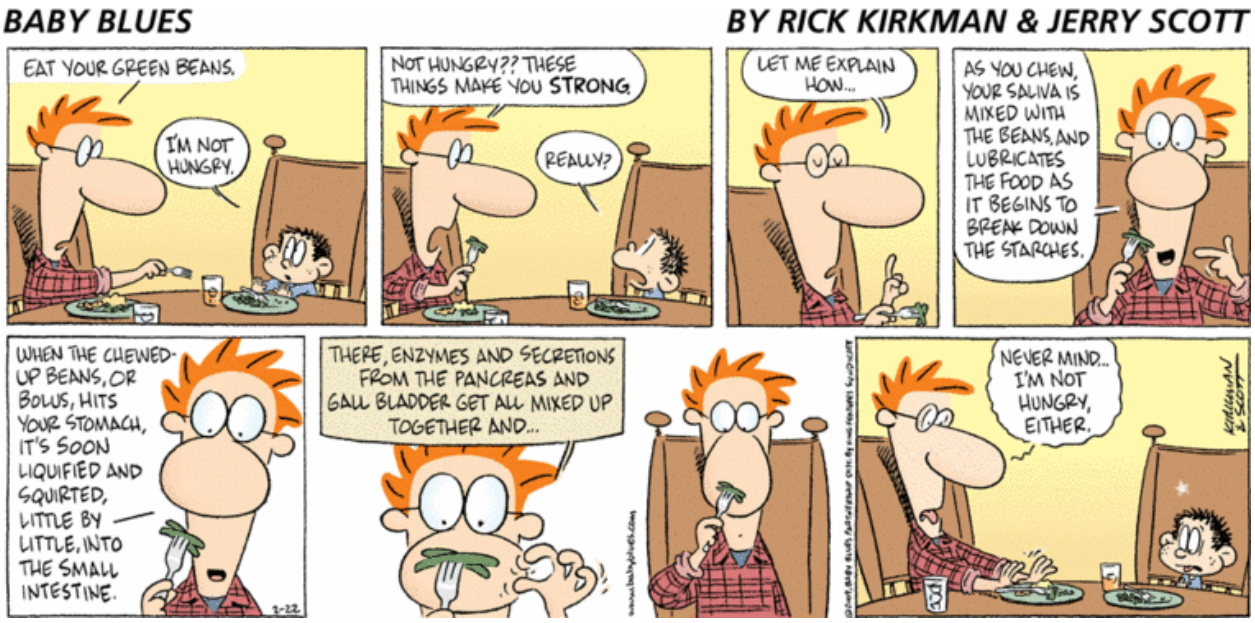
Digestion

Mrs. Kornelsen

Bio30S



My best attempt to draw the digestive system by memory before learning about it in Bio 30S…

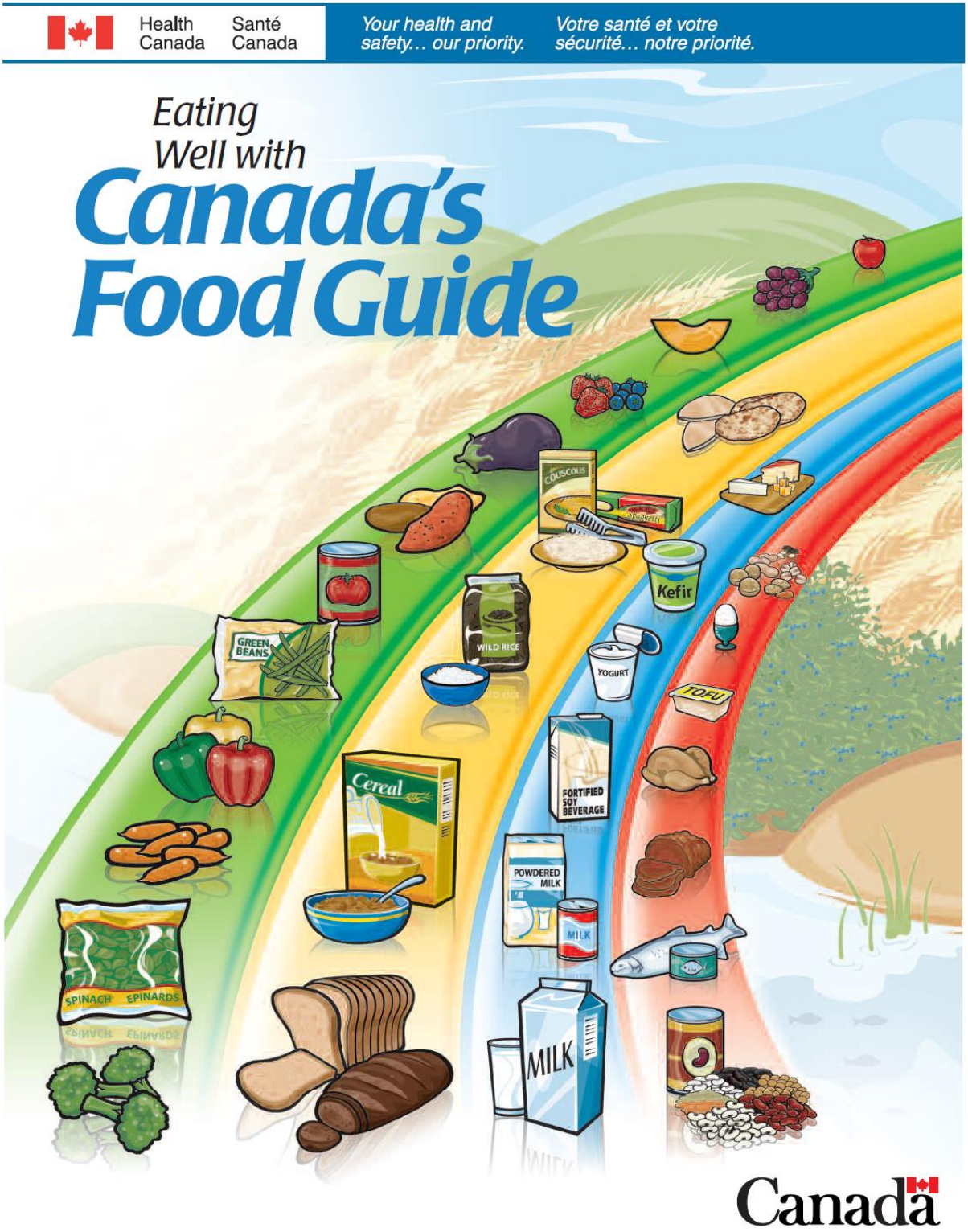
Brainstorming:

Make a list of all the words you can recall that are related to the digestive system.

Learning checklist – Digestion

Learning increases when you have a goal to work towards. Use this checklist as guide to track how well you are grasping the material. In the center column, rate your understand of the topic from 1-5 with 1 being the lowest and 5 being the highest. Be sure to write down any questions you have about the topic in the last column so that you know what you have yet to learn.

Outcomes	Understanding	Questions?
Digestion - Identify major structures and functions of the human digestive system from a diagram, model or specimen. Include: tongue, teeth, salivary glands, epiglottis, esophagus, pharynx, sphincters, stomach, small intestine, large intestine, rectum, anus, appendix, liver, gall bladder, pancreas, uvula		
Introduction to Mechanical and Chemical Digestion - Describe the processes of mechanical digestion that take place at various sites along the alimentary canal. Include: chewing in the mouth, peristalsis along the tract, muscle contractions in the stomach, emulsification by bile in the small intestine		
Identify functions of secretions along the digestive tract. Include: to lubricate, to protect.		
Identify the sites of chemical digestion along the alimentary canal as well as identify the type of nutrient being digested. Include: starch in the mouth; proteins in the stomach, carbohydrates, lipids and proteins in the small intestine.		
Enzymes and Chemical Digestion - Explain the role of enzymes in chemical digestion of nutrients and identify factors that influence their action. *Examples: pH, temperature, coenzymes, inhibitors, surface area…*		
Absorption - Describe the processes of absorption that take place at various sites along the alimentary canal. Include: uptake of nutrients by villi in the small intestine, uptake of water in the large intestine		
The Liver – Describe the homeostatic role of the liver with respect to the regulation of nutrient levels in the blood and nutrient storage. Include: carbohydrate metabolism.		
Nutrition – Describe the functions of the six basic types of nutrients: carbohydrates, lipids, proteins, vitamins, minerals and water.		
Identify dietary sources for each of the six basic types of nutrients		
Wellness – Evaluate personal food intake and related food decisions. *Examples: % daily values of nutrients, portion size, nutrient labels, balance between lifestyle and consumption…*		
Investigate and describe conditions/disorders that affect the digestive process.		
Decision-making – Use the decision-making process to investigate an issue related to digestion and nutrition. *Examples: dietary disorders, diabetes, media influence on body image, fad diets, specialized diets …*		


Health Canada
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Eating Well with
Canada's Food Guide
COUSCOUS
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WILD RICE
YOGURT
TOFU
FORTIFIED SOY BEVERAGE
Cereal
POWDERED MILK
MILK
SPINACH
EPINARDS
MILK
Canada

Recommended Number of Food Guide Servings per Day

	Children			Teens		Adults			
Age in Years	2-3	4-8	9-13	14-18		19-50		51+	
Sex	Girls and Boys			Females	Males	Females	Males	Females	Males
Vegetables and Fruit	4	5	6	7	8	7-8	8-10	7	7
Grain Products	3	4	6	6	7	6-7	8	6	7
Milk and Alternatives	2	2	3-4	3-4	3-4	2	2	3	3
Meat and Alternatives	1	1	1-2	2	3	2	3	2	3

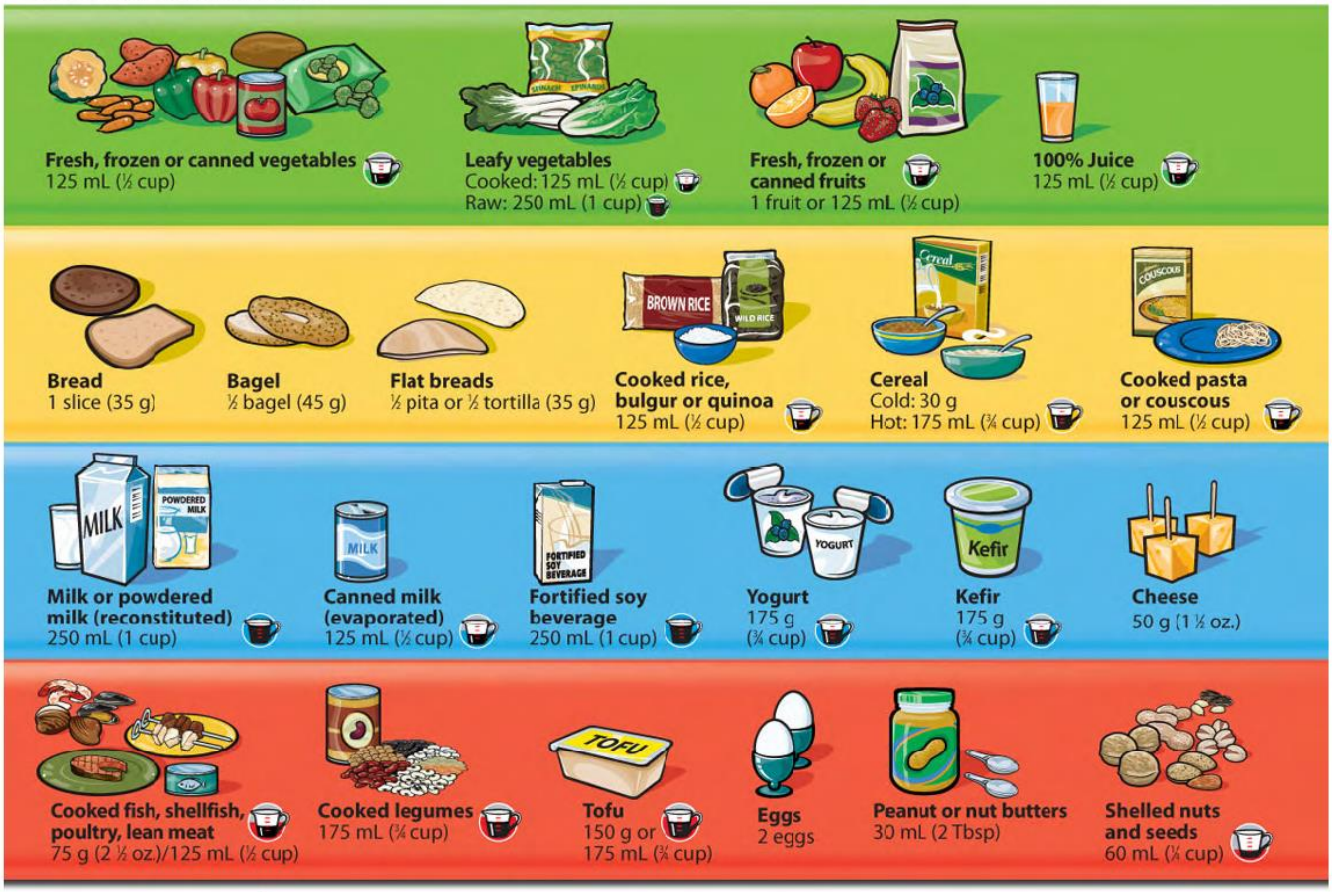
The chart above shows how many Food Guide Servings you need from each of the four food groups every day.

Having the amount and type of food recommended and following the tips in *Canada's Food Guide* will help:

- Meet your needs for vitamins, minerals and other nutrients.
- Reduce your risk of obesity, type 2 diabetes, heart disease, certain types of cancer and osteoporosis.
- Contribute to your overall health and vitality.

What is One Food Guide Serving?

Look at the examples below.



Oils and Fats

- Include a small amount – 30 to 45 mL (2 to 3 Tbsp) – of unsaturated fat each day. This includes oil used for cooking, salad dressings, margarine and mayonnaise.
- Use vegetable oils such as canola, olive and soybean.
- Choose soft margarines that are low in saturated and trans fats.
- Limit butter, hard margarine, lard and shortening.

Make each Food Guide Serving count…

wherever you are – at home, at school, at work or when eating out!

Eat at least one dark green and one orange vegetable each day.

- Go for dark green vegetables such as broccoli, romaine lettuce and spinach.
- Go for orange vegetables such as carrots, sweet potatoes and winter squash.

Choose vegetables and fruit prepared with little or no added fat, sugar or salt.

- Enjoy vegetables steamed, baked or stir-fried instead of deep-fried.

Have vegetables and fruit more often than juice.

Make at least half of your grain products whole grain each day.

- Eat a variety of whole grains such as barley, brown rice, oats, quinoa and wild rice.
- Enjoy whole grain breads, oatmeal or whole wheat pasta.

Choose grain products that are lower in fat, sugar or salt.

- Compare the Nutrition Facts table on labels to make wise choices.
- Enjoy the true taste of grain products. When adding sauces or spreads, use small amounts.

Drink skim, 1%, or 2% milk each day.

- Have 500 mL (2 cups) of milk every day for adequate vitamin D.
- Drink fortified soy beverages if you do not drink milk.

Select lower fat milk alternatives.

- Compare the Nutrition Facts table on yogurts or cheeses to make wise choices.

Have meat alternatives such as beans, lentils and tofu often.

Eat at least two Food Guide Servings of fish each week.*

- Choose fish such as char, herring, mackerel, salmon, sardines and trout.

Select lean meat and alternatives prepared with little or no added fat or salt.

- Trim the visible fat from meats. Remove the skin on poultry.
- Use cooking methods such as roasting, baking or poaching that require little or no added fat.
- If you eat luncheon meats, sausages or prepackaged meats, choose those lower in salt (sodium) and fat.

Enjoy a variety of foods from the four food groups.

Satisfy your thirst with water!

Drink water regularly. It's a calorie-free way to quench your thirst. Drink more water in hot weather or when you are very active.

* Health Canada provides advice for limiting exposure to mercury from certain types of fish. Refer to www.healthcanada.gc.ca for the latest information.

Advice for different ages and stages...

Children

Following *Canada's Food Guide* helps children grow and thrive.

Young children have small appetites and need calories for growth and development.

- Serve small nutritious meals and snacks each day.
- Do not restrict nutritious foods because of their fat content. Offer a variety of foods from the four food groups.
- Most of all... be a good role model.

Women of childbearing age

All women who could become pregnant and those who are pregnant or breastfeeding need a multivitamin containing **folic acid** every day. Pregnant women need to ensure that their multivitamin also contains **iron**. A health care professional can help you find the multivitamin that's right for you.

Pregnant and breastfeeding women need more calories. Include an extra 2 to 3 Food Guide Servings each day.

Here are two examples:

- Have fruit and yogurt for a snack, or
- Have an extra slice of toast at breakfast and an extra glass of milk at supper.

Men and women over 50

The need for **vitamin D** increases after the age of 50.

In addition to following *Canada's Food Guide*, everyone over the age of 50 should take a daily vitamin D supplement of 10 µg (400 IU).

How do I count Food Guide Servings in a meal?

Here is an example:

Vegetable and beef stir-fry with rice, a glass of milk and an apple for dessert		
250 mL (1 cup) mixed broccoli, carrot and sweet red pepper	=	2 **Vegetables and Fruit** Food Guide Servings
75 g (2 ½ oz.) lean beef	=	1 **Meat and Alternatives** Food Guide Serving
250 mL (1 cup) brown rice	=	2 **Grain Products** Food Guide Servings
5 mL (1 tsp) canola oil	=	part of your **Oils and Fats** intake for the day
250 mL (1 cup) 1% milk	=	1 **Milk and Alternatives** Food Guide Serving
1 apple	=	1 **Vegetables and Fruit** Food Guide Serving

Eat well and be active today and every day!

The benefits of eating well and being active include:

- Better overall health.
- Lower risk of disease.
- A healthy body weight.
- Feeling and looking better.
- More energy.
- Stronger muscles and bones.

Be active

To be active every day is a step towards better health and a healthy body weight.

Canada's Physical Activity Guide recommends building 30 to 60 minutes of moderate physical activity into daily life for adults and at least 90 minutes a day for children and youth. You don't have to do it all at once. Add it up in periods of at least 10 minutes at a time for adults and five minutes at a time for children and youth.

Start slowly and build up.

Eat well

Another important step towards better health and a healthy body weight is to follow *Canada's Food Guide* by:

- Eating the recommended amount and type of food each day.
- Limiting foods and beverages high in calories, fat, sugar or salt (sodium) such as cakes and pastries, chocolate and candies, cookies and granola bars, doughnuts and muffins, ice cream and frozen desserts, french fries, potato chips, nachos and other salty snacks, alcohol, fruit flavoured drinks, soft drinks, sports and energy drinks, and sweetened hot or cold drinks.

Read the label

- Compare the Nutrition Facts table on food labels to choose products that contain less fat, saturated fat, trans fat, sugar and sodium.
- Keep in mind that the calories and nutrients listed are for the amount of food found at the top of the Nutrition Facts table.

Nutrition Facts

Per 0 mL (0 g)

Amount		% Daily Value
Calories 0		
Fat 0 g		**0** %
Saturates 0 g		**0** %
+ Trans 0 g		
Cholesterol 0 mg		
Sodium 0 mg		**0** %
Carbohydrate 0 g		**0** %
Fibre 0 g		**0** %
Sugars 0 g		
Protein 0 g		
Vitamin A 0 %	Vitamin C	0 %
Calcium 0 %	Iron	0 %

Limit trans fat

When a Nutrition Facts table is not available, ask for nutrition information to choose foods lower in trans and saturated fats.

Take a step today...

- ✓ Have breakfast every day. It may help control your hunger later in the day.
- ✓ Walk wherever you can – get off the bus early, use the stairs.
- ✓ Benefit from eating vegetables and fruit at all meals and as snacks.
- ✓ Spend less time being inactive such as watching TV or playing computer games.
- ✓ Request nutrition information about menu items when eating out to help you make healthier choices.
- ✓ Enjoy eating with family and friends!
- ✓ Take time to eat and savour every bite!

For more information, interactive tools, or additional copies visit Canada's Food Guide on-line at:
www.healthcanada.gc.ca/foodguide

or contact:

Publications
Health Canada
Ottawa, Ontario K1A 0K9
E-Mail: publications@hc-sc.gc.ca
Tel.: 1-866-225-0709
Fax: (613) 941-5366
TTY: 1-800-267-1245

Également disponible en français sous le titre : Bien manger avec le Guide alimentaire canadien

This publication can be made available on request on diskette, large print, audio-cassette and braille.

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Foods

Online Digestion Animation:
http://highered.mcgraw-hill.com/sites/0072495855/student_view0/chapter26/animation__organs_of_digestion.html

Foods are divided up into the following six basic categories:

i) Carbohydrates
ii) Lipids
iii) Proteins
iv) Water
v) Minerals
vi) Vitamins

Carbohydrates, lipids and proteins are broken down to provide energy and building materials for your body. Water, minerals and vitamins are necessary so that the energy and building materials can be used properly. The body needs a way of breaking this material down into useable parts for a number of reasons. For instance many substances are insoluble in water and cannot be absorbed unless changed into soluble material. Similarly, many substances are too complex for the cell to use and must be made smaller. Many large molecules are foreign matter and the body will be stimulated to produce an immune response against them.

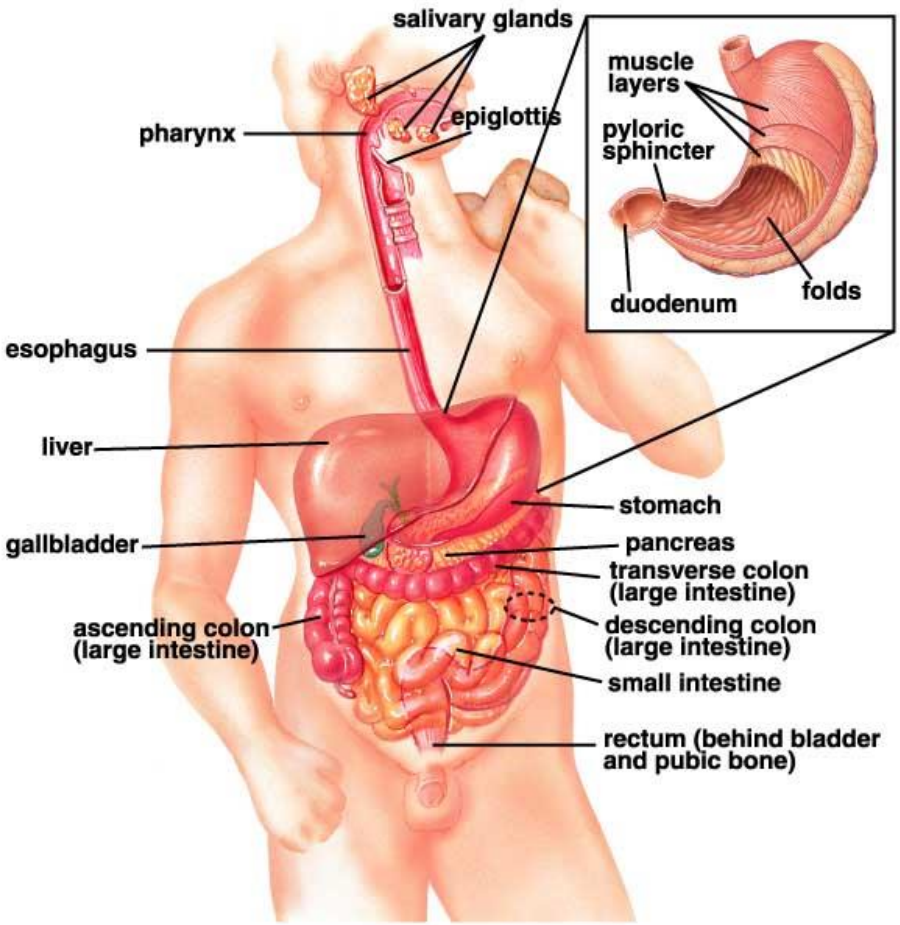
Introduction to Digestion

The Digestive System is responsible for the breaking down off food and nutrients that we eat.

A basic definition for Digestion is: _____

_____

Your body contains what might be described as a "disassembly" line. This line begins with a completed product, food. As the food passes along the line it is broken down into its basic parts by various chemicals (enzymes). _____.



Mechanical and Chemical Digestion

How are mechanical and chemical digestion different?

- _____ is the mechanical process of breaking down food into smaller pieces
- _____ is the breaking down of these smaller food pieces into even small molecular-sized particles

- Physical digestion occurs through _____
- Chemical digestion occurs through _____ via the secretions in the digestive tract, beginning with amylase in the mouth.

Alimentary Canal

The alimentary canal is the pathway through which _____ the body and solid _____

-
-
-
-
-
-
-
-

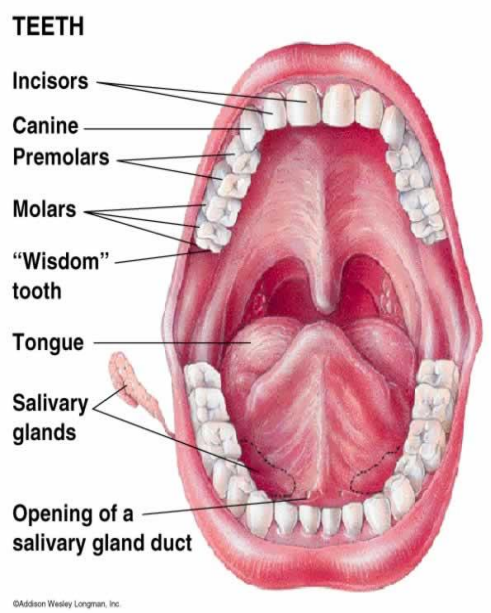
Mouth

The mouth is the first structure of the alimentary canal and connects to the **oral pharynx**. It contains multiple structures that begin digestion, structures such as: _____ _____. The mouth is involved in both chemical and physical digestion.

Mechanical Digestion in the mouth - food is broken up into smaller bits by your teeth and tongue to increase the surface area that chemical digestion will act upon.

Teeth:

- There are 4 types of teeth
  1.
  2.
  3.
  4.
- Incisors: at the front of the mouth, four on top four on the bottom. These teeth are excellent for _____.
- Canines (cuspids): on each side of the incisors. Being pointed in shape they are used to _____.
- Premolars and Molars: behind the canines. Both are flattened on the upper surfaces and are used for _____.



Tongue:

The tongue aids in digestion by manipulating the food within the mouth. It aids in chewing by _____ the food on the molars so it can be chewed. It aids in _____ with the food and when the food is soft it rolls it into a ball known as a bolus. It then initiates swallowing by pressing the **bolus** against the hard palate and forcing the food backwards. The tongue is involved in physical digestion.

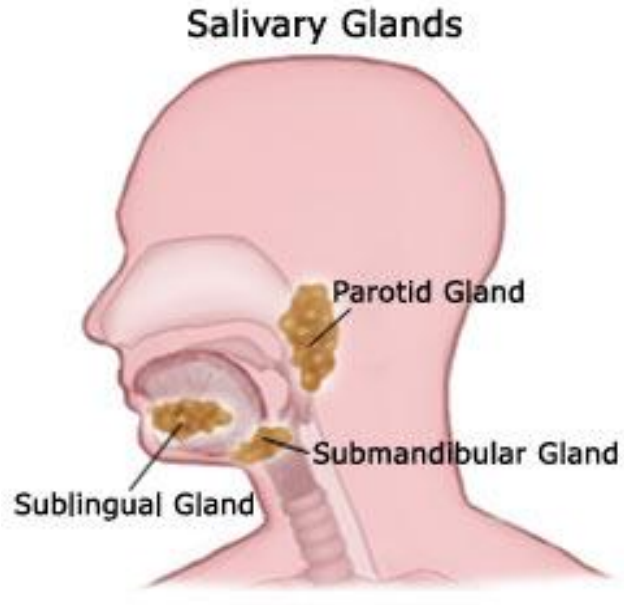
Chemical Digestion in the Mouth - Three pairs of glands (_____) combine to form the liquid, saliva which is composed of water, mucous and salivary _____(an enzyme). Saliva enters the mouth through small tubes where it serves a number of functions including:

i) _____ making it easier for chewing and swallowing

ii) begin the chemical process of digestion by breaking down _____ _____

iii) to act as a _____to reduce tooth decay.

Amylase also has antibiotic properties.

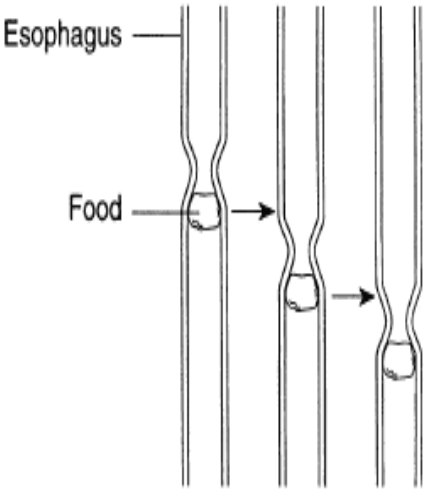


Interesting Fact:

Parotid Gland - This is the largest of the glands and the one that usually becomes enlarged during an attack of mumps.

When swallowing begins three things happen:

1. Food is formed into a ball called a _____ and the tongue pushes up against the hard palate.
2. The flap of tissue (_____) hanging from the rear of the roof of the mouth is pushed back, closing off the passageway leading from the nose to the throat.
3. The flap of tissue (_____) at the top of the windpipe (trachea) closes over the windpipe opening. The food has no choice. It cannot go up to the nose or down to the lungs. The only opening available to it is the esophagus, a tube 25 cm long. This tube passes from the throat down through the diaphragm to the stomach. Muscles in the wall of the esophagus contact and relax in such a way that slow wavelike ripples are set up along the length of the esophagus. These waves, called _____ move food through the esophagus to the stomach, a process which takes about six seconds. Peristalsis is another form of _____.



Questions – Introduction to Digestion and the Alimentary Canal

1. List the parts of the alimentary canal in order.

2. What is the importance and function of the tongue?

3. What are the three salivary glands?

4. What are the components and functions of saliva?

5. Name a way saliva promotes dental health.

6. What teeth would you use for biting off a piece of celery?

7. What teeth would you use for chewing a piece of celery?

8. How does saliva aid in chemical digestion?

9. How does your food go down your esophagus and not your trachea or up your nose?

10. What is the difference between mechanical digestion and chemical digestion?

Demo – What happens when you chew a cracker?

What type(s) (mechanical/physical) digestion occur in your mouth when you chew a cracker?

Physical Digestion:

Chemical Digestion:

Now, chew 2 unsalted soda crackers for two minutes – WITHOUT SWALLOWING?

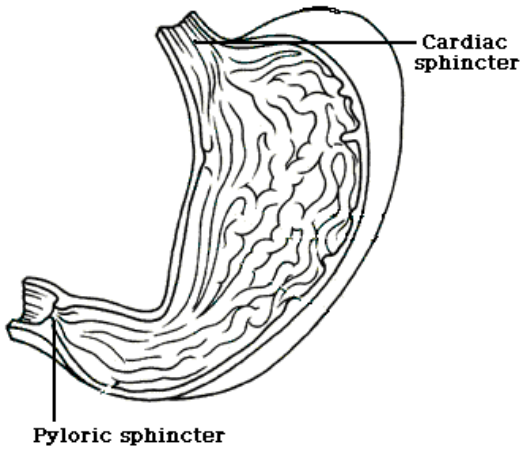
Does the cracker feel dry at first?

Do you notice any change in taste and texture?

Write down what you think caused your observations.

The Stomach

Many people, when asked to point to their stomach, will indicate a region somewhere in the middle of their abdomen. Actually, your stomach is located on your left side just below the diaphragm. It is partially, covered by the lower ribs on this side. Instead of being a round ball-like structure, your stomach resembles the shape of the letter "J". it has a capacity of about one to two litres. Food enters the stomach through a valve-like circular muscle called the **cardiac sphincter** which is located at the end of the esophagus. Three layers of muscles in the stomach wall contract and relax in a sequence that produces a churning action. The food is mixed by this form of mechanical digestion with digestive juices and hydrochloric acid (chemical digestion) which is produced by glands in the stomach wall. The stomach contains 35 million gastric glands. These glands are contained in the many folds, or **rugae**, of the stomach. Chief Cells produce digestive enzymes like **pepsin**. Parietal Cells produce **hydrochloric acid (HCl)** which aids in protein digestion and kills bacteria. The majority of proteins are broken down into amino acids at this time. Little, if any change occurs in the fats and carbohydrates.

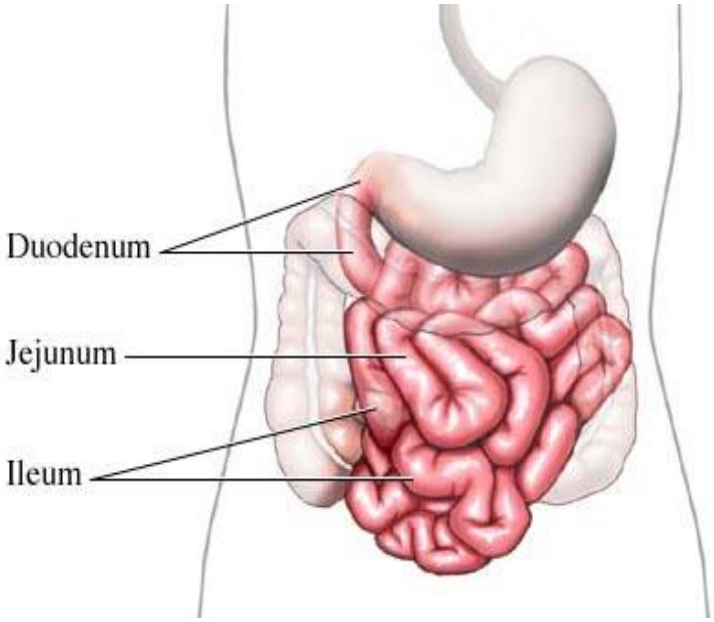


An interesting question arises at this point. It has been stated that the digestive juices and hydrochloric acid in the stomach act on proteins. Your stomach itself is composed largely of proteins. Why then don't the digestive juices digest the stomach itself? The answer lies largely in the formations of a layer of mucous produced by mucous glands in the stomach wall. This sticky liquid forms a layer which coats the inner lining of the stomach and acts as a protective shield against the strong digestive juices and hydrochloric acid. If the mucous layer beaks down at any point, the stomach wall is attacked and worn away by the chemicals. An ulcer occurs.

After a sufficient length of time for digestion (depends on the type of food and its quantity) the muscles in the stomach use **peristalsis** to carry the food, now in a thick liquid form called **chyme**, to the lower portion of the stomach. The pyloric sphincter opens and a small portion of the stomach contents is squirted into the first section of the small intestine, the duodenum. The release of the thick liquid from the stomach takes place slowly to allow sufficient time for the small intestine to do its work.

The Small Intestine, Liver and Pancreas

Your small intestine is the most important part of your digestive system. It is in this region that digestion is completed and the products of digestion are absorbed into the bloodstream. You could lead a near normal life without a stomach. The same could not be said should you lose your small intestine.
The "small" part of the name refers to its diameter.



The importance of the small intestine is illustrated by its length. Approximately 3 meters of tube divided into the following three regions:

i) Duodenum
ii) Jejunum
iii) Ileum.

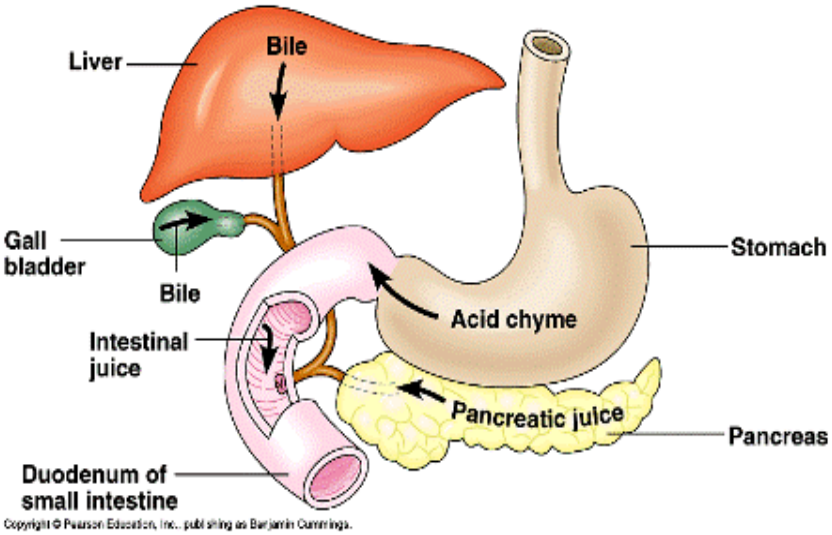
Resources:
http://www.teachersdomain.org/resource/oer08.sci.life.gen.obesity/

http://www.whfoods.

Along with digestive juices formed in the wall of the small intestine itself, two very important glands of your body add their contribution to the digestive chemicals, your **liver** and **pancreas.**

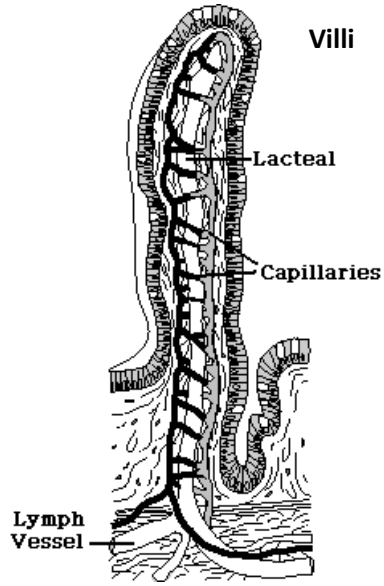
i) **The Liver** - the largest gland in the body, produces a substance called ***bile***. The bile is stored in the liver in a small sac (gall bladder). When we eat foods that contain fat, the bile is conducted through a small tube to the beginning portion of the small intestine (duodenum). Here it acts as a liquid hammer, breaking large fat molecules into smaller, more easily-handled fat molecules so that lipase can more easily digest the fats. This breaking down of fats by bile is called **emulsification.** The bile also serves to deacidify the chime. Excess bile is stored in the **gall bladder.**

ii) **The Pancreas** - second largest gland in the body produces digestive juices and sodium bicarbonate which enters the duodenum at the same point as the bile. Sodium bicarbonate changes the pH of the chyme from a pH of 2 to a more alkaline pH of 8. This allows for the enzyme **trypsin** to further digest proteins.



Peristalsis of the small intestine serves two purposes. The chyme is both mixed with the digestive juices and slowly moved along the length of the intestinal tube. The final break down of proteins, carbohydrates and fats occurs during this time. The end products of the break down include **amino acids, monosaccharides, glycerol and fatty acids**. As in the stomach, a layer of mucous protects the inner wall of the small intestine from damage by the digestive juices.

The digested food molecules are absorbed through the inner wall of the small intestine into the bloodstream. To increase the surface area available for absorption, millions of tiny finger-like projections called villi extend into the small intestine from its inner lining (see figure below). Monosaccharides, amino acids, vitamins and minerals are picked up by the capillaries of the villi and transported to the bloodstream. The glycerol and fatty acids produced by lipid digestion are taken up by the lacteal and transported to the lymphatic system. The absorbed nutrients can now be carried to all parts of your body. Substances which cannot be digested, along with a considerable amount of water from digestive juices, now pass through from the ileum to the large intestine.



The Large Intestine

The small intestine joins the large intestine (**colon**) on the right side of your body below the level of the top of your hip bone. The large intestine, 1.5 m in total length curving in to the ***rectum*** and finally exit at the **anus**. Material is moved through the large intestine by peristaltic waves in the intestinal wall. A certain amount of water is removed from the waste material and returned to the body from the large intestine. Here, too, a large number of bacteria act on some of the wastes to form gases and to synthesize K and B vitamins. As water is removed, the remnants of digestion take on a more solid form (feces). These are stored in the rectum, the last 20 cm of the large intestine. A muscular valve (anal sphincter) closes off the lower portion of the rectum. When this valve opens, the wastes are released from the body (elimination) through the opening of the rectum, the *anus*.

http://www.whfoods.com/genpage.php?tname=faq&dbid=16#dig2

The total time required for the journey of materials through the entire digestive system is about one and a half days.

Did You Know?

The amount of intestinal bacteria varies depending on diet and use of antibiotics but can make up more than half the weight of fecal material. An infection with "bad" bacteria creates an irritation that causes an increase in mucus production and a failure to reabsorb water from stool, leading to diarrhea. Of course, the use of antibiotics disturbs the bacterial flora in the gut and often leads to abnormal gut function until the "healthy" bacteria return.

Questions

Stomach

1. Outline the chemical and physical digestion that takes place in the stomach. Be specific.

2. What happens to the following in the stomach:

i) Protein -

ii) Carbohydrates -

iii) Lipids –

3. What is the food called as it leaves the stomach? What is the food called as it leaves the mouth (review)?

4. Why don't the gastric juices break down stomach tissue?

5. Through which opening does food enter the stomach? Leave the stomach?

6. How is an ulcer formed?

The small intestine, liver and pancreas

7. What are the three parts of the small intestine?

8. How does the liver aid in digestion? Be specific.

9. What does bile do? Where is excess bile stored?

10. How does the pancreas aid in digestion? Be specific.

11. Why could you almost lead a normal life without a stomach, but not without a small intestine?

12. Which enzyme digests protein?

13. Describe the structure of the wall of the small intestine. Why is the small intestine designed this way?

14. Where does the final breakdown of proteins, carbohydrates, and fats occur?

15. What are picked up by the capillaries of the small intestine and taken to the bloodstream?

16. What is picked up by the lacteal in the small intestine and transported to the lymphatic system?

17. What is passed on to the large intestine?

Large intestine

18. What is another name for the large intestine?

19. Describe what happens in the large intestine?

20. Where is feces stored and excreted?

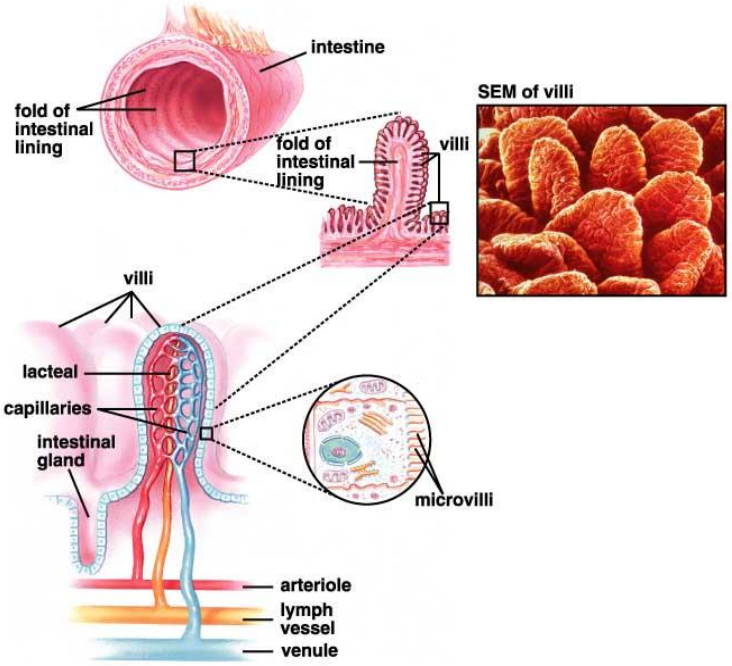
Absorption

Absorption is a very important part of the digestive process. It allows digested food to be transferred to the bloodstream and transported to the cells in the body. Most absorption occurs in the duodenum and jejunum of the small intestine. However, some water, certain ions, and such drugs as aspirin and ethanol are absorbed from the stomach into the blood (accounting for the quick relief of a headache after swallowing aspirin and the rapid appearance of ethanol in the blood after drinking alcohol).

The inner surface of the small intestine has long finger-like tubes called **villi** that greatly increase the surface area for absorption. Villi increase the surface area by a factor of 10. The epithelial cells that cover the villi are lined with **microvilli** that further increase the surface area.

Absorption through the intestinal wall takes place by diffusion and active transport. Many substances must move through the membranes from an area of low concentration to one of higher concentration. Amino acids, for example, are absorbed by active transport.

A thin-walled capillary (small blood vessel) network extends through the core of the villus (singular form of villi). Most dissolved nutrients, which have already been absorbed by passive transport through the epithelial cells, pass into the capillaries. However, the products of fat digestion do not pass into the capillaries, but instead enter a vessel called a **lacteal**, which is part of the lymphatic system of the body. The absorbed fat droplets are transported to adipose (fat) tissue where they are stored.



The large intestine absorbs water, salts, and vitamins. Bacteria in the large intestine, such as *E. coli*, produce vitamins (including vitamin K) that are absorbed.

Mechanical Digestion Summary Chart

Where the mechanical digestion takes place.	Diagram of the organ	Description of digestion type	Key word(s) associated with this digestion type
Mouth			
Esophagus			
Stomach			
Small Intestine			

Chemical Digestion Summary Chart

Where the chemical digestion takes place.	Diagram of the organ	What is being digested?	What enzymes or secretions are being used and where are they produced?
Mouth			
Stomach			
Small Intestine			

Digestive Juices Demo:

Hands on Digestion

Materials

- a small lump of hamburger (meatball size)
- one plastic baggie
- 1M HCl
- Digestive Juice A (pepsin, trypsin and water)
- Digestive Juice B (bile salts, pancreatin enzyme and water)

Procedure:

Place the hamburger, 3 eyedroppers full of 1M HCl, one tablespoon of Digestive Juice A and two tablespoons of Digestive Juice B into a plastic bag. Knead the bad with your hands (simulates the stomach) for about 10-15 minutes, it will have been reduced to mainly liquid and have a definite odor.

Notes:

Activity

On a piece of paper draw the alimentary canal. Include all of the structures of the alimentary canal as well as the liver, gall bladder, and pancreas.

At each point in the alimentary canal, list the mechanical and chemical digestion.
The chemical digestion should contain the enzymes or secretions involved as well as what it breaks down (ie: Trypsin breaks down proteins to amino acids)

** Prepare for Digestion Quiz*
** Do Digestion Review Activity*

Digestion Summary Enzymes and Glands

What are enzymes made of?

Enzymes are protein molecules, and so are made up of _____. Most enzymes contain between 100 and 1,000 amino acids.

These amino acids are joined together in a long chain, which is folded to produce a unique 3D structure.

Why are enzymes so specific?

Enzymes are very specific about which reactions they catalyze. Only molecules with exactly the right shape will bind to the enzyme and react. These are the _____, or substrate, molecules.

The part of the enzyme to which the reactant binds is called the active site.

This is a very specific shape and the most important part of the enzyme.

What happens at the active site?

In the same way that a key fits into a lock, so a substrate is thought to fit into an enzyme's active site. The enzyme is the _____, and the reactant is the _____.

Factors affecting enzymes

The rate of enzyme–catalyzed reactions depends on several factors. What are some of these?

Factors that affect the rate of a reaction include:

-

-

-

-

All enzymes work best at only one particular temperature and pH: this is called the _____.

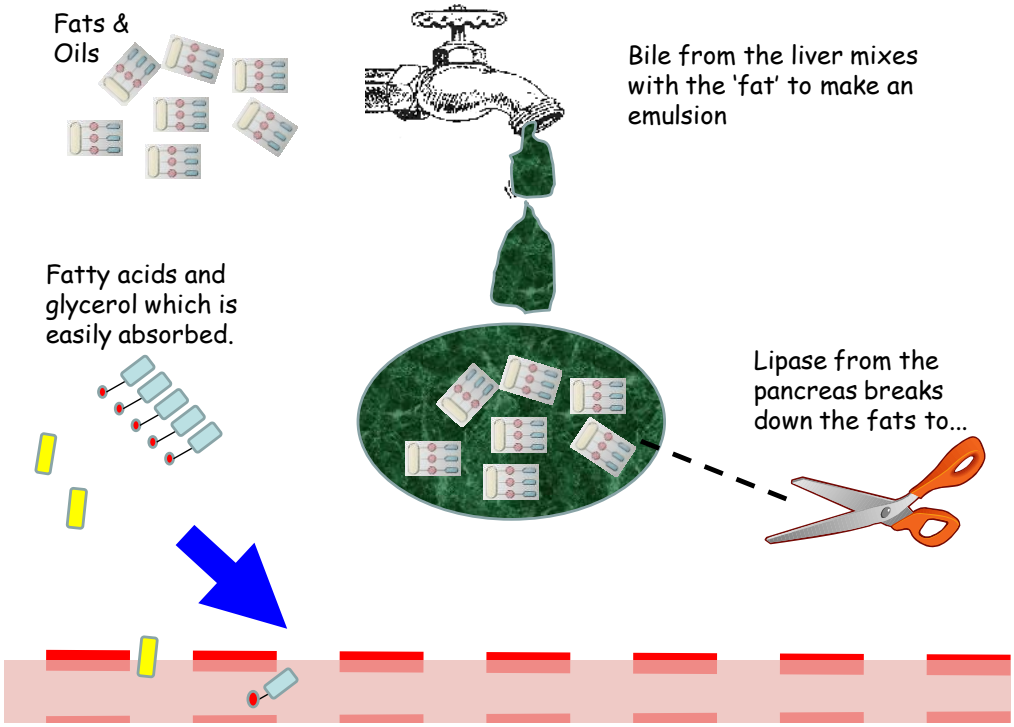
Different enzymes have different optimum temperatures and pH values.

If the temperature and pH changes sufficiently beyond an enzyme's optimum, the shape of the enzyme irreversibly changes.

This affects the shape of the active site and means that the enzyme will no longer work.

When this happens the enzyme is _____.

Do "The effect of Amylase of Breakfast Cereals" Lab



Cross out the wrong answers...

Fats and oils are essential to our **diet/ food / suntan**.

They are used in the **production / destruction / recycling** of cell membranes, for storing energy and for heat insulation.

Lipase is produced in the **pancreas/ stomach / oesophagus**.

The stomach pH is too **acidic / alkaline / salty** for it to work.

Bile is needed to make a **paint / emulsion / mixture**.

Bile is made in the **stomach / kidneys / heart / liver**.

One product of fat digestion is **glucose / glycerol / gluey acid.**

Fatty acids & glycerol are easily **absorbed / secreted / drip** into the blood stream

Proteins are essential in the diet for _____

Proteins are large branched molecules (_____) found in all types of meat and soya beans.

Proteases are enzymes that digest proteins examples are_____.

Proteins are too _____ to be absorbed into the blood stream.

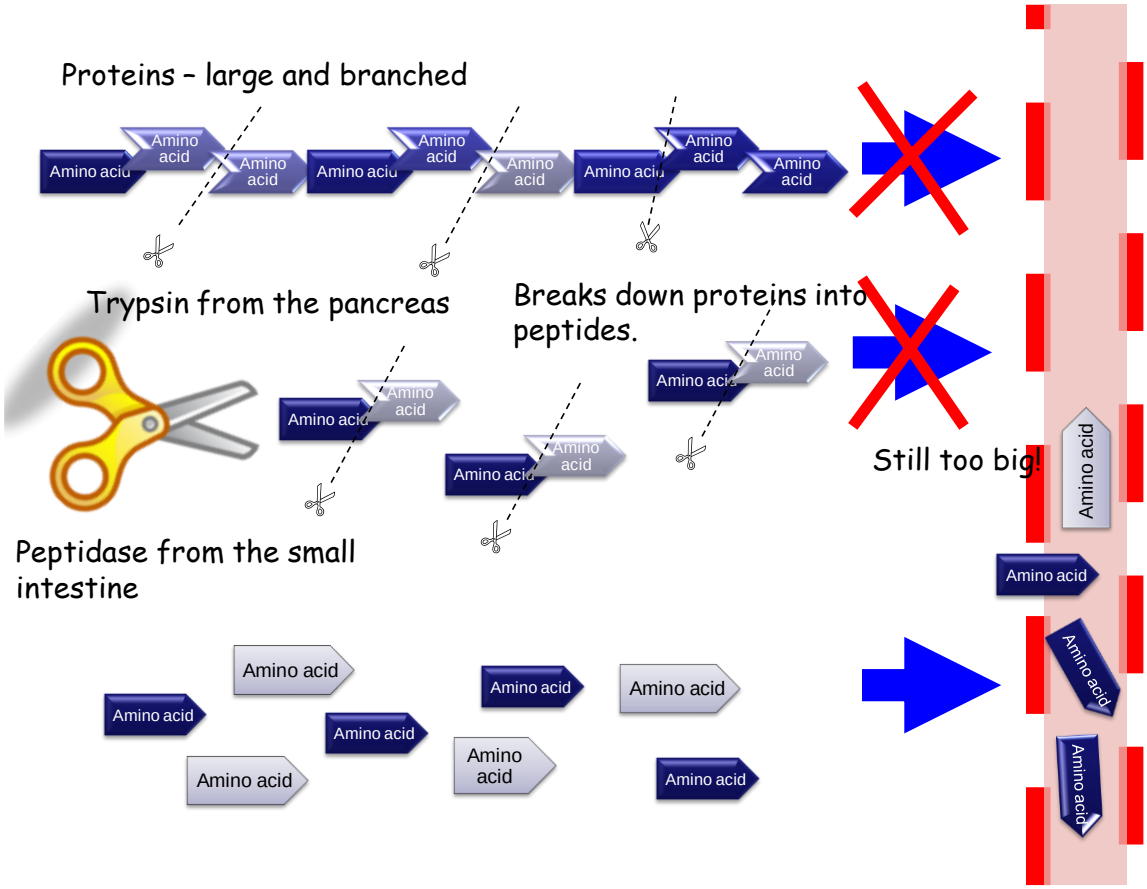
Trypsin is produced in the _____.

Trypsin is released into the _____ and breaks down proteins to form peptides.

Peptidase is produced by the _____.

Peptidase breaks down peptides into individual _____ that are easily absorbed.

What pH do you think these enzymes work best in? _____



Ready, Set.... Go!
A look at Enzyme Activity

Introduction:

An enzyme is a protein catalyst that speeds up a chemical reaction in the body. Different factors can have great effects on how an enzyme functions. An example would be temperature. Enzymes are essential mediators which aid in the process of digestion.

Purpose:

The purpose of this activity is to demonstrate enzyme reactions and the environmental variables that affect these reactions.

Materials (per group):

- 50 Pennies
- Beaker
- Ice
- Water
- Masking Tape
- Piece of construction paper

Procedure:

TRIAL #1

1. Lay out 50 pennies on the desk you are sitting at.
2. a) One group member will act as the recorder
   b) The second group member will be in charge of timing
   c) The third group member will attempt to pick up as many pennies as possible in 10 seconds.
3. The team member picking up the pennies must follow these rules:
   - → Only allowed to grab one penny at a time
   - → Can only use the index finger and thumb to grab pennies
   - → Place they penny Heads Up on the piece of construction paper
4. The other team members will be in charge of helping count the number of pennies picked up and placed on the piece of construction paper.
5. This process will be repeated with the same person picking up pennies for six 10 second trials. Be sure to record results in data table.

TRIAL #2

6. The effect of denaturation will be tested in this trial. Denaturation is a form of inhibition in which the enzyme changes shape. As a result, the substrate is not able to bind correctly and the enzyme becomes ineffective.
7. The student whose job was to grab pennies will now tape their index finger and thumb together with masking tape.
8. Like trial #1 the students will have six 10 second intervals to pick up as many pennies as they can and place them on the construction paper. Be sure to record results in data table.

TRIAL #3

9. Effect of temperature on enzyme function and effectiveness.

10. The student responsible for picking up pennies will now place their index finger and thumb in a beaker of ice water for 10 seconds before each interval of picking up pennies.
11. Like the other trials students will do six 10 second intervals of picking up pennies. Be sure to record results in data table.

Data Collection

Time (in seconds)	***TRIAL #1 Normal Enzyme Activity***	***TRIAL #2 Denaturation***	***Trial #3 Effect of Temperature***
0-10			
11-20			
21-30			
31-40			
41-50			
51-60			
TOTAL:			

Interpretation Questions:

1. In this activity, what object represented the enzyme? the substrate?

2. If more substrate were present in Trial #1 at the beginning would the initial rate have been higher? Why or why not?

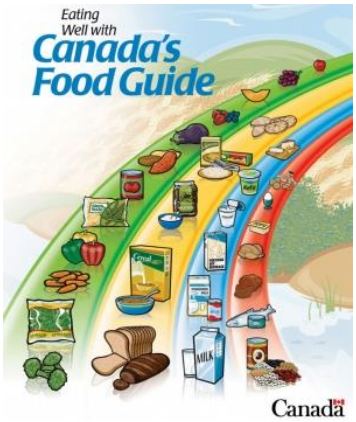
3. What happened to the active site of the enzyme during Trial #2?

4. Why does an enzyme not work as well if its active site is changed?

5. What environmental factors affect the enzyme shape?

Human Nutrition

In addition to providing energy, food must also provide certain essential nutrients that cannot be manufactured by the body. The human diet must provide the following:



- **carbohydrates** – monosaccharides, polysaccharides, disaccharides
- **amino acids** - nine "essential" amino acids needed for protein synthesis and cannot be synthesized from other substances.
- **fats** - three "essential" fatty acids that cannot be synthesized from other substances.
- **minerals** - a few like calcium in relatively large amounts; most, like potassium, in "trace" amounts.
- **vitamins** - small organic molecules that we cannot synthesize from other substances in our diet.
- **water** - the most abundant substance in the human body. The body requires about 2.5 L per day.

* We also need energy (calories) that we cannot produce on our own

How dietary needs are established

Determining what substances must be incorporated in the human diet, and how much of each, is - even after years of research - still under active study. All food substances can be divided into two general groups: organic foods – produced by living organisms (carbohydrates, fats, proteins, vitamins) and inorganic foods – come from soil, rocks and the sea (minerals and water). Let's look at the different categories of nutrients.

Carbohydrates

Carbohydrates provide the majority of the energy in most diets. In Canada, energy is measured in joules (J) or kilojoules (kJ). In the United States, food energy is measured in calories. One calorie is equal to 4.18 kilojoules. The calorie is still used on many food labels. Age, sex, size, health, and the intensity of physical activity strongly affect the daily need for energy.

The table below outlines daily energy requirements for different age groups and levels of activity.

Description of Person	Energy Requirements (kJ per day)
newborn	2 000
child (2-3)	6 000
teenage girl	9 500
teenage boy	12 000
office worker	11 000
heavy manual worker	15 000

Good sources of carbohydrates include breads, cereals, pasta, potatoes and rice.

Cellulose, another complex carbohydrate, is found in all plant walls and is not digestible by humans. However, cellulose (also known as **fiber**) is still an important item to include in the diet as it helps in the elimination of wastes. Some sources of fiber include bran and spinach.

Fats

The fats in our diet provide the basic building blocks from which we synthesize our own fat, as well as other lipids such as cholesterol and various phospholipids. Fat provides our most concentrated form of energy. Its energy content is over twice as great as carbohydrates and proteins.

There are essential fatty acids that cannot be synthesized by our bodies and must be incorporated in the diet. All of these are unsaturated fats.

Types of fats

- **Saturated** - no double bonds between the carbon atoms in the fatty acid chains. Most animal fats (e.g. butter) are highly saturated
- **Monounsaturated -** have a single double bond in the fatty acid chains. Examples: olive, peanut, and rapeseed (canola) oil
- **Polyunsaturated** - have two or more double bonds in their fatty acid chains. Examples: corn, soy bean, cottonseed, sunflower, and safflower oils
- **Trans Fats** - have been partially hydrogenated producing fewer double bonds. Example: margarine
- **Omega-3 fats** - have at least one double bond three carbon atoms in from the end of the fatty acid molecule. Fish oils are a rich source of omega-3 fatty acids

Many studies have examined the relationship between fat in the diet and cardiovascular disease. There is still no consensus, but the evidence seems to indicate that:

- a diet high in fat is harmful
- mono and polyunsaturated fats are less harmful than saturated ones
- trans unsaturated fats may be worse than saturated fats
- ingestion of omega-3 unsaturated fats may be protective

Protein

Whether you are a vegetarian or a “meat eater”, you must have protein in your diet in order to survive. The protein in the food you eat is the main source of the chemical building blocks you need to build your own protein molecules.

Much of our body structure is constructed from protein molecules, making up about 15% of the mass of the average person. Muscle, cartilage, ligaments, skin and hair are all mainly protein materials. Food sources of protein include fish, meat, eggs, milk, cheese, beans, nuts and lentils.

Humans must include adequate amounts of 9 amino acids in their diet. These **"essential" amino acids** cannot be synthesized from other substances. Two of the essential amino acids, lysine and tryptophan, are not found in most plant proteins. Therefore, strict vegetarians should take special measures to ensure that their diet contains sufficient amounts of these two amino acids. The list below summarizes the "essential" amino acids. *(The amino acids are just for reference. I won’t ask you to identify them on a test)*

HISTIDINE is found abundantly in hemoglobin; has been used in the treatment of rheumatoid arthritis, allergic diseases, ulcers & anemia. A deficiency can cause poor hearing.

TRYPTOPHAN - A natural relaxant, helps alleviate insomnia by inducing normal sleep; reduces anxiety & depression; helps in the treatment of migraine headaches; helps the immune system; helps reduce the risk of artery & heart spasms; works with Lysine in reducing cholesterol levels.

LYSINE - Insures the adequate absorption of calcium; helps form collagen (which makes up bone cartilage & connective tissues); aids in the production of antibodies, hormones & enzymes. Recent studies have shown that Lysine may be effective against herpes by improving the balance of nutrients that reduce viral growth. A deficiency may result in tiredness, inability to concentrate, irritability, bloodshot eyes, retarded growth, hair loss, anemia & reproductive problems.

METHIONINE - Is a principle supplier of sulfur which prevents disorders of the hair, skin and nails; helps lower cholesterol levels by increasing the liver's production of lecithin; reduces liver fat and protects the kidneys; a natural chelating agent for heavy metals; regulates the formation of ammonia and creates ammonia-free urine which reduces bladder irritation; influences hair follicles and promotes hair growth.

PHENYLALAINE - Used by the brain to produce Norepinephrine, a chemical that transmits signals between nerve cells and the brain; keeps you awake & alert; reduces hunger pains; functions as an antidepressant and helps improve memory.

THREONINE - Is an important constituent of collagen, Elastin, and enamel protein; helps prevents fat build-up in the liver; helps the digestive and intestinal tracts function more smoothly; assists metabolism and assimilation.

VALINE - Promotes mental vigor, muscle coordination and calm emotions.

LEUCINE & ISOLEUCINE - they provide ingredients for the manufacturing of other essential biochemical components in the body, some of which are utilized for the production of energy, stimulants to the upper brain and helping you to be more alert.

Vitamins

Vitamins are organic nutrients that are required in small amounts to maintain growth and metabolism. Vitamins can be categorized into two main groups: fat soluble and water soluble. Fat soluble vitamins can be stored in the liver. However, accumulation of excess amounts can be toxic (poisonous). Water soluble vitamins cannot be stored by the body and must be included regularly in the diet.

A great deal of attention is being generated by a group of vitamins called **antioxidants**. These vitamins include C, E, and beta carotene (the chemical parent of vitamin A). Early research has indicted that antioxidants lessen the danger of a harmful group of molecules known as **oxygen-free radicals**. Free radicals are formed in your body by exposure to sunlight, X rays, ozone, tobacco smoke, car exhaust, and other environmental pollutants. Oxygen-free radicals have been known to cause mutations (changes in the genetic information) in body cells. Many scientists believe that free radicals play a major role in the development of cancer, heart disease and lung disease. Eating foods rich in antioxidants could aid in the prevention of these diseases.

The following table summarizes the important vitamins required by the body. *(Just for reference as well. I do not expect you to memorize this)*

Vitamin	Function in the Body	Food Sources	Deficiency Symptoms
Water Soluble			
B3 or **Niacin** or **Nicotinic Acid**	proper circulation, healthy functioning of the nervous system, proper protein and carbohydrate metabolism.	yeast, whole wheat, green leafy vegetables, tomatoes, nuts, sunflower seeds and peanuts.	pellagra, diarrhea, insomnia, anemia and mental disorders.
B12 or **Cyanocobalim**	production of red blood cells and for several metabolic and enzymatic processes.	milk, bananas, peanuts and sunflower seeds.	certain types of anemia, poor appetite and chronic fatigue.
B9 or **Folic Acid** or **Folacin**	growth of all body cells, healing processes and protein metabolism.	whole grains, nuts and fresh leafy vegetables such as asparagus, green beans and peas.	certain types of anemia, skin disorders and impaired circulation.
B5 or **Panthothinic Acid**	normal growth of hair and prevents dermatitis	wheat germ, whole grains, green vegetables, and peanuts.	mental depression, irritability, muscular weakness, insomnia and skin disorders.
C or **Ascorbic Acid**	growth and maintenance of body tissues - joints, bones, teeth and gums, protects against infection and helps in quick healing of wounds.	citrus fruits, green leafy vegetables, *amla*, sprouted Bengal and green grams.	scurvy, anemia, tooth decay, bleeding gums, painful and swollen parts, slow healing of wounds and premature aging.

Fat Soluble			
A	maintain health of epithelial cells; formation of light-absorbing pigment; growth of bones and teeth	liver, broccoli, green and yellow vegetables, tomatoes, butter, egg yolk	poor vision, night blindness, kidney problems
D	proper bone and teeth formation and metabolism of calcium and phosphorus.	rays of the sun, milk, butter, and sprouted seeds.	rickets, tooth decay, pyorrhea, muscular weakness and gross deficiencies of bones.
E	normal reproductory function, fertility and physical vigor. It dilates blood vessels and improves circulation.	wheat or cereal germ, whole grain products, green leafy vegetables, milk and all whole, raw or sprouted seeds.	degeneration of reproductive tissues, liver disorders and sluggish circulation.
K	clotting of blood and for prevention of bleeding.	green leafy vegetables, spinach, cabbage and tomatoes.	certain types of anemia, skin disorders and impaired circulation

Minerals and Water

A mineral is an inorganic substance that functions as a building material or takes part in a chemical reaction. Minerals make up a bout 4% of your total body weight, most of that being in you skeleton. Some important minerals and their functions are listed in the table below.

Mineral	Function in the Body	Food Sources	Deficiency Symptoms
Calcium	**teeth and bone formation, muscle and nerve activity, blood clotting**	**milk, cheese, grains, beans, hard water**	**soft bones and teeth, osteoporosis**
Sodium	nerve activity, body pH regulation	table salt, vegetables, canned meat	dehydration
Iron	formation of hemoglobin (transports oxygen throughout the body)	green vegetables, liver, whole wheat bread, grains, nuts	lack of energy, anemia
Iodine	formation of thyroid hormone	seafood , eggs, iodized salt	swollen thyroid gland, goiter
Potassium	nerve and muscle activity	meats, grains, milk, fruits, green vegetables	weak muscles
Phosphorus	teeth and bone formation, blood pH, part of enzymes and nucleic acids	meats, fish, dairy products, grains	poor development of bones and teeth

Water

The importance of water was discussed in detail in Module 2. All living things require water to survive. Approximately 70-90% of your body is water. Water facilitates the chemical reactions in your body and is necessary for the breakdown of foods during digestion (hydrolysis). Water is also an excellent solvent and helps to maintain body temperature. Your body loses approximately 2.5 L of water per day through exhalation, sweat, and urine. You must replenish this lost water or dehydration can result.

Food Labels:

Have you ever looked at the information provided to you on food labels? The information currently provided varies depending on the type of food and the manufacturer. Health Canada is working to improve nutrition information on pre-packaged food labels. The following "Nutrition Facts" box will be present on all foods and provide the consumer with important nutritional information.

*notice the values given are for a specific amount -- compare to how much you eat
**daily amount tells you if a good has a little or a lot of a nutrient per serving

Nutrition Exercise

1. List and briefly describe the six essential nutrients that you must provide in your diet.

2. How can vegetarians provide all the essential nutrients?

3. How do you obtain most of the energy that your body requires? What is the approximate amount of energy that you require?

4. Even though a diet high in fat is considered to be potentially dangerous, why must we consume some fat in our diet?

5. What is the result of consuming more energy than the body requires?

6. a) Explain why vitamins and mineral must be included in your diet.

   b) Name one vitamin and one mineral and describe the function in the body, a food source for each, and a possible deficiency symptom.

7. Why are antioxidants an important group of vitamins?

8. Why can a person survive for weeks with out food but only days without water?

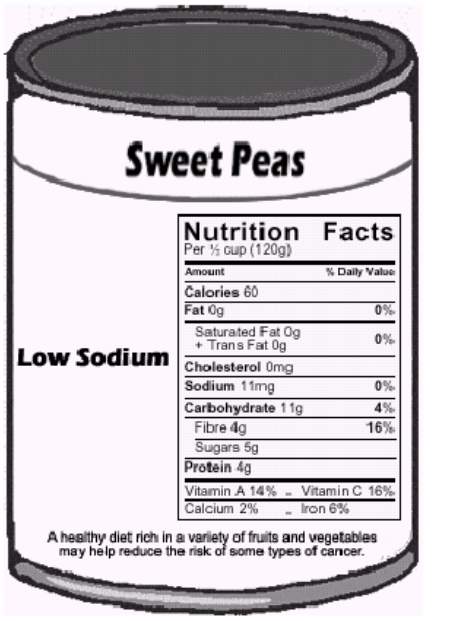
9. Study the following food label.

a) What food group does this food item belong to?

b) List the essential nutrients provided by this food item.

c) Could you survive by eating this food alone? Why?

d) List two "healthy" characteristics of this food.



Six Types of Nutrients - Summary

Nutrient	Function	Examples
1.		
2.		
3.		
4.		
5.		
6.		

GO the HEALTHY WAY...
Eat Well, Live Well and Feel Great!

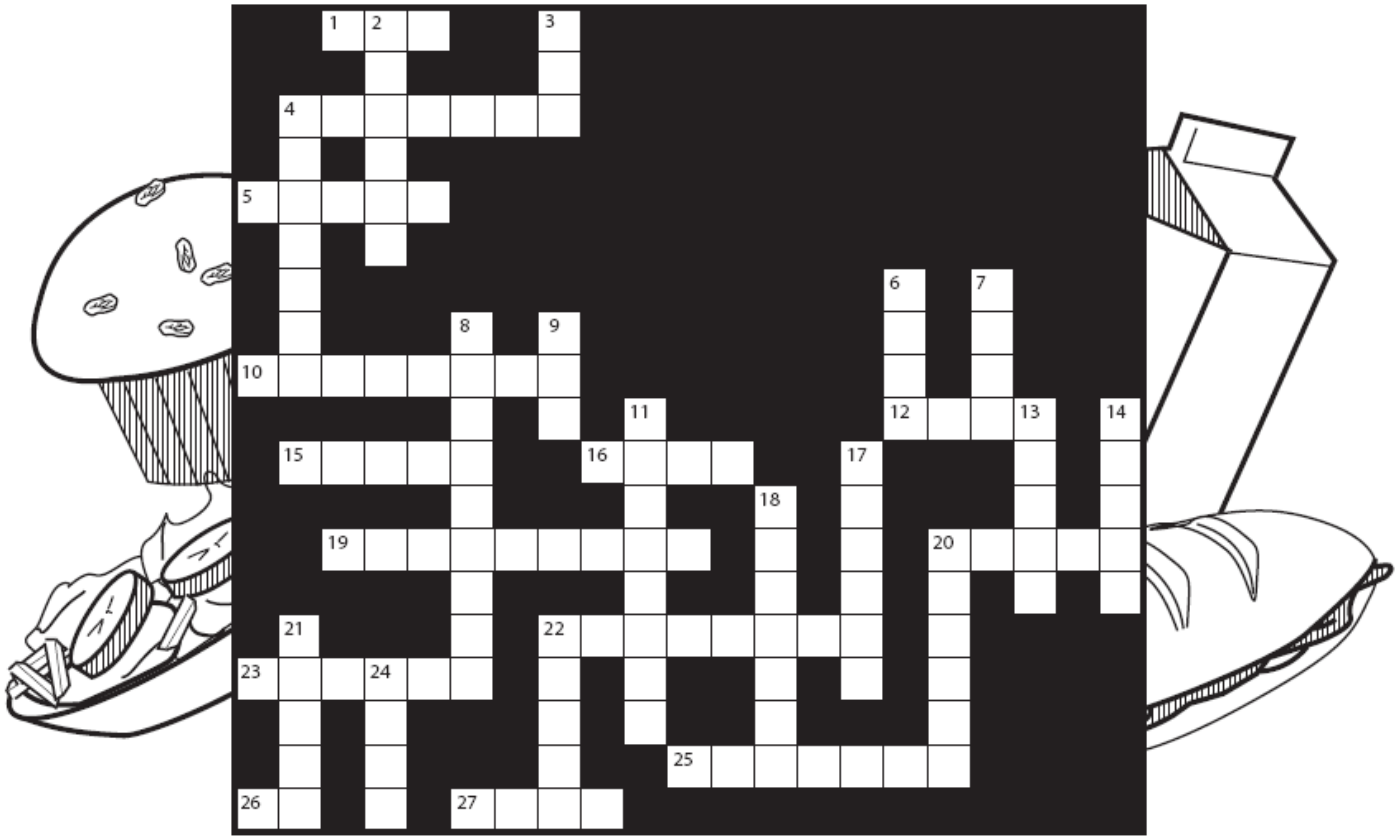
Brought to you by:
Dietitians of Canada
Les diététistes du Canada
www.dietitians.ca/eatwell

GREAT FOOD ON THE MOVE!

"I'm picking the kids up from school, taking Jane to dance, then taking Susan to soccer practice and then we're all going to parent teacher interviews. Oh, dear, what's for dinner?" Sound familiar? You're not alone.

Have fun doing this crossword puzzle and take away a few ideas on how to eat healthy when you're pressed for time.

Have a great tip on how to eat healthy while on the run? Submit your idea at **www.dietitians.ca/eatwell**.



ACROSS

1. Likes to be cooked first and then rest in a cooler in your car for a snack
4. Done by cows and busy people
5. Drink me anytime!
10. The Earl would be pleased to see curried tuna, chicken with grapes or cheese with tomato and sprouts lying inside
12. They love to help make lunches and snacks
15. Parents of the world rejoice! An option for fries at fast food restaurants and school cafeterias
16. Likes to cozy up in a thermos
19. Perfect for lunch the next day without all the fuss
20. A wise option for 'large'
22. Choose me for a savoury snack instead of chips
23. Too many have gotten too big, but in the right size, I'm a perfect morning snack
25. I love to be in sticks or coins and go great with any lunch
26. I'm eating well, being active and feeling great; who am I?
27. Line me with lettuce, top me with turkey, add carrots for crunch, roll me up and say yummy!

DOWN

2. We stick together in green, red or purple bunches
3. I can give you great exercise if you just put a leash on me. Who am I?
4. I love to sit on yogurt, be mixed with dried fruit or wait in a plastic bag all by myself to be eaten
6. Kids like me brown, parents like me skim and everyone loves me for my calcium
7. Keep hot foods hot and cold foods _ _ _ _
8. Provides trusted food and nutrition advice
9. Trusted source of health information (www.canadian-health-network.ca)
11. A V.I.P. to take care of
13. Toss me or layer me, and then dress me up
14. When all the running around is done, a great place to eat meals
17. Sometimes holy, sometimes not; goes great as a snack with fruit
18. A great place to store 'batches' of food ready to go
20. Walk up and down me to get where you're going
21. A food beverage that comes in a variety of colors
22. Loved by young and old; great hot or cold and has all food groups if planned well
24. More important than how you look is how you _ _ _ _

Chapter 34

Analyzing Dietary Fiber

Leading nutritionists are now recommending that humans go back to a diet more similar to that of our ancestors 20 000 years ago. No, this doesn't mean that you'll soon find mastodon burgers at your favorite fast-food restaurant. But it is a strong suggestion that people incorporate more plant foods such as whole grains, nuts, fruits, and vegetables into their diets in order to get more dietary fiber. Dietary fiber is the part of plants that can't be digested, so it passes through the digestive system without being broken down. Composed mainly of cellulose and derived from the tough cell walls of plant cells, dietary fiber has been shown to lower cholesterol, reduce the risk of colon cancer, and effectively treat common intestinal ills, such as constipation. In this activity, you will examine the fiber content of certain foods and learn how you can incorporate more fiber into your diet.

Part A: Dietary Fiber Content in Foods

Table 1 shows the dietary fiber content of some common foods. Use the table to answer the questions below.

Table 1: Dietary Fiber Content of Some Foods

Food	Portion	Fiber (g)
Breads		
bagel	1	1.2
English muffin	1	1.6
white bread	1 slice	0.5
whole-wheat bread	1 slice	2.1
doughnut	1	negligible
Grains and grain products		
puffed-rice cereal	1 cup	1.2
crisped-rice cereal	1 cup	0.3
toasted-oat cereal	1 cup	2.5
high-fiber cereal	1 cup	9.0
white rice	1/2 cup	1.0
brown rice	1/2 cup	1.7
Fruits and Vegetables		
apple, with peel	1 small	3.7
apple, peeled	1 small	1.4
pear, with peel	1 small	4.3
pear, peeled	1 small	2.4
banana	1	1.8
orange	1	3.1
carrot, raw	1	2.3
broccoli, cooked	1/2 cup	2.0
tomato, raw	1 medium	1.6
iceberg lettuce	1 cup	1.4
sweet potato, skin	1 medium	3.4
Beans		
chick-peas, canned	1/2 cup	7.0
black-eyed peas	1/2 cup	8.3
lentils	1/2 cup	5.2
pinto bean chili	1/2 cup	4.6
Snacks		
potato chips	3 cups	1.0
popcorn	3 cups	2.7

1. Based on Table 1, which group of foods is the best source of dietary fiber?

_____

2. The American Dietetic Association recommends 20 to 35 grams of dietary fiber daily. What is your daily fiber intake? In your science notebook or journal, list the amount and types of foods you ate yesterday. Then use Table 1 to find the fiber content of each food. For foods not listed in the table, consult additional reference sources.

Part B: Fitting Fiber into Your Diet

Does fitting fiber into your diet mean a great change in how you eat? Actually, changing your diet to include more fiber is easy; one way it can be done is by simply substituting a high-fiber food for a low-fiber food in the same food group. For example, at breakfast, a slice of whole-wheat toast, a carbohydrate with 2.1 grams of dietary fiber, can be substituted for a doughnut, a carbohydrate with negligible fiber content. You may wish to include more foods from certain food groups, such as beans. Use Table 1 and other references to adjust the menu below so that it forms a balanced diet that includes at least 35 grams of dietary fiber.

Old Menu		New Menu	
Breakfast	**Fiber (g)**	**Breakfast**	**Fiber (g)**
doughnut	negligible		
orange juice	0.1		
corn flakes	0.5		
Lunch		**Lunch**	
hamburger on white bun	0.7		
french fries	3.1		
Dinner		**Dinner**	
lettuce and tomato salad	3.0		
chicken	negligible		
white rice	0.2		
Snacks		**Snacks**	
apple	3.0		
potato chips	1.0		
Daily Total:	**11.6 g**	**Daily Total:**	

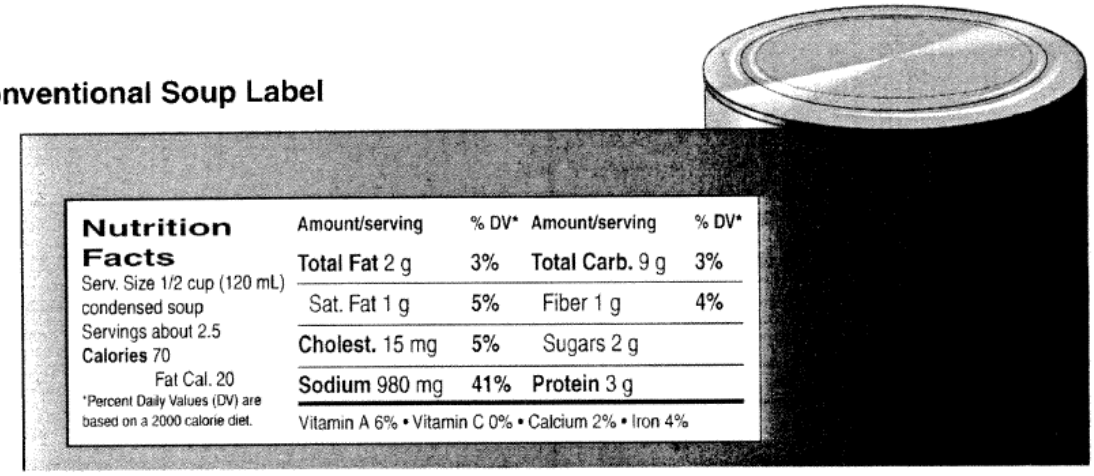
Master 51

Information on a Food Label

Reteaching Skills

Use with Chapter 35, Section 35.2

A. Conventional Soup Label



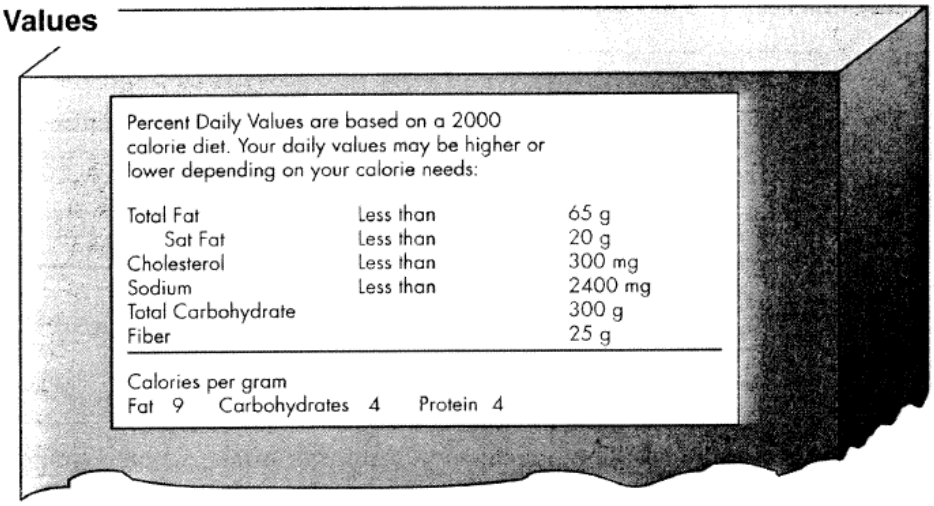
Nutrition Facts

Serv. Size 1/2 cup (120 mL) condensed soup
Servings about 2.5
Calories 70
Fat Cal. 20
*Percent Daily Values (DV) are based on a 2000 calorie diet.

Amount/serving	% DV*	Amount/serving	% DV*
Total Fat 2 g	3%	**Total Carb.** 9 g	3%
Sat. Fat 1 g	5%	Fiber 1 g	4%
Cholest. 15 mg	5%	Sugars 2 g	
Sodium 980 mg	41%	**Protein** 3 g	

Vitamin A 6% • Vitamin C 0% • Calcium 2% • Iron 4%

Daily Values

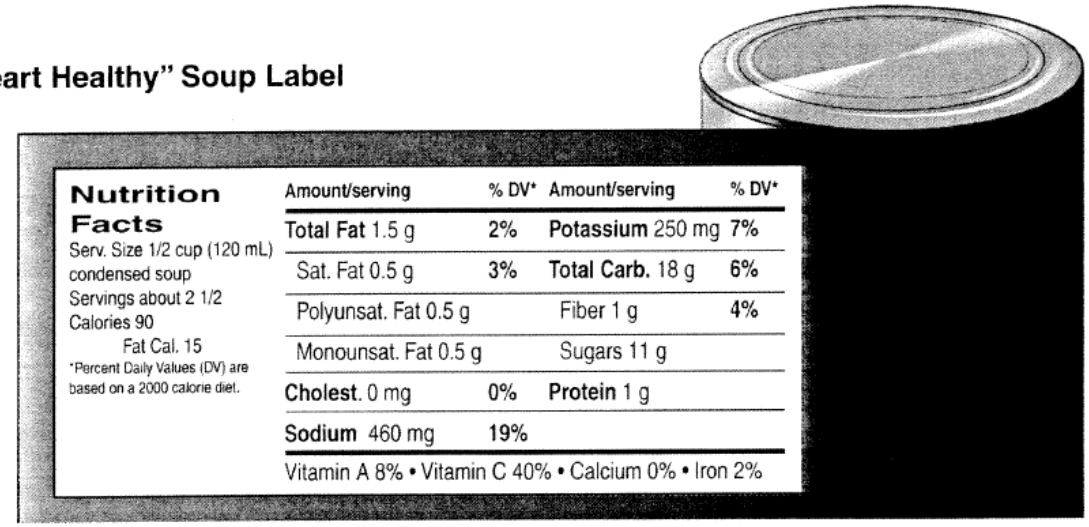


Percent Daily Values are based on a 2000 calorie diet. Your daily values may be higher or lower depending on your calorie needs:

Total Fat	Less than	65 g
Sat Fat	Less than	20 g
Cholesterol	Less than	300 mg
Sodium	Less than	2400 mg
Total Carbohydrate		300 g
Fiber		25 g

Calories per gram
Fat 9 Carbohydrates 4 Protein 4

B. "Heart Healthy" Soup Label



Nutrition Facts

Serv. Size 1/2 cup (120 mL) condensed soup
Servings about 2 1/2
Calories 90
Fat Cal. 15
*Percent Daily Values (DV) are based on a 2000 calorie diet.

Amount/serving	% DV*	Amount/serving	% DV*
Total Fat 1.5 g	2%	**Potassium** 250 mg	7%
Sat. Fat 0.5 g	3%	**Total Carb.** 18 g	6%
Polyunsat. Fat 0.5 g		Fiber 1 g	4%
Monounsat. Fat 0.5 g		Sugars 11 g	
Cholest. 0 mg	0%	**Protein** 1 g	
Sodium 460 mg	19%		

Vitamin A 8% • Vitamin C 40% • Calcium 0% • Iron 2%

Worksheet 51

Information on a Food Label

Reteaching Skills

Use with Chapter 35, Section 35.2

1. The serving size for both soups is 1/2 cup of condensed soup. Why do you think the manufacturer refers to *condensed* soup? Give your answer in scientific terms.

2. Fill in this chart to compare the nutritional content per serving of each product. Be sure to include the units of measure.

	Total Fat	Sat. Fat	Cholesterol	Sodium	Total Carb.	Fiber	Sugars	Protein	Calories	Fat Calories
A										
B										

3. People with diabetes need to be careful about their sugar intake. Which soup seems better for them?

4. People with high blood pressure need to be careful about their salt intake. Which soup seems better for them?

5. People with heart disease need to watch their cholesterol and saturated fat intake. Which soup seems better for them?

6. People with weight problems need to monitor their Calorie intake. Which soup seems better for them?

7. After comparing the two products, which would you prefer to eat? Explain your choice.

Testing for Nutrients - Lab

Background:

Substances in food that can be used by an organism for energy of for growth and repair are called nutrients. Nutrients include carbohydrates, proteins, lipids, minerals and vitamins. Cells of all organisms are composed of these nutrients and water. There are several chemical tests that can be used to determine which nutrients, if any, are present in a substance. You will use some of these tests in this activity.

Objectives:

In this activity you will learn how to perform tests on several foods to determine the presence of carbohydrates, proteins and fats.

Materials:

All stations: Goggles

Station 1: Carbohydrate test - starch

Spot plate

Lugol's/iodine solution (a few drops per food sample)

Station 2: Carbohydrate test – simple sugar

8 Pyrex test tubes

Test tube rack

Distilled water

Benedict's solution

Boiling water bath

Hot plate

Test tube holder

Glass stir stick

Station 3: Protein test

8 test tubes

Test tube rock

Distilled water

Biuret reagent

Glass stir rod

Station 4: lipid/fat test

Brown paper towel

Food samples:

1. Carrot
2. Bread
3. Potato
4. Apple
5. Onion
6. Walnut
7. Cheese
8. McMush

Procedures:

Note: Keep your food sample on paper towels, numbered according to their position in table 1. Wash your hands after handling each sample, to avoid transferring food particles form one food to another.

Station 1: Carbohydrate test – starch

- *Number 6 depressions in a spot plate 1 to 8.*
- *Then, using a knife, chop up one sample of food to be tested into tiny pieces and put them in the proper place. CAUTION: to avoid cutting yourself, be careful when cutting the samples.*
- Add a few drops of Lugol's solution to each food sample, in order to test for starch. Observe the samples for any colour change indicating a positive result for starch.
    - Record your observations in Table 1. If a food sample shows a positive reaction for starch, place a plus sign (+) in the proper space. If a food sample shows a negative reaction, place a minus sign (-) in the proper space.
- Clean up your work area.

Station 2: Carbohydrate test- simple sugar

1. *Number 8 Pyrex test tubes 1, 2, 3, 4, 5, 6 , 7, and 8. Then add the initials of a person in your group to each – this will help you identify your test tubes in the boiling water bath. Set them in the test tube rack.*
2. *Using the knife, chop up or crush each food sample to be tested into tiny pieces. Then place each crushed food sample in the proper test tube.*
3. Add 3 mL of water to each test tube. Then add 3 mL of Benedict's solution of each tube, to test for simple sugars. Swirl the contents to mix them. Place the test tubes in the boiling-water bath for 3 minutes.
4. At the end of 3 minutes, using the test tube holder, remove your test tubes from the boiling-water bath and place them in the test tube rack. Observe them for an indication of the presence of simple sugar.
    - Record your observations in Table 1. If a food sample shows a positive reaction for starch, place a plus sign (+) in the proper space. If a food sample shows a negative reaction, place a minus sign (-) in the proper space.
5. Clean up your work area.

Station 3: Protein test

1. *Number 8 test tubes 1 to 8. Place them in the test tube rack.*
2. *Crush each food sample separately, and transfer the samples to the proper test tubes.*
3. Add 3 mL of distilled water to each tube and gently swirl the contents to mix them.
4. 1 drop at a time, add biuret reagent to each test tube to test for proteins. Watch the samples as you continue to add drops until there is a colour charge Or you have added 10 drops.
    - Record your observations in Table 1. If a food sample shows a positive reaction for starch, place a plus sign (+) in the proper space. If a food sample shows a negative reaction, place a minus sign (-) in the proper space.
5. Clean up your work area.

Station 4: Lipid/Fat test

1. *Number 8 squares of brown paper towel 1 to 8.*
2. *Rub each solid food sample on the proper piece of brown paper towel.*
3. When the squares have dried, observe them for the presence of fats/lipids.
    - Record your observations in Table 1. If a food sample shows a positive reaction for starch, place a plus sign (+) in the proper space. If a food sample shows a negative reaction, place a minus sign (-) in the proper space.
4. Clean up your work area.

Table 1:

Nutrient	Food Tested							
	Carrot	Bread	Potato	Apple	Onion	Walnut	Cheese	McMush
Starch								
Simple sugar								
Protein								
Fats								

Homeostasis and Blood Sugar Levels

In Unit 1, we discussed homeostasis as an important theme in biology and a very important process of maintaining a constant internal environment in the body. The regulation of blood sugar levels is a good example of homeostasis in action.

The pancreas contains clusters of **endocrine** (hormone-producing) cells. These cells secrete the hormones insulin and glucagon, which regulate blood glucose levels.

After a meal, blood glucose levels rise and chemical receptors cause the release of **insulin**, which triggers cells to increase their permeability glucose. Excess glucose is converted to glycogen in the liver and skeletal muscle cells. As glucose levels in the blood fall, further insulin production is inhibited. A decrease in blood glucose levels causes the release of **glucagon**. Glucagon causes the breakdown of glycogen into glucose, which in turn is released into the blood to maintain glucose levels and homeostasis.

Control of Digestive Secretions

A fascinating feature of the digestive system is that it contains its own regulators, both hormonal and nervous. The major hormones that control the functions of the digestive system are produced and released by cells in the lining of the stomach and small intestine. These hormones are released into the blood of the digestive tract, travel back to the heart and through the arteries, and return to the digestive system, where they stimulate digestive juices and cause organ movement. The hormones that control digestion are gastrin, secretin, and cholecystokinin (CCK).

Gastrin secretion is stimulated by the presence of protein in the stomach and causes the stomach to release gastric juices and increase stomach motility. **Secretin** secretion is triggered by food passing into the duodenum. This hormone promotes release of sodium bicarbonate secretions from the pancreas and stops further passage of food into the intestine until the acid is neutralized. It also stimulates the liver to produce bile. **CCK** is released from intestinal wall in response to the presence of fats and causes the pancreas to produce the pancreatic enzymes and causes the gallbladder to empty.

Two types of nerves help to control the action of the digestive system. **Extrinsic** (outside) nerves come to the digestive organs from the unconscious part of the brain or from the spinal cord. They release a chemical called acetylcholine and another called adrenaline. Acetylcholine causes the muscle of the digestive organs to squeeze with more force and increase the "push" of food and juice through the digestive tract. Acetylcholine also causes the stomach and pancreas to produce more digestive juice. Adrenaline relaxes the muscle of the stomach and intestine and decreases the flow of blood to these organs. Seeing, smelling or tasting food produces gastric secretions even before there is food in the stomach.

Even more important, though, are the **intrinsic** (inside) nerves, which make up a very dense network embedded in the walls of the esophagus, stomach, small intestine, and colon. The intrinsic nerves are triggered to act when the walls of the hollow organs are stretched by food. They release many different substances that speed up or delay the movement of food and the production of juices by the digestive organs.

A Doctor's Guide to Diagnosing Digestion Disorders

The human body is a very efficient machine. Most of the time it works well, adjusting to changes in the environment, resisting infections, and adapting to meet a host of potential dangers. However, the body is not perfect; it cannot always cope with a particular infection or its own systems may fail and sickness results. You must diagnose your patients and advise them of a treatment plan.

Potential Questions

1. What can I help you with today?
2. How have you been feeling lately? What are your symptoms?
3. Has anything else been different lately? Have you had any tests done?
4. Do you have pain anywhere?
5. What is your diet like?
6. Are you eating well?
7. Are you under more stress than normal?

Once you begin to narrow down to a few potential diagnosis ask more specific questions based on what you know about the diseases.

Possible diagnosis

Heartburn
Lactose intolerant
Gall bladder malfunction
Type II diabetes
Malnutrition
Cancer of stomach/bowel
Liver cirrhosis

Heartburn

- A painful or burning sensation in the esophagus, just below the breastbone.
- Caused by reverse peristalsis of gastric acid.
- The pain often rises in the chest and may radiate to the neck, throat, or jaw.
- Heartburn is also identified as one of the causes of chronic cough, and may even mimic asthma.
- More common after a meal of fat-laden or acidic foods, after taking aspirin, drinking alcohol, smoking, or eating chocolate.
- Obesity, pregnancy, emotional turmoil, and tension can also trigger heartburn.
- Treatment - antacid pills like Turns, Gelusil and Maalox

Lactose intolerance

- The body cannot easily digest lactose, a type of natural sugar found in milk and dairy products.
- Symptoms may include nausea, diarrhea, gas, bloating, and abdominal pain.
- Generally runs in the family.
- Treatment - reduce dairy products in your diet; or ingest lactase enzymes.

Gall bladder malfunction

- Gas and bloating after eating; especially fatty foods.
- Pain in the right shoulder blade.
- Patients may experience non-specific pain or pain ever where.
- No known cause.
- Treatment - reduced fat diet; if pain continues or gall stones form then surgery is necessary.

Type II diabetes

- Often present in older individuals.
- Increased risk in patients with poor diets, who are in active, or who are overweight. o Caused because the body's cells do not recognize insulin any longer.
- Common symptoms include: thirst, increased urination, sores on feet, and blurry vision.
- There is increased glucose in the patient's urine.
- Treatment - controlled diet and regular exercise.

Malnutrition

- Common symptoms of malnutrition include: weight loss without dieting, decreased appetite, listlessness, hair and skin appears less unhealthy, water retention, and perhaps a swollen abdomen.
- Malnutrition could be because of a social, psychological, or medical reason.
- Can often accompany high stress situations.
- Will occur with a lack of any one of the essential nutrients; you do not need to be deficient in all nutrients to be malnourished.
- Often a patient will have visibly swollen glands; especially in the neck.
- Treatment - begin with a diet plan; if not successful continue with medical testing.

Cancer of stomach

- Symptoms of stomach cancer at the early stages are hard to identify.
- Symptoms include feeling full after a small meal, nausea, bloating, localized discomfort and vomiting.
- There is no history of genetic or environmental causes.
- Treatment - refer your patient to an oncologist (cancer specialist) for further testing and treatment.

Liver cirrhosis

- A group of chronic diseases of the liver in which normal liver cells are damaged and replaced by scar tissue, decreasing the amount of normal liver tissue.
- The two major problems that eventually cause symptoms are loss of functioning liver cells and distortion of the liver caused by scarring.
- The person may experience fatigue, weakness, and exhaustion.
- Loss of appetite is usual, often with nausea and weight loss.
- Treatment - if due to alcohol and not severe, cease consumption of alcohol. If the liver degeneration has become severe surgery and transplant options need to be followed up.

Diagnosis Activity:

Patient Number	Patient's symptoms	Your diagnosis	Suggested Treatments:
1.			
2.			
3.			
4,			
5.			
6.			
7.			
8.			
9.			
10.			

11.			
12.			

Review Questions

1. Complete the letters in the following table.

Digestive Secretions and Their Functions	
a)	
Serous fluid/Mucous	Lubricates food during chewing
Salivary Amylase	Digests starch into maltose
Stomach	
Hydrochloric Acid	Initiates digestion of protein and kills bacteria
Pepsin	**b)**
Mucous	Lubricates food and protects lining of stomach
Intrinsic Factor	Aids in absorption of Vitamin B_{12} by large intestine
Pancreas	
c)	Neutralizes acid and activates digestive enzymes
Pancreatic Amylase	Digests starch and glycogen into disaccharides
Lipase	**d)**
Trypsin	Digest protein into peptides
Liver/Gall Bladder	
e)	Emulsify fats
Small Intestine	
Maltase	Digests maltose into glucose
Sucrase	Digests sucrose into glucose and fructose
Lactase	Digests lactose into glucose and galactose
Peptidase	**g)**
Nuclease	Digests nucleic acids into sugar and nitrogen bases

2. Describe the structure of the interior surface of the small intestine and explain how this structure relates to its function.

3. Explain how the regulation of blood sugar levels demonstrates homeostasis.

4. Explain how digestive secretions are controlled by the nervous system and endocrine system.

DO DIGESTIVE DISORDERS RESEARCH ASSIGNMENT

Digestion Review

1. Complete the chart below listing the enzymes produced by each organ and the material it is acted upon

Organ	Gland	Secretion	Purpose
Mouth	salivary glands	saliva	1.
			2.
			3.
Stomach		1.	Digests proteins→_____
		2.	2.
		3.	3. lines stomach for protection
Liver	Liver	bile	1.
			2.
Pancreas	Pancreas	1. sodium bicarbonate	1.
		2. trypsin	2. _____→ amino acids
		3.	3. lipid → _____
Small intestine	Intestinal gland	Maltase	1.
			2. Digests sucrose into glucose and fructose
			3. Digests lactose into glucose and galactose

2. State one similarity and one difference between physical and chemical digestion.

Similarity- _____

_____

Difference- _____

_____

3. State the function of the following in the digestive process:

Bile: _____

Pepsin:_____

Sphincters: _____

Peristalsis: _____

Sodium bicarbonate:_____

HCl:_____

Mucous:_____

Amylase:_____

Lipase:_____

Liver:_____

Gall bladder:_____

Pancreas:_____

Villi:_____

Uvula: _____

Tongue: _____

4. Two hormones produced in the pancreas are _____and

_____.

5. Discuss the negative feedback mechanism for the homeostasis of blood sugar levels. Include the sensor, coordinating center, and effector. Describe what hormones are used as well as what and where chemical changes happen in your body.

_____
_____
_____
_____
_____
_____
_____

6. State the function of the following nutrients in the human body.

a) carbohydrates-_____
b) lipids –_____
c) proteins –_____
d) minerals-_____
e) vitamins-_____
f) water-_____

7. Five disorders of the digestive system include _____, _____,

_____, _____, and _____.

8. Describe mechanical Digestion in the following places:

i) Mouth
ii) Esophagus
iii) Stomach
iv) Small intestine (2 methods)

9. Describe absorption in the small intestine. What specifically is absorbed and how is it absorbed?

10. How is the structure of villi related to its function?

11. If you at a piece of bread, which is a carbohydrate, where would it begin to be digested? By what enzyme?

12. If you ate a piece of steak , where would it begin to be digested? By what enzyme? What are the end products?

13. If you drank a table of olive oil, where would it be digested? By what enzyme? What are the end products?

14. Celiac's disease stunts the villi in your small intestine. How does this affect your health?

15. What factors affect enzymes?

16. What is the function of the large intestine?

17. Outline 5 different wellness tips. List two you intent on implementing in your life.

18. List the six basic nutrients which are essential for a well balanced diet. Give two examples each of where you can obtain them.

19. What are the differences between saturated, monounsaturated, polyunsaturated, trans, and omega-3 fats?

20. Why is it important to have fat in our diet?

21. Why must we be aware of which amino acids we ingest and not just the amount of protein we ingest?

22. What are antioxidants?

23. List 4 important minerals and where you can obtain them from.

24. Study your diagram of the digestive system and review all questions in your booklet.
25. Know how to interpret the information on a nutrition label.
26. Complete the “Learning Checklist” you received at the beginning of the unit. Evaluate yourself on how far you have come. These are the outcomes you will be tested on.