Amino Acids

- Contain hydrogen group, amino group(NH_2), acid group(=O, OH), side chain is unique to each amino acid
- 20 amino acids, 9 are essential

Transamination: Process by which our bodies make non-essential amino acids.

- Amino groups get transferred onto another carbon molecule

Peptide Bond: Bond occurring between an amino group and the acid group

- Bond forms a long amino acid chain

# of Amino Acids in Proteins

- **2:** dipeptide
- **3:** tripeptide
- **A few:** oligopeptides
- **A lot:** polypeptides

Protein Shape: Different amino acids in the chain are attracted to each other, causing complex folding of the molecule

- Folding determines the shape- which determines function

Genetic Mutation: Causes proteins that don't work

- One protein may contain several polypeptide chains
- *E.g. Sickle Cell Anemia*

Protein Digestion

- **Mouth:** Mechanical digestion
- **Stomach:** Acid denatures and unravels protein
  - Pepsin breaks long proteins into smaller chunks and single amino acids
  - Denatured proteins are nonfunctional
- **Small Intestine:** Release of enzymes **trypsin and chymotrypsin** from pancreas break down remaining proteins into oligopeptides, tripeptides, dipeptides and amino acids
- Free amino acids, di- and tripeptides can then be absorbed into intestinal cells
- The cells break di and tripeptides into AAs

1. Mechanical digestion in mouth

2. Stomach, pepsin and HCl denture proteins
3. Small intestine breaks proteins down even further (via trypsin and chymotrypsin as well as intestinal cells)
4. Once they are in intestinal cells, they move into the bloodstream and go to the liver(processing centre). Liver then decides where to send them

Functions of Proteins

- Energy production
- Synthesize glucose or fatty acids
- Synthesize non protein molecule that contain nitrogen
- Dietary protein is used to make body protein
- **Protein Turnover:** old cells are broken down and we save the amino acids of proteins to use again

How Protein is Made

- DNA tells body how to string amino acids together to make proteins
- **Transcription:** RNA message
- **Translation:** Creating protein from RNA message

1. In the nucleus, the code for protein is copied or transcribed from the DNA gene into a molecule of messenger RNA (mRNA)
2. **Transcription:** The mRNA takes the genetic information from the nucleus to structures called ribosomes in the cytosol, where proteins are made
3. **Translation:** In the cytosol, transfer RNA (tRNA) reads the genetic code and delivers the needed amino acid to the ribosome to form a polypeptide chain

Protein in the Body

- Provide structure to muscle, skin, bones, organs, blood cells and tendons
- **Enzymes:** Allow chemical reactions to happen
- **Transport Proteins into cell membrane via;**
    - Facilitated diffusion and active transport
- **Transport proteins within blood circulation**
    - **Albumin:** Transports nutrients such as calcium, zinc and vitamin b6
    - Lipoproteins transport proteins in blood
- **Contractile Proteins**
    - **Actin & Myosin:** Proteins in muscle that allow them to contract
- **Protein Hormones**: these include; Glucagon, insulin, prolactin(milk production), gastrin(stomach)
- **Maintains fluid balance**: specific proteins help maintain fluid content circulating in our blood
    - Fluids are attracted to protein(simple diffusion)
    - Balanced concentrations of protein are needed between the insides and outsides of cells and in the blood (intra/extra cellular fluid)
    - If not- swelling of tissues occurs

- **Maintains Immune System**
  - **Antibodies:** Proteins that destroy invaders (bacteria, viruses)
- **Acid-Base Balance:** Some proteins are buffers, and help the body maintain constant pH
- **Provide Energy:**
  - If you get rid of the amino acid group you can:
    - Burn the acid group for energy
    - Turn acid group into fat
    - Turn acid group into glucose

Removing Nitrogen

- Protein deamination results in ammonia
- Nitrogen is toxic
- Liver turns ammonia into urea

1. Amino group is removed by deamination
2. Deamination of some amino acids produces 3-carbon molecule that be used to synthesize glucose via gluconeogenesis or be used to synthesize fatty acids
3. Deamination of some amino acids results in 2-carbon molecules that form acetyl-CoA, which can enter the citric acid cycle or be used to synthesize fatty acids
4. Deamination of some amino acids forms molecules that are intermediates in the citric acid cycle
5. High-energy electrons from the breakdown of amino acids are transferred to the ETC where energy is trapped and used to produce ATP and water

Feb 17 Lecture: Proteins Continued

AMDR:

Age Group	**% From Calories**		
	Carbs	**Proteins**	**Fats**
1-3 Yrs	45-65%	5-20%	30-40%
4-18 Yrs		10-30%	25-35%
19+ Yrs		10-35%	20-35%

Lack of Protein

- Sacrifices in the body are made, such as;
  - Muscle is broken down for amino acids
  - Enzymes are broken down
  - Impaired cell function, nutrient transport and fluid balance

Marasmus and Kwashiorkor

1. **Marasmus:** Severe protein energy malnutrition

- Chronic condition
- Low in protein, calories, carbs, fat, vitamins and minerals
- **Emaciation:** Slowly starving to death, common with Marasmus
    - Body fat stores are used for energy, body proteins are used for energy
    - Results in stunted growth, dehydration, increased risk of infections and heart failure
    - Known as **cachexia** in children in Canada

2. **Kwashiorkor:** Severe protein malnutrition

- Children with Kwash have hair changes, miserable expression, very underweight and puffed out belly, skin changes and oedema
- Children are weaned from breast milk and are given an adult diet too early
- Stunting in growth
- Skinny legs and big stomach
    - Big stomach caused by excess fluid and fatty liver
    - Low blood proteins causes fluid imbalance, preventing blood proteins from transporting fat

Too Much Protein

- High protein intakes (above 35% kcal) is associated with high saturated fat intake and lower intake of grains, fruits & veggies
- Causes increased risk of heart disease & cancer
- May contribute to bone loss with aging (increase calcium excretion)
- Eating extra protein won't make you jacked

What Happens to Extra Protein

- TUrned into glucose to be burned for energy or to be stored as fat

How Much Protein Is Enough?

- A 60kg (130lb) women needs 48g
- A 80kg (180lb) man needs 64g

Feb 27 Lecture: Vegetarianism and Veganism

Protein Quality: A measure of how efficiently a protein in the diet can be used to make body proteins

- The health of proteins is dependant on:

1. Complete vs incomplete
2. Digestibility of protein

3. Nutrients found in protein food

Complete Protein: Protein that provides all essential amino acids
- Animal products/ animal source, or soy products

Incomplete Protein: Protein that lacks 1 or more essential amino acids
- *E.g. Grains lack isoleucine and lysine, legumes lack methionine and tryptophan*

Protein Complementation: Process of combining proteins from different sources so that they collectively provide all 9 essential amino acids

Vegetarianism

Vegetarian	**Poultry**	**Fish**	**Milk**	**Eggs**	**-Vegetarian**	**Poultry**	**Fish**	**Milk**	**Eggs**
Semi-	X	X	X	X	**Lacto-**			X	
Lacto-ovo-Pesco		X	X	X	**Ovo-**				X
Lacto-Ovo-			X	X	**Flexitarian**	Eats meat occasionally			
Pescatarian		X			**Vegan**	NO animal products			

Why Become Vegetarian
- **Religion:** Hinduism, buddhism
- **Ethical Reasons:** Belief that animal treatment is inhumane
- **Food Safety:** *e.g. Mad cow disease, hormones and antibiotics that are fed to animals*
- **Ecological Reasons:** Meat calories cost more than plant calories in terms of financial and environmental costs
    - Antibiotics, greenhouse gases, forests, transport
- **Health Reasons:** High in fibre, vitamins and minerals and low in sat fat

Obesity
- Normal BMI= 12-24
- Within Canada, BMI >25 on average

Estimated Energy Requirement (EER)
- Energy balance occurs when energy intake = energy expenditure

Basal Metabolic Rate (BMR): Energy needed to maintain our body's resting functions (60-70% of energy expenditure)

- Factors that affect BMR are: lean body mass(the more muscle, the more energy burned) gender, growth, body size, age, stress/injury/illness, low energy diets, thyroid hormones levels

Mar 1 Lecture: Energy Expenditure

Thermal Effect of Food: Energy needed to digestion, absorb, transport and metabolize food

- 10% of energy used to metabolize food

Eating more Kcals than Burning

- Energy stored as:

1. **Triglycerides:** Stored in adipose tissue
2. **Glycogen:** Stored in muscles and liver

- Body generally stores 200-500g of glycogen
- **Amino Acids:** from protein are first to synthesize needed body proteins
- **Carbs:** Used to maintain blood glucose and build glycogen stores
- **Fat:** not used as a source of fuel normally

Direct Calorimetry: Measures amount of heat released by the body

BMI(Body Mass Index):
Healthy Body Weight Chart

Classification	BMI Range	Risk of Health Problems
Underweight	< 18.5	Increased
Normal Weight	18.5-24.9	Lowest
Overweight	25.0-29.9	Increased
Obese Class I	30.0-34.9	High
Obese Class II	35.0-39.9	Very high
Obese Class III	> 40	Extremely high

Child's Percentile	Weight Category
Below 3rd Percentile	Risk for underweight
3rd Percentile to below 85th percentile	Healthy weight
85th to 97th percentile	Overweight
Above the 97th percentile to the 99.9th	Obese

percentile	
Above the 99.9th percentile	Severely obese

Fat Distribution

- **Visceral Adipose Tissue:** Fat around the organs
  - More metabolically active
  - An increase increases risk of disease
  - Apple shape bodies
- **Subcutaneous Adipose Tissue:** Fat under the skin

Waist Circumference

- Measure halfway between ribs and hip bone OR an inch above belly button
- Risk for M > 120 cm (40 inches)
- Risk for F > 88 cm (35 inches)

Multiple Choice Questions:

1. **What is the end of a fatty acid chain containing a methyl group called?**

a. Omega

b. Alpha

c. Delta

d. Beta

2. Identify which substances below are the oily substances found in coffee
3. Quinnes and Flavonoids
4. Kahweol and Cafestol
5. Cafestol and Quinnes
6. Kahweol and Catechin

7. Which Amino Acids are essential in the diet but only under certain conditions
a. Dispense amino acids
b. Conditionally essential amino acids
c. Polypeptides
d. Dipeptides